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MEDICAL RESEARCH COUNCIL

CHILD LIFE INVESTIGATIONS

POVERTY, NUTRITION & GROWTH

Studies of Child Life in Cities and Rural Districts of Scotland

(assisted by the Carnegie United Kingdom Trust)

LONDON
PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
1926

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POVERTY, NUTRITION & GROWTH

Studies of Child Life in Cities and Rural Districts of Scotland

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PREFACE

The Report here presented gives the results of work begun in 1919, when the Council were in a position to return to the studies of child life which the war had interrupted. It has been done under the general supervision of the Scottish Committee for Child Life Investigation, but the chief burden of organization and direction has fallen upon Professor Noël Paton, their Chairman. The Council are especially indebted to him for the heavy personal sacrifices he has made to ensure the smooth progress and the completion of the work. The Council are under a great obligation also to the University of Glasgow for the facilities which have been granted in the premises of the University Department of Physiology for the statistical and other work required at various stages of the inquiry.

At the close of 1922 the Carnegie United Kingdom Trust generously provided a grant of £2,000 for such assistance as would allow the collection of data from the industrial centres, Edinburgh, Glasgow, and Dundee, to be accelerated, and to enable comparative studies to be made upon a similar plan in agricultural areas and mining districts. As a result of this timely and generous co-operation the urban surveys were completed in 1923, and those of the rural and mining districts in 1924. The subsequent statistical treatment of the collected data was completed during 1925; this was made possible by the further liberality of the Carnegie Trust, who made a grant of £500 for statistical assistance.

The Council would here add an expression of their own cordial thanks to all those to whom personal acknowledgement is paid by the authors of the Report for valuable services given in various ways.

Medical Research Council,
15 York Buildings, Adelphi,
London, W.C. 2. *May* 4, 1926.

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CONTENTS

POVERTY, NUTRITION, AND GROWTH: STUDIES OF CHILD LIFE IN CITIES AND RURAL DISTRICTS OF SCOTLAND

INTRODUCTION

The character of the adult population of any country, its health, vigour, and working capacity, is determined by the development and growth of the children, and this in turn is influenced, not only by environment after birth, but also by factors working while the child is yet unborn. The importance of child welfare is widely recognized, but many of the factors making for the health and for the normal development and growth of the child are still little known.

It is therefore not surprising that the problems of child life have been the subject of much attention during the past two decades. It has been shown that the children of the poor of our great cities are subject to a greater mortality not only during infancy but also during childhood, and that those who survive are of poorer physique, being, on an average, lighter and smaller than the children of the wealthier urban dwellers, or than those of the same social class but reared under rural conditions. Yet among these slum children can be found individuals who are taller and better nourished than the average child of the better-class home.

Many hypotheses have been advanced to explain the physical inferiority of the average slum child. It is perhaps most frequently ascribed to poverty and bad housing conditions, with the resulting defective feeding and want of fresh air. The necessity of more generous diet and of more ample air-space in the home has been preached, but no conclusive evidence has been adduced to indicate how far the absence of these is really responsible.

Of late years there has been a tendency to emphasize the importance of antenatal influences, more especially of the health and nutrition of the mother during pregnancy, but here again direct evidence is wanting. The influence of the mother does not terminate at birth, but is operative from infancy throughout childhood and school age; in fact, till the child leaves the parental home. To what extent the condition of the child is modified by maternal care has never been properly investigated.

The influence of the father is less direct and, apart from disease, drink, crime, or unemployment, leading to insufficiency of earnings, is manifestly of secondary importance. This is fortunate, since it is extremely difficult to gain reliable information about him.

One possibility that cannot be ignored is that the physical characters of the slum child are, in part, determined by heredity, and that the stunted urban population may result from the survival of those best fitted for town life. Although at one time the towns were largely and regularly recruited from the surrounding country, there is at the present time evidence of the formation of a town-breeding population less abundantly reinforced from outside. The question of the possible influence of heredity has therefore to be explored.

At present we are ignorant of the relative importance of these different factors in modifying growth and thus determining the future character of the nation, the great majority of which—some eighty per cent.—are town-dwellers. Without definite knowledge, the application of remedial measures is mere groping in the dark which may or may not prove beneficial and which may even be prejudicial. Large sums are spent upon child welfare schemes of various kinds. Is this expenditure productive of its optimum effect, or can it be directed into better channels ?

The present investigation was begun in 1919 to attempt to determine more precisely to what extent any or all of the above conditions act in modifying the growth and nutrition of the child. Its purpose was not to demonstrate what was already known, viz. that the town child of the poorer classes is on the average less well grown and less vigorous than the child of the well-to-do or than the country child, but to study the influence of the various parental and environmental conditions of the slum child and to try to ascertain why some slum children remain puny and small while others are large and strong.

The study was made upon the populations of the slums of the three Scottish towns—Glasgow, Edinburgh, and Dundee—and, in order to throw further light upon the problem, an investigation has also been made of the children of agricultural labourers and of rural miners and the environmental conditions under which they live.

Such an investigation must necessarily be a statistical one, and the difficulties of conducting it on scientific lines were fully recognized from the first. The initial difficulty was to secure a fair sample of the population studied. This proved less difficult than was expected, firstly on account of the well-defined slum areas in the three cities, and secondly, because of the experience of the investigators selected and the ready assistance given by Medical Officers of Health and their Health Visitors. Further, the Child Welfare Centres throughout the cities not only furnished infants of the class which was to be studied, but gave the entrée to the houses of the parents, and thus secured a similarity in the material throughout each part of the investigation and gave a random sample without selection.

In determining whether the sample dealt with was adequate we were guided by the advice of Dr. Brownlee. After a statistical analysis of the earlier work he decided that 100 children of each age and sex in each town should be included in the study, and this has been done.

That the families studied are representative of the class under consideration is indicated by the fact that in Glasgow 43·7 per cent. lived in one-roomed houses, 53·7 per cent. in two-roomed houses, and only 2·54 per cent. in houses of three and more rooms. In Dundee the numbers were 29·1, 66·5, and 4·4 per cent., while in Edinburgh they were 40·0, 53·1, and 6·9 per cent. Thus, in each of the towns, over 93 per cent. of the families investigated lived in one- or two-roomed houses.

The danger of concentrating on families living in the worst conditions was guarded against and largely obviated by the random selection of families through the Child Welfare Centres. On the other hand, it might be thought that the poorest class might have objected to the visits of the investigators and thus prevented the collection of the necessary information. Only in one or two cases was it found that the parents had a superstitious dread of allowing their children to be weighed or measured.

While certain of the data obtained can be expressed in definite figures, e.g. the height and weight of the child, income, air-space, &c., others are not capable of such expression. Among these are the health of the mother, the care taken of her children and her house. Here the danger of the personal equation of the various observers had to be guarded against and a uniform system of assessment had to be secured. This was done by arranging numerous meetings of the investigators to discuss and decide what should be the standard of ' care of children ', ' cleanliness of house ', &c. Where possible, the results of one investigator were checked against those of another, as will be seen when ' care of children ' and cleanliness of house ' are dealt with.

The investigation is part of a scheme for the study of the problems of child life initiated by the Medical Research Council. It was conducted under the auspices of the Scottish Branch of the Child Life Investigation Committee. In 1923 the Carnegie United Kingdom Trust made a substantial grant which enabled the urban investigation to be expedited, and rendered it possible to extend the study to agricultural labourers and rural coal-miners in Scotland, thus affording a valuable comparison between urban and rural conditions of life in the same social class and enabling some of the conclusions arrived at from the investigation of the slums to be checked by the results in other communities.

Professor Noël Paton and Professor Leonard Findlay are responsible for the planning and general management of the investigation and, by the instruction of the Committee, for the preparation of the Report, and they are responsible for the conclusions.

The Committee is indebted to Miss Agnew, the organizing secretary, for the able manner in which she has supervised the work and for the arduous labour of looking up and preparing the accounts of the previous work upon the different branches of the subject.

Thanks are due to the Medical Officers of Health for Child Welfare in Glasgow, Edinburgh, and Dundee. Dr. T. Y. Finlay, Edinburgh, was a member of the Committee, and Dr. Barbara Sutherland, Glasgow, and Dr. Scott Dickson, Dundee, gave invaluable help. Thanks are also due to the doctors and nurses at the various Child Welfare Centres who so ungrudgingly gave much of their time to the work.

Acknowledgement must also be made of the help received from the Medical Officers of Health of the counties of Perth, Stirling, Fife, Forfar, East Lothian, Berwick, Dumfries, and Ayr, who, with their staffs, gave much useful guidance.

We have pleasure in recording that from the various Education

Authorities in all the areas studied, permission to use the weighing apparatus in the schools and facilities for weighing and measuring the children were, in all cases, most courteously and readily granted.

The investigations by house-to-house visiting fell upon Miss Ferguson, Miss Gribbon, Miss Tully, Miss Swanson, Miss Urie, Miss Clark, Miss MacNae, Miss Crawford, Miss Bryce Buchanan, Miss Kerr, Dr. Lilian Dickson, Dr. Olive Somerville, and Dr. Catherine A. S. Blair, all of whom discharged their duties with care and intelligence.

In the statistical part of the work, which was carried out in the Institute of Physiology of the University of Glasgow, we are indebted in the first place to Dr. Brownlee and Dr. Young, who themselves, with the assistance of Miss Tully, made a preliminary survey of the results, and who have given valuable advice on various matters. Subsequently Dr. Major Greenwood has assisted us in various ways in suggesting the use of particular statistical methods, in allowing Dr. P. L. MacKinlay, who has been largely responsible for the actual analyses, to work in his department and under his direct and constant supervision, and in arranging for Miss C. M. Thompson to spend some time in Glasgow instructing the local workers in statistical methods. Dr. Edgar Schuster's help in the preparation of diagrams and charts has been invaluable. We desire to record our sense of obligation to Drs. Brownlee, Young, Greenwood, and Schuster in all these directions. Our thanks are also due to those members of the Statistical Committee who were good enough to read and criticize the statistical part of this Report.

Miss Mabel Clark, Dr. MacKinlay, and Mr. Robb undertook the statistical examination of the returns from the Welfare Centres after these had been very thoroughly examined and checked by Miss Agnew and all returns of doubtful value had been eliminated.

Miss Tully undertook the statistical examination of the data collected by house-to-house visitation of children over one year, while Dr. MacKinlay analysed the data of children under one year.

Dr. MacKinlay has given general supervision to the statistical work and he is responsible for various special statistical parts of the Report.

Dr. Catherine A. S. Blair and Dr. O. Somerville are responsible for the statistical work of the agricultural and mining investigations.

We have considered it our duty to present the evidence collected as fully and as clearly as we can and with as little personal comment as possible, so that the reader may draw the conclusions to which it leads. It must be remembered that these are applicable only to the classes studied.

Our business as scientific men is to attempt to gain knowledge, and we do not venture to usurp the function of the administrator by suggesting how it may be applied.

In the hope that this, which is a pioneer piece of work, may be the starting-point of further investigations we have given a very full account of the work previously recorded, much of which is difficult to trace and to obtain. We are very sensible that in spite of the pains which have been taken in collecting and compiling it, it is far from complete.

PART I

POPULATIONS STUDIED AND METHODS EMPLOYED

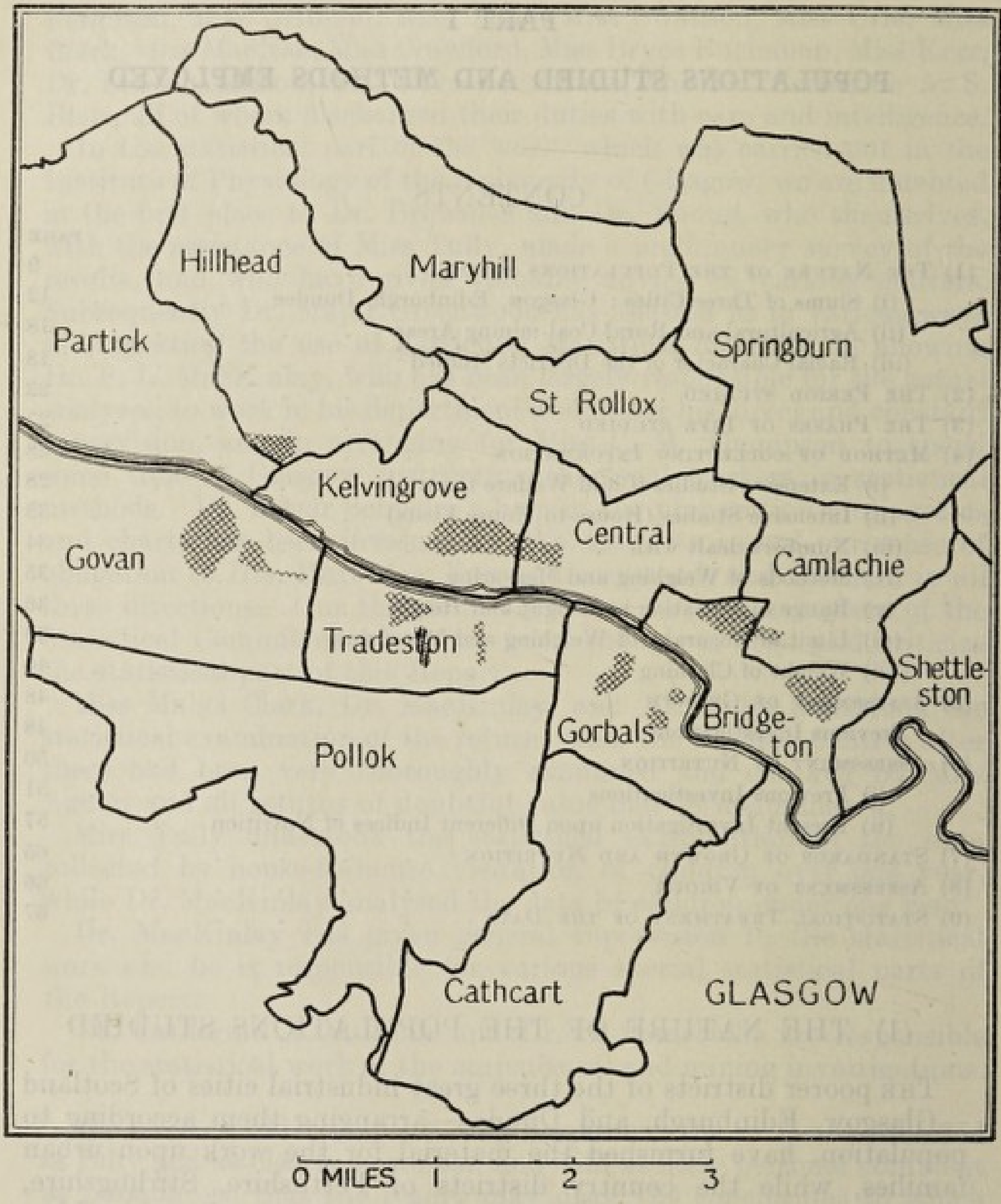
CONTENTS

(1) THE NATURE OF THE POPULATIONS STUDIED

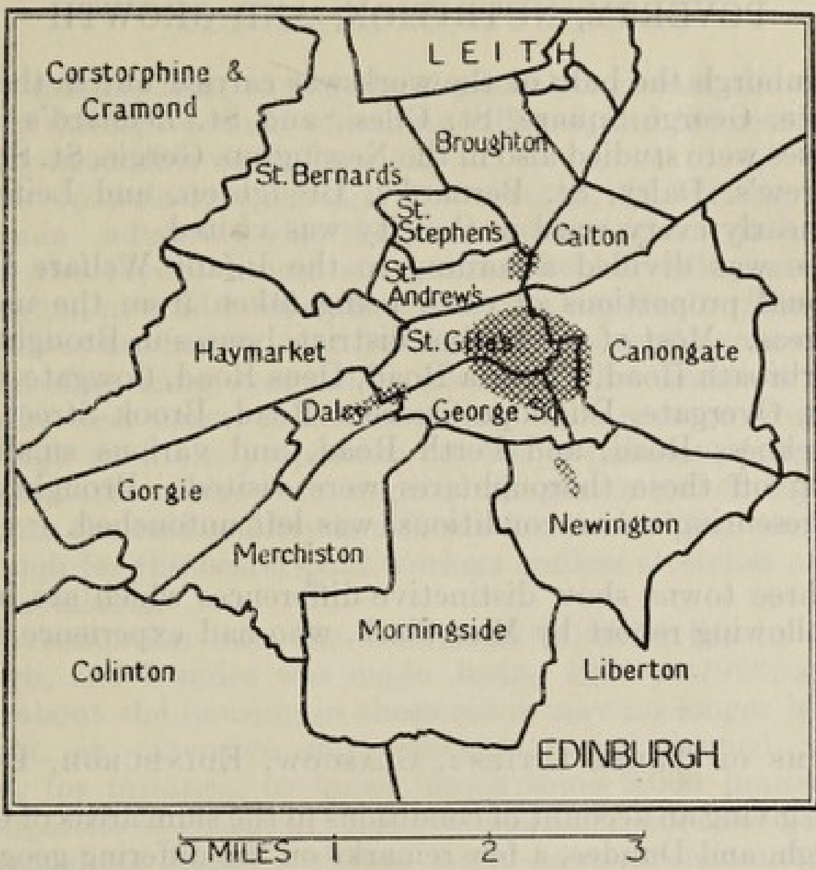
The poorer districts of the three great industrial cities of Scotland —Glasgow, Edinburgh, and Dundee—arranging them according to population, have furnished the material for the work upon urban families, while the country districts of Perthshire, Stirlingshire, Forfarshire, Fifeshire, East Lothian, Berwickshire, Dumfriesshire, and Ayrshire were used for the investigation of agricultural and mining populations.

The districts of the three towns in which the families studied were situated are indicated in the accompanying maps by the shaded areas.

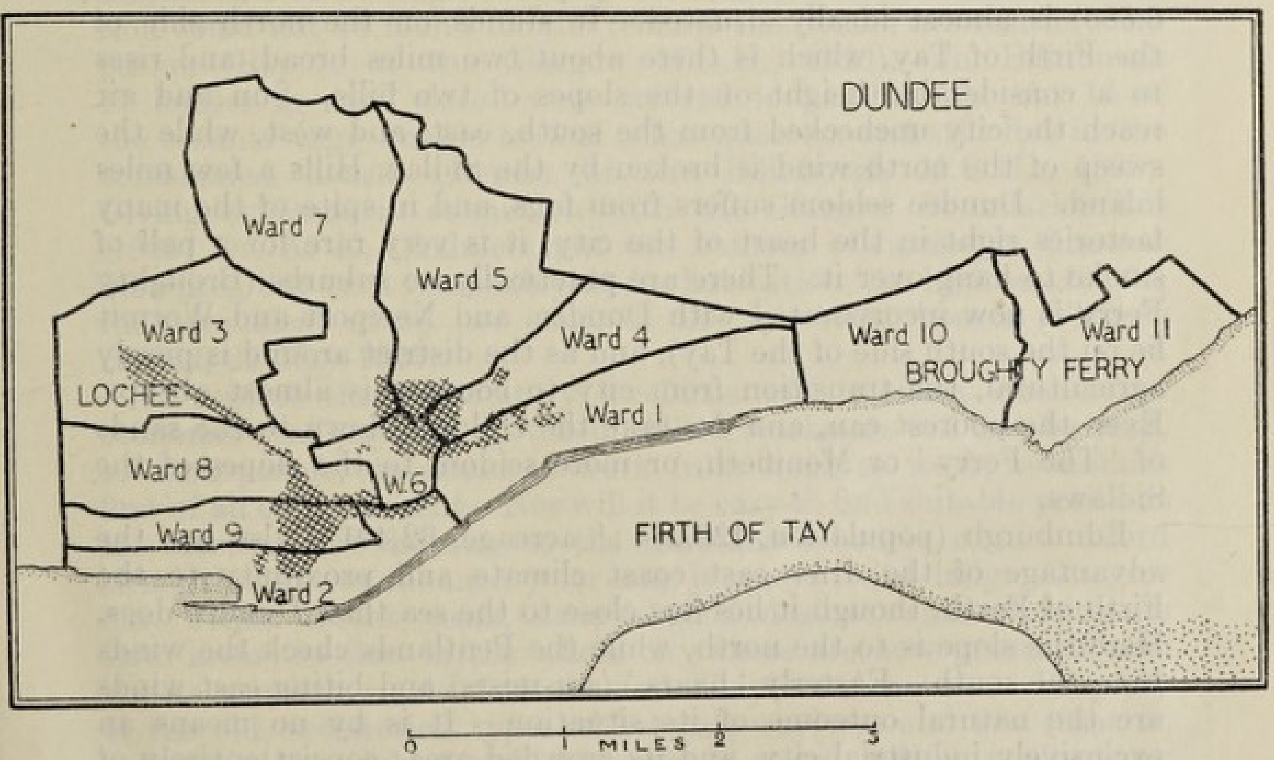
In Glasgow, on the north side, families were visited in the parliamentary divisions of Kelvingrove, Central, Camlachie, Bridgeton, and on the borders of Partick and Hillhead. On the south side of the city families were studied in the Govan, Tradeston, and Gorbals divisions. The greater part of the work was carried out in Anderston (Kelvingrove) and Bridgeton.



MAP A. Glasgow, showing parliamentary divisions of the city and the areas studied (shaded).



Map B. Edinburgh, showing wards of the city and the areas studied (shaded).



Map C. Dundee, showing wards of the city and the areas studied (shaded).

In Edinburgh the bulk of the work was carried out in the Calton, Canongate, George Square, St. Giles', and St. Leonard's districts. A few cases were studied also in the Newington, Gorgie, St. Stephen's, St. Andrew's, Dalry, St. Bernard's, Broughton, and Leith wards, so that nearly every ward in the city was visited.

Dundee was divided according to the Infant Welfare Districts, fairly equal proportions of cases being taken from the more congested areas. Most of the Lochee district, houses in Broughty Ferry Road, Arbroath Road, Victoria Road, Deus Road, Cowgate, Seagate, Hilltown, Overgate, Dudhope Crescent Road, Brook Street, Hawkhill, Blackness Road, and Perth Road, and various small streets branching off these thoroughfares were visited. Broughty Ferry, as not presenting urban conditions, was left untouched.

The three towns show distinctive differences which are indicated in the following report by Miss Clark, who had experience in all of them.

(i) Slums of Three Cities: Glasgow, Edinburgh, Dundee

Before giving an account of conditions in the slum areas of Glasgow, Edinburgh, and Dundee, a few remarks on the differing geographical features of the cities may be appropriate, as the situation of each city must to some extent affect the living if not the housing conditions.

Of the three cities, Dundee (population, 168,315;[1] acreage, 6,585) is almost ideally situated. It stands on the north side of the Firth of Tay, which is there about two miles broad, and rises to a considerable height on the slopes of two hills. Sun and air reach the city unchecked from the south, east, and west, while the sweep of the north wind is broken by the Sidlaw Hills a few miles inland. Dundee seldom suffers from fogs, and in spite of the many factories right in the heart of the city, it is very rare for a pall of smoke to hang over it. There are practically no suburbs (Broughty Ferry is now incorporated with Dundee, and Newport and Wormit lie on the south side of the Tay), and as the district around is purely agricultural, the transition from city to country is almost abrupt. Even the poorest can, and do, take the children down to the sands of 'The Ferry' or Monifieth, or more seldom to the slopes of the Sidlaws.

Edinburgh (population, 420,264;[1] acreage, 32,401[2]) also has the advantage of the drier east coast climate and proximity to the Firth of Forth, though it lies less close to the sea than Dundee does. Here the slope is to the north, while the Pentlands check the winds from the south. Easterly 'haars' (sea-mists) and biting east winds are the natural outcome of its situation. It is by no means an exclusively industrial city, and its crowded areas consist entirely of tenements, not of tenements side by side with factories, as in Dundee and Glasgow, because its factories are more on the outskirts. The county of Midlothian is largely agricultural, but there is also an

[1] 1921 Census.
[2] This includes the large rural district to the south.

extensive mining area, so that to the south and east the exit from the city is through a chain of mining villages, and the seaside is not so directly accessible as in Dundee.

Glasgow (population, 1,034,174;[1] acreage, 18,589) has none of the 'seaside' advantages of the two eastern cities. It lies in the valley of the Clyde, almost surrounded by low hills, with a few lesser heights, now all built over, within the city itself. The districts near the river are hardly ever free from damp, while grey mists and black fogs often hang over the entire city. The climate is typically that of the west coast, mild but moist. The area covered by the city, though small in proportion to the population, is enormous, and the suburbs merge into mining villages or other towns. To get out into the real country is difficult for most of the poor population, though for the better-paid workers endless stretches of sea and land are available.

The investigation into the conditions of child life in Glasgow, Edinburgh, and Dundee was made during 1919 to 1923, and some remarks about the housing in these cities may no longer be strictly applicable, as extensive improvements were planned, it being proposed, for instance, to knock down some 2,000 houses in the worst properties of Glasgow. But condemnation does not necessarily imply immediate action; witness many houses condemned several years ago as unfit for human habitation and shut up, but reopened during the housing shortage and inhabited at the time of the investigation. For example, a closing order was issued in 1919 regarding a tenement of 24 single-room houses, but as adequate accommodation could not be found for the tenants the houses are still in occupation (Report of the Glasgow M.O.H., 1923). In Edinburgh 17 houses in one 'close' were ordered to be shut up, but 14 of the tenants were unable to find other quarters and still live in the condemned houses (Report of the Edinburgh M.O.H., 1923). Giving evidence in connexion with the Glasgow Boundaries Bill (1925) Dr. A. K. Chalmers put the number of houses in Glasgow inhabited but 'not reasonably fit for habitation' as high as 13,000, the equivalent of 5½ per cent. of the inhabited houses (*Glasgow Herald*, 29 May 1925).

To replace these insanitary dwellings with sanitary ones at an economic rent payable by the unskilled workman will not be easy, as such people, uncertain of work from week to week, economize first of all on house rent. Nor will it be easy to find suitable positions for erecting new houses, as the unskilled labourer cannot afford either the time or the money for long journeys twice daily. Glasgow has, within recent years, done a good deal towards clearing its slum areas, so that in the whole city there are now practically no streets consisting solely of old and dilapidated houses. Property of the old two-storied type, with small windows and low (that is, not more than eight feet high) roofs, of course still exists in many parts. Such conditions are found in the Calton district and near the Forth and Clyde Canal. In these properties the plaster is often ruinous and full of bugs, and in one house lately visited the floor was in such a state that the tenant had fallen through it and furniture had

[1] 1921 Census.

to be placed over the more unsafe parts. The newer block-buildings are much superior to the old style in width of street, air-space indoors given by the higher roofs, air-space out of doors afforded by courts, and amount of sanitary accommodation per family, but there still remains much room for improvement. The wider streets are all to the good, but enough sunlight cannot enter the rooms when on either side of the street tenements rise three and four stories high. The crowded parts of Glasgow, too, are badly off for so-called 'lungs'; Glasgow Green is the only really big breathing-space right in the midst of the poorer working-class districts, and hence most of the children are forced to play in the streets. The hills within the city are chiefly in the better residential parts, so that the streets below are far from being airy. Garngad is an exception. It stands high and the hill is not entirely built over, but, even there, 'backlands' may soon fill up the now vacant spaces. These backlands are the cause of much of the overcrowding, being, as the name implies, houses which occupy all the courtyard or backgreen space between the buildings in two parallel streets, and make cleanliness of the entries more than ever impossible. Three- or four-flatted tenements house so many tenants to each entry and stair that the ventilation and cleanliness of the passages is bound to leave much to be desired. Nor can the mothers take an infant in arms and a 'toddler' out for daily air and exercise when she lives up three or four stories and is herself worn out with child-bearing and housework. When such tenement blocks are built with outer stairs (that is, stairs in a projecting but roofed-in part of the block), and with open balconies running from the central stair to the different houses (plats, as they are known in Dundee), small children can play in safety on the balcony, while the baby sleeps in his banana-cot in the open air, all under the eye of the mother at her housework.

According to the census returns for 1921, Glasgow contains altogether 40,689 houses consisting of one room only, 62·6 per cent. of its population is housed in one- or two-roomed houses, while Edinburgh, with its 7,879 one-roomed houses, has only 37·6 per cent. of its population in houses of one or two rooms. Of the population of Dundee, 59·7 per cent. live in one- or two-roomed houses, and of one-roomed houses there are 6,650.

The same returns give the persons per acre as—Glasgow, 55·6, Dundee, 25·5, Edinburgh, 12·9—the last figure is the result of a large extent of land to the south being included within the boundaries. If we exclude the wards of Liberton, Colinton, and Corstorphine and Cramond, totalling nearly 20,000 acres, which take in the land to the south and have a population of only 1·2 persons to the acre, the density of the rest of Edinburgh rises to 31·9 persons per acre.

In many individual cases the conditions are even worse. In December 1923 we found living in one room in Glasgow a man, his wife, and seven children—and that room was ticketed as containing 1,200 cubic feet. Undoubtedly, the inhabitants themselves are often to blame for the dirt they live in, but to keep clean and wholesome a single room where nine human beings have to sleep, wash, dress, and eat, seems little short of impossible, and there is little wonder that many mothers give up the attempt. Yet in the same 'close' and living under identical housing conditions, one does come across homes which show startling contrasts—here the room is cleaned daily and looks cheerful and cosy, though poor; there, week-old filth litters floor and beds and to sit down anywhere is an unpleasing experience. The children, too, show the same contrast —here, they are in tidy if somewhat threadbare clothes and have clean though white faces and well-kept hair; there, their clothes are filthy and smelly and their bodies are covered with the dirt certainly of days. Another defect of these large tenements is the poor sanitary accommodation. The usual allowance in Glasgow is one water-closet to four tenants, but that means about 20 persons using one closet, if the door locks; if not—which happens very often —any and every one comes in from the street and the state of the closet is better imagined than described.

Edinburgh's most crowded areas lie within a very small compass, chiefly the wards of St. Leonard's, St. Giles', and Calton. St. Leonard's, according to an Edinburgh councillor (7.2.24), is the worst spot in Great Britain, some of the houses being two stories below the level of the street. But in many ways the Edinburgh slums are in pleasing contrast to those of Glasgow and Dundee. Much of the property consists of very high tenements of seven or eight flats, remnants of better days when the High Street and Canongate were the abode of the nobility. Such houses are very solidly built and the rooms are large. It is seldom that one finds under 400 cubic feet of air-space per person, whereas in Glasgow and Dundee 200 cubic feet per person is not unusual. These old houses have high ceilings, ten feet being quite normal, and the windows are also of good size. The winding stairs to the seventh or eighth flat, however, are a great drawback, making it particularly difficult for mothers to take their babies out daily. Fortunately the streets on the whole are wide, and nearly all are airy, so that the rooms are, or can be, well ventilated. It is still very much the rule in all three cities to keep the windows closed during the night, so that an early morning visitor finds the atmosphere unendurable. Quite a distinction in the Edinburgh properties is the number of houses with inside water-closets. Most of those seen were well kept, and at least the tenant has the satisfaction of knowing that they are not used by all and sundry. Where outside accommodation is given, we did not find any water-closet used by more than four families. The houses are, on the whole, better kept than in Glasgow or Dundee, a really filthy house (that is, vermin ridden and littered with human filth) being seldom seen. But here, also, the human factor is the deciding one, vivid contrasts in comfort and cleanliness being found on the same stairs. Where the Corporation has cleared away old properties and erected new, the new often fill three sides of a square, the fourth side being left open, so giving good ventilation for all the houses opening on to it. Balconies, too, are made use of in such new properties. Another great asset to the Edinburgh slums is the fact that they lie chiefly between good breathing-spaces—the Castle slopes, the Meadows, and Arthur's Seat—all of which are literally covered with children revelling in the air and freedom.

Dundee's streets also are mostly airy, which results from the situation of the city and not from the way the city has been built. A few wider streets run more or less parallel to the Firth of Tay, and these are intersected by numerous very narrow lanes, the chief dwelling-places of unskilled labourers and their families, and in Dundee the proportion of unskilled labourers is very high, with unemployment correspondingly rife. The jute trade, which has been the staple industry of Dundee for the past century, takes skilled women, and most of the male labour can be done by boys, who are turned off when they reach the age of 18 and thus remain unskilled labourers. The jute factories are scattered throughout the town, and nearly every narrow lane is bordered by a high, noisy and dusty factory, which shuts out air and sun from the workers' homes immediately opposite, but sends in jute dust and intolerable noise. Nor do such houses even get air freely from the other side, as 'backlands' abound, and one sometimes passes through two successive properties to reach the third, which may abut on a high wall. In Dundee there are still entire streets of old houses, with dilapidated plaster, infested with bugs, where the wooden and twisting stairways are death-traps (though the worst are now lighted by gas or electricity, day and night), with attics six and a half feet in height, with sloping ceilings, and very often with door and window so close together that more than half the room can never get any fresh air. In such old houses the windows are small (2 ft. 6 in. by 4 ft., or less), so that the fresh air has little chance of entering. All through the slum quarters of this city the stairs are, in general, very badly kept, there being little enforcement of 'turns' in the washing and sweeping, and children as well as cats dirty them. Water-closets are equally badly kept—in one property the visitor was several times met on the stairs by the overflow—and are far too few for each property. In one house there was still (in 1922) no sanitary accommodation whatever, while in another, a three-story tenement, there was one water-closet, in the courtyard, which had to satisfy sixteen families. Small wonder, therefore, that so many mothers make their children use a pail instead. This pail often stands unemptied in the house till next day, and from laziness may be emptied out of a window into the court, as was done in the middle ages. The contents of such a pail missed the visitor by only a few inches as she passed to a backland one morning. Often it would seem as if the contents of the pail had been scattered over the room, it being literally impossible to find a clean spot to stand on. Not a single house visited had a bath; the kitchen sink had to answer a multiplicity of purposes, and in many upper flats, and quite generally in attics, there was no water in the room; a common tap at the stairhead had to supply all the tenants. Overcrowding was rife. A notable case was man, wife, and thirteen children in two rooms (3,000 cub. feet). In another case, a man, his wife, and five children lived in one room below the street level and facing north. There are still many open ashpits, and these are often filled to overflowing, not with ashes alone, a few hours after the clearing out. Such an ashpit makes it impossible to open a window facing the court and, especially in summer, constitutes a veritable nuisance. Even the sea-breeze cannot overcome the stench, and the 'plats' become untenable. The Dundee people certainly take full advantage of these outside stairs and 'plats' which are the daily playground for children of all ages. They also take full advantage of the parks and shore, and in fine weather there is a steady procession of children of all sizes (with or without a mother) going down to the 'Green' to play and dig. Being so much in the open gives the children a rosy country appearance, in marked contrast to the white faces one sees in Glasgow. M. L. C.

Descriptions of some typical families in Glasgow will be found on p. 322, and of typical Dundee families on p. 324.

Proportion of Skilled and Unskilled Workers among the Fathers of the Families studied

The working-class families living in the slum areas of the three towns include those of unskilled labourers and various grades of skilled artisans. In Glasgow the latter class forms a considerable proportion, as the ship-building, engineering, and other trades require a large number of such men. Although it is difficult to draw a hard and fast line between skilled and unskilled workers, we have estimated that in the Glasgow families some 50 per cent. of the fathers were unskilled labourers and about 50 per cent. skilled workmen. About 27 per cent. of the skilled and about 36 per cent. of the unskilled were unemployed during the period of the study and a much larger proportion were working short time. In Edinburgh about 70 per cent. were unskilled and about 30 per cent. were skilled, and of these about 19 per cent. of the skilled and 32 per cent. of the unskilled were unemployed. In Dundee just over 74 per cent. were unskilled and 26 per cent. were skilled. About 36 per cent. of the unskilled and about 23 per cent. of the skilled were unemployed.

Mean Incomes

The differences in the incomes of the families studied in the three towns will be considered later, but the following table shows the average income per person per week:

TABLE 1. *Mean Income per Person per Week of Families studied in Three Towns.*

Town.	*Income per person per week.*
Glasgow . . .	9·32/-
Edinburgh . . .	8·24/-
Dundee . . .	7·58/-

In Glasgow 9·5 per cent. had incomes above 25*s.* per person per week, in Dundee 2·5 per cent., and in Edinburgh none of the families had incomes above that limit. This is to be explained by the higher proportion of skilled workmen studied in Glasgow.

Condition of Houses

The proportion of houses classed by the investigators as clean and dirty in the three towns is of interest. The figures are given in the appended table.

TABLE 2. *Proportion of Clean Houses.*

Town.	*Number of families studied.*	*Percentage of families with house clean.*
Glasgow	788	59·39
Edinburgh	606	78·71
Dundee	864	56·48

The proportion of families living in houses of one, two, and more than two rooms is given in the following table:

TABLE 3. *Proportion of Different-sized Houses of Families studied (in percentages).*

	One-roomed.	*Two-roomed.*	*Three or more Rooms.*
Glasgow	43·7	53·7	2·54
Edinburgh	40·0	53·1	6·90
Dundee	29·1	66·5	4·40

(ii) AGRICULTURAL AND RURAL COAL-MINING AREAS

The districts selected for the investigation of agricultural labourers' and rural miners' families are shown in Map D by means of shaded areas. They are situated in the counties of Perth, Forfar, Fife, Stirling, East Lothian, Berwick, Dumfries, and Ayr.

The selection was made so that the areas should be typical of the classes investigated. It was desirable, as far as possible, to choose parts of the country independent of the towns for their supplies and possessing characters as sharply differentiated as possible from urban districts.

Descriptions of the social conditions, housing, &c., will be found on pp. 254 and 280.

(iii) RACIAL CHARACTER OF THE DISTRICTS STUDIED

Miss Agnew has prepared the following report:

Beddoe (1870) from the results of his anthropometric survey of the inhabitants of the British Isles deduces that, in general, the natives of Scotland and of the north and north-east of England exceed in stature those of Wales and of the south and west of England. He finds a definitely lesser size among the inhabitants of the large industrial towns, e. g. in Glasgow and Edinburgh, as compared with dwellers in the rural parts of Scotland. He gives the following figures for the three industrial towns studied in this investigation:

	Cases.	*Height.* ft.	in.
Glasgow and Edinburgh (includes several of the upper class)	26	5	7·98
Glasgow (patients at Glasgow Infirmary with slight ailments)	21	5	6·63
Dundee and rest of Angus (mixed classes, natives of all parts of the country and living in Dundee)	15	5	9·72

MAP D. Scotland, showing the agricultural, mining, and insular areas studied (shaded).

For the country districts studied in the present investigation he gives the following average heights:

	Cases.	Height. ft.	in.
Pitteadie, near Kirkcaldy, Fife (agricultural ploughmen and land workmen)	36	5	9·43
Kirkcaldy and neighbourhood (a fair sample of the Artillery Volunteers, mostly artisans and natives of Kirkcaldy and other towns in Fife)	26	5	9·13
Fife in general (a mixture of all classes born in Mid and West Fife living mostly in towns)	19	5	8·61
Fife (average of returns)	95	5	9·12
Dundonald (general population of a rural district, all born in Ayrshire)	20	5	10·35
Dundonald (general population of a rural district, all born in Ayrshire)	48	5	10·53
Dundonald (rural parishes)	57	5	11·17
Dumfries (miscellaneous)	15	5	9·22
Berwickshire (farmers and peasants of local descent)	25	5	11·28
,, (rural population)	15	5	9·45
Eastern and Middle Marches and Lothian	16	5	9·40

The report of the Anthropometric Committee of the British Association (1883) gives a series of figures which support Beddoe's statement that Scotland is peopled by a taller race than Wales or Southern England. Table 4 gives the mean stature and mean weight of adult males in the United Kingdom.

TABLE 4. *Heights and Weights of Adult Males in Britain.*

Country.	*Mean stature.* in.	*Mean weight.* lb.	*Height divided by weight.*
Scotland	68·71	165·3	0·416
Ireland	67·90	155·0	0·441
England	67·36	154·1	0·435
Wales	66·66	158·3	0·421

Tocher (1924) found significant variation in stature in different parts of Scotland, the northern area being inhabited by the tallest. He says, 'There is a tall population in Galloway and the border counties, while the mean stature of the population of Lanark, Renfrew, and Ayr is significantly less than that of the remaining population. This is also true of the midland counties of Perth, Forfar, and Fife.' Tocher's conclusions are based upon a study of the statures of soldiers from various recruiting districts, and within the limits of each district he makes no distinction between town and rural dwellers. In a personal communication, later, he says that the Lanark-Renfrew-Ayr group contains many soldiers from Glasgow and that the Perth-Forfar-Fife group contains soldiers from Dundee. This probably, to some extent at least, accounts for the relatively small stature in these two groups. His summarized statement of the variation in stature throughout the whole country is as follows:

Group.	*Recruiting area.*	*Mean stature.* mm.	*Standard deviation.* mm.
1	Orkney, Shetland, Caithness, Sutherland, Ross, Cromarty, Nairn, Inverness	1,746·09	59·65
2	Elgin, Banff, Aberdeen, Kincardine	1,719·78	58·50
3	Perth, Forfar, Fife, Kinross, Clackmannan	1,706·26	55·15
4	Stirling, Dumbarton, Argyll, Bute, Arran	1,720·66	54·00
5	Renfrew, Ayr, Lanark	1,699·17	58·75
6	Dumfries, Kirkcudbright, Wigtown	1,731·54	58·65
7	Linlithgow, Midlothian, Peebles, Selkirk, Roxburgh, Berwick, Haddington	1,719·78	62·75

He gives the mean stature of men from Lanarkshire including Glasgow as 66·85 inches, of those from Haddington as 68·7 inches, and of those from Inverness as 68·69 inches. He gives a map showing the distribution of the population classed by mean stature. This shows the most marked excess over the mean to be in the northern section of the country, and the most marked deficiency to be in the district of Lanarkshire.

An examination of the returns made by various Scottish Education Authorities (see pp. 76 to 79) shows that the height of children attending rural schools in Scotland is quite definitely greater than the height of those attending schools in the large centres.

The possibility that stature may be affected by environment renders difficult any decision as to how far the differences in stature observed in Scotland are racial and how far they are due to environmental influences. Elderton (1911–12) says, 'In many large towns there are considerable foreign elements not yet blended with the native population, e. g. in Scotland and England we find Italian, Irish, Jewish, and even Polish groups. In many cases these non-native elements form a considerable percentage of the population, and if, as often happens, they are the poorer section, then we may discover a relation between physique and environment which is not causal but racial in origin.' *This foreign element other than Irish in the urban population was not included in the present study.*

Various surveys of the pigmentation—hair and eye colour—of the Scottish population yield information bearing on the question of the existence of racial differences in rural and in urban districts of the country.

Gray (1907) gives an interesting statement of the distribution in Scotland of deviation from the normal in hair and eye colour. In order to indicate this divergence numbers were first determined for each district which indicate how often the observed frequencies of hair and eye colours in that district would be drawn as a random sample from a population in which the frequencies are the same as for the whole of Scotland. For example, Glasgow is marked with the number 43·6. This signifies that, if $10^{43 \cdot 6}$ samples were drawn at random from a population having everywhere the same average frequency of hair colours as the average frequency for the whole of Scotland, the special frequencies of the hair colours in Glasgow would be drawn only once. In other words, the odds against the population of Glasgow being a random sample of the population of Scotland are $10^{43 \cdot 6}$ to 1. Gray gives the following figures as indicating the divergence from the average pigmentation of the whole of Scotland for the three towns studied in this investigation:

	Hair.	*Eyes.*
Glasgow	43·6	59·4
Edinburgh . . .	1·9	10·1
Dundee	3·7	8·0

As indicated above, the higher the index figures, the greater is the divergence from the average for the whole country, and in view of the great divergence indicated by the Glasgow index figures it is not surprising that Gray should remark—'These odds are enough and more than enough to establish the important conclusion that the population of Glasgow has been so much changed by an urban environment and by alien immigration that it can no longer as a whole be regarded as Scotch.'

In the rural districts studied by Gray the index figures are, on the whole, low, showing that there is less divergence from average pigmentation in the rural districts than in the large towns, if we except Edinburgh, which approximates more closely to the average of the whole country in hair colour than do the other large towns. We give, in Table 5, the index figures recorded by Gray for the counties studied in this investigation.

When it is remembered that an index figure of three or under may be taken as closely approximating to the average type of the country, it will be seen from the figures that a very considerable proportion of the rural districts studied appear to be closely related to the normal Scottish type and to be definitely different from the population of such a large centre as Glasgow.

Tocher (1908–9) using the same material as Gray in the preceding paper, i.e. 257,766 boys and 244,389 girls attending Scottish schools, published a pigmentation survey of school children in Scotland, and, like Gray, emphasized the difference between the hair and eye colours in densely and in sparsely populated districts. He considered that the eastern counties generally could justifiably be described as samples of the general population (this would include Forfar, Fife, Haddington and Stirling which have been studied in this investigation). He stated that 'populous counties are fairly representative of the general population, but the great cities (except Edinburgh) are divergent'.

TABLE 5. *Hair and Eye Pigmentation Indices (from Gray) in Districts of Present Study.*

District.	*Hair.*	*Eye.*
Ayrshire	2·3	4·4
	4·9	1·7
	2·1	3·6
Dumfriesshire	6·7	2·1
	0·7	3·3
Haddington	1·0	5·2
Fifeshire	4·1	0·9
	6·5	1·9
	1·0	2·3
	2·1	0·9
	2·7	2·5
Perthshire	10·5	4·8
	6·9	7·6
Forfarshire	2·5	1·1
	0·7	0·9
	0·4	2·1
Stirlingshire	1·9	7·1
	2·5	3·8
	1·0	2·5
Berwickshire	6·7	3·1
Lewis	2·1	9·9

Table 6 gives the hair colour index figures for the three towns studied together with the index figures for the immediately adjacent country. A minus sign indicates deficiency to the extent indicated by the figure given.

TABLE 6. *Boys' Hair Colour (from Tocher).*

	Fair.	*Red.*	*Medium.*	*Dark.*	*Black.*
Lanark	1·62	— 0·08	0·25	— 5·34	— 0·71
Glasgow	— 12·0	— 1·16	7·36	4·57	— 1·52
Forfar	0·54	0·06	0·58	— 0·66	— 2·33
Dundee	— 3·77	— 0·33	4·00	— 0·99	1·37
Edinburgh County	3·10	0·12	1·14	— 3·79	— 2·63
Edinburgh	3·19	0·45	0·62	— 1·66	— 2·29

These figures indicate a marked deficiency of fair hair and a marked excess of medium and dark hair in Glasgow as compared with the surrounding country; a less marked deficiency of fair hair and a less marked excess of medium and of black hair in Dundee as compared with the surrounding country; a close approximation in pigmentation between Edinburgh and the surrounding country. Tocher considered two factors as probably influencing the pigmentation of the larger towns and making them differ from the general population of the country—(i) The presence of foreigners, and (ii) Selective birth or death rates.

He found that the foreign element of the population was closely related to the density of population. The density per square mile of the three towns, Glasgow Edinburgh, and Dundee, he gives as follows:

Glasgow, 39,331 per square mile.
Edinburgh, 20,089 per square mile.
Dundee, 28,069 per square mile.

Glasgow, containing as it does about one-fifth of the population of Scotland, greatly exceeds any other Scottish town in density of population and has more foreigners per 1,000 than any other town in Scotland. It is in Glasgow where an extreme divergence from the Scottish mean of hair and eye colour has been observed. Tocher says 'it is . . . the predominant feature of the more densely populated and larger portion of the city to be brown or dark in hair colour and medium or dark in eye colour'. The foreign elements in Glasgow are of races tending to darkness of hair and eye colour to the extent of 85 per cent., only 15 per cent. belonging to races having fair hair and light or blue eyes predominant.

TABLE 7. *Proportions of the Total Foreign Elements in Glasgow.*

Russians and Poles	60 per cent.
Italians	15 „ „
Other dark-haired races	10 „ „
Blond type—Germans, Swedes, Norwegians, &c.	15 „ „

There is a considerable Irish element in Glasgow, estimated by Tocher at 100,000 men.

It is to the existence of these racial elements that Tocher ascribes much of the divergence in Glasgow from the Scottish mean. It is shown that the Highland, Irish, and foreign elements all contribute to increase the proportion of the dark-haired classes. He, however, suggests that these factors do not account for the presence of an excess of medium hair, and says 'the main cause of the large excess of medium hair in densely populated parts probably arises from the blending of colour in the offspring of fair-haired and dark-haired persons. . . . In densely populated areas, greater opportunities for intermixture occur, and it is shown that in the large sparsely populated districts fair hair and dark hair, indicative of at least two types, occur in excess, while in urban districts these excesses mainly disappear and excess of medium hair appears.'

Referring to the possibility of a selective death or birth rate, he says, 'It is well known that mortality is higher in more densely populated regions than others. It has been proved that certain classes (medium hair, medium eyes and dark eyes) are more characteristic of crowded areas than others. It is therefore to be expected that these classes would be positively correlated with the death-rate. It is shown that an increase in the proportions of medium hair and dark eyes is associated with an increase in the death-rate. This does not necessarily mean that persons belonging to these classes are less virile, but simply that a large proportion of them live under conditions which are productive of a higher mortality. . . . It is proved that the number of births per family is greater on an average in densely populated parts and, as a consequence, that the number of births per family is greater where there are large proportions of medium hair and medium eyes. The lower classes are found in the denser centres. Thus it is likely that the medium haired, medium eyed lower classes are on the average more fertile than the remaining population.'

The general conclusion to be drawn from such a survey as Tocher's and its results is that there are quite definite racial differences in Scotland as a whole, and that differences tend to be more manifest in the large cities. In considering the various groups of data collected in the present investigation, it is therefore necessary to keep in view the possibility that variations in growth which seem to be associated with different environment may be more or less associated with racial differences in the populations studied.

In Glasgow an attempt has been made to test the homogeneity of the population dealt with by an examination of some 4,000 school children, as regards height, weight, and colour of hair and eyes. The results have been analysed by MacKinlay (1924). The conclusion arrived at is in agreement with Tocher's and Gray's conclusions that medium eyes and brown hair are largely in excess in densely populated town areas. Like Elderton (1911–12), MacKinlay finds no significant association between weight or stature and hair and eye colours. It may be noted, however, that Elderton suggests that the lack of significant association may be due to the fact that, in her data at least, the children showed little marked differences in pigmentation, there being little admixture of foreign elements. J. A.

(2) THE PERIOD STUDIED

The investigation was carried out in Glasgow from October 1919 to May 1923, in Edinburgh from October 1919 to July 1923, and in Dundee from May 1921 to July 1923.

It must be remembered that during the period covered by the investigation the economic condition of the people has undergone changes. It therefore seems advisable to inquire whether during the period studied the children were subjected to specially bad or abnormally good conditions likely to affect them physically. Upon this Miss Agnew makes the following report:

Economic Conditions during the Period of Study

In October 1919, when the inquiry was started, the average percentage increase in the cost of all necessities—food, rent, clothing, fuel, and light, &c.—over the cost in 1914 was 115·2. This percentage increase in the cost of living is stated in the official returns of the *Labour Gazette* to have been calculated to 'show the average increase in the cost of maintaining unchanged the pre-war standard of living of working-class families—i. e. the standard actually prevailing in working-class families before the war, irrespective of whether such standard was adequate or not'.

Much criticism has from time to time been levelled at the cost of living index numbers, as officially computed, on the ground that these do not truly reflect the changes which have actually occurred. The basis for the present index figures given by the Board of Trade was an inquiry made by the Board of Trade in 1904 into the budgets of 1,944 families, whose average expenditure in food did not exceed 22*s*. 6*d*. per week. From this it will be seen that the figures are properly applicable only to the labouring class and that they do not take any account of any change in dietary or other item of expenditure arising out of war conditions. The general criticism of the figures follows these lines, but for the purposes of this inquiry, which has been carried out on the poorer town and rural populations in Scotland, they seem to afford, simply because of the limited character of their origin, a more accurate test than if they were applied to the working class in general.

From the date of the commencement of the inquiry in October 1919 till November 1920 the average percentage increase in the cost of living steadily rose from 115 to 176 per cent. Since that date, there has been a gradual fall, interrupted by slight fluctuations, until at the end of the inquiry in July 1923 the percentage increase in cost of living was 69. The following table, extracted from the *Labour Gazette*, gives the range of variation over the entire period:

TABLE 8. *Average Percentage Increase of Cost of Living since July* 1914 *for Years* 1919–23.

Month.	*1919.*	*1920.*	*1921.*	*1922.*	*1923.*
January	—	125	165	92	78
February	—	130	151	88	77
March	—	130	141	86	76
April	—	132	133	82	74
May	—	141	128	81	70
June	—	150	119	80	69
July	—	152	119	84	69
August	—	155	122	81	—
September	—	161	120	79	—
October	115–120	164	110	78	—
November	120–125	176	103	80	—
December	120	169	99	80	—

It might be suggested that these figures indicate a very marked range of variation in the economic pressure upon the subjects of the investigation, but an examination of the wages of the various types of labourers from 1919 to 1924, as supplied to us by the Industrial Relations Department of the Ministry of Labour in Scotland, indicates that, whatever may have been the case in the higher grades, the wages of the labouring classes, during the period studied, varied more or less directly with the cost of living, and in consequence the economic conditions have been comparatively constant,

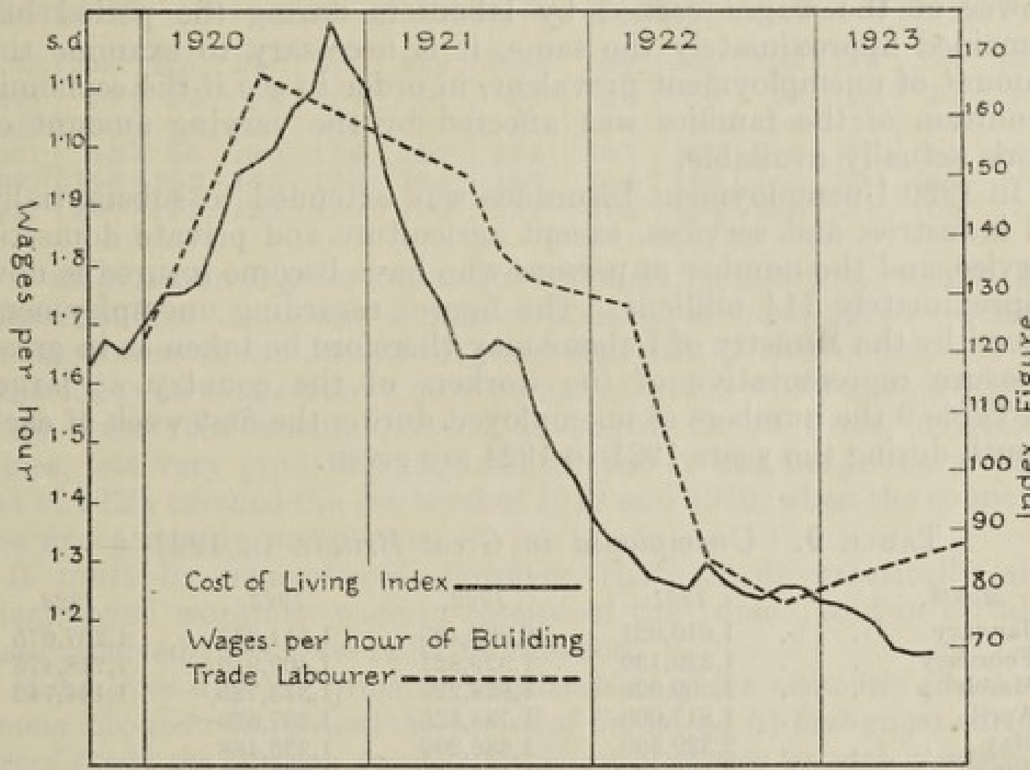


CHART I. Variation in the cost of living index and in wages of building-trade labourers, 1920–3.

and by no means so variable as would be suggested by the list of index numbers quoted above. To illustrate this point, the wages of labourers in the building trades from 1920 to 1923 have been graphed, along with the cost of living indices for the same period. The resultant curves show a rather striking parallelism. From all this, the inference is justifiable that so far as the class of labour under review is concerned, the actual purchasing power of wages during the period has been approximately constant.

This may seem rather contradictory to certain general information which has appeared in the press in regard to wages in the mining industry, in the iron and steel trades, and in engineering and shipbuilding. It has to be pointed out, however, that we are dealing with the labouring classes, and that these enjoyed a much higher percentage of increase in wages owing to war circumstances than did the skilled men. It was the practice to give uniform advances to all classes of labour, with the result that the percentage increase was much greater where wages were low in pre-war times. The reverse process of reductions has, in the main, been carried out on the same basis, so that the labourers' *percentage* of increase is now much higher than that of the craftsman in most industries. While, therefore, it may be the case that in a number of industries the average increase is less than the cost of living figures, it will generally be found that this is actually higher than the cost of living index numbers in the case of labourers. In the majority of the industries in the West of Scotland, labourers' wages are roughly 100 per cent. above the standards of 1914, whereas the cost of living percentages during 1923, the later period of the investigation, never exceeded 81.

While it appears reasonable to infer that the actual purchasing power of the wages earned by labourers during the period has remained approximately the same, it is necessary to examine the amount of unemployment prevalent, in order to see if the economic condition of the families was affected by the varying amount of work actually available.

In 1920 Unemployment Insurance was extended to substantially all industries and services, except agriculture and private domestic service, and the number of persons who have become insured is now approximately 11½ millions. The figures regarding unemployment issued by the Ministry of Labour may therefore be taken as in great measure representative of the workers of the country at large. In Table 9 the numbers of unemployed during the first week of each month during the years 1921 to 1924 are given.

TABLE 9. *Unemployed in Great Britain in* 1921–4.

Month.	*1921.*	*1922.*	*1923.*	*1924.*
January . .	1,010,021	2,003,493	1,511,377	1,267,675
February . .	1,329,130	1,929,821	1,409,916	1,248,475
March . . .	1,509,029	1,828,223	1,343,725	1,134,742
April . . .	1,817,009	1,735,525	1,307,629	—
May . . .	2,329,399	1,686,299	1,235,488	—
June . . .	2,580,429	1,475,405	1,220,394	—
July . . .	2,507,670	1,423,038	1,225,937	—
August . . .	1,836,191	1,352,248	1,228,541	—
September . .	1,613,782	1,342,292	1,275,396	—
October . .	1,441,281	1,353,183	1,290,092	—
November . .	1,746,742	1,387,878	1,286,360	—
December . .	1,845,723	1,414,619	1,237,505	—

The percentage of unemployment for the same period is shown in Table 10.

TABLE 10. *Percentage of Unemployed in Great Britain for* 1921–4.

Month.	*1921.*	*1922.*	*1923.*	*1924.*
January . .	10·6	17·0	12·9	11·8
February . .	12·4	16·4	12·0	10·6
March . . .	14·5	15·4	11·3	9·8
April . . .	19·2	15·2	11·2	—
May . . .	22·3	14·0	11·0	—
June . . .	21·3	13·1	11·1	—
July . . .	16·9	12·5	11·4	—
August . . .	14·7	12·3	11·7	—
September . .	13·5	12·2	11·6	—
October . .	13·8	12·1	11·6	—
November . .	16·4	12·5	11·4	—
December . .	17·2	12·3	10·5	—

These figures, as already indicated, do not cover the entire period 1919–23, but we have been able to obtain from the Ministry of Labour a table, the data of which run from 1919 to 1923, giving the percentage of unemployed among members of certain Trade Unions. The workers on which the data in the table are based were mainly skilled workmen, and the figures cannot therefore be used as a quantitative measure of the total amount of unemployment; but they are compiled on approximately the same basis throughout and may therefore be regarded as roughly comparable. (See Table 11.)

TABLE 11. *Percentage of Unemployed (chiefly Skilled Workmen).*

Year.	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May.*	*June.*	*July.*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
1919	2·8	2·8	2·8	2·7	2·1	1·7	2·0	2·2	1·6	2·6	2·9	3·2
1920	1·6	1·6	1·1	0·9	1·1	1·2	1·4	1·6	2·2	5·3	3·7	6·0
1921	8·5	8·5	10·0	17·6	22·2	23·1	16·7	16·3	14·8	15·6	15·9	16·5
1922	16·8	16·3	16·3	17·0	16·4	15·7	14·4	14·5	14·6	14·0	14·2	14·0
1923	13·7	12·3	12·3	11·3	11·3	11·1	11·3	11·4	11·3	10·9	10·5	9·7

It may reasonably be inferred from these figures that within the period studied there was a time of scarcity of work which reached its maximum about June 1921, and that this period of scarcity of work followed immediately on a period in which work was plentiful. Since June 1921 unemployment, as shown in all three foregoing tables, has very gradually diminished, but it has not, even at the end of 1923, reached the low level of 1919 and 1920, when the country was exceptionally prosperous.

It must be remembered, however, that all, or practically all, unemployed workmen were in receipt of the ‘ dole ’, and in certain cases received Poor Law relief in addition.

It therefore appears, from a consideration of the economic situation among labourers throughout the period of the study, (i) *that wages varied directly with the varying purchasing power of money in such a manner that the purchasing power of the total wages remained approximately the same, and* (ii) *that, while there was, within the period, a spell of plenty of work, followed by a time of acute unemployment which very gradually diminished, yet the effect of the unemployment insurance of the great mass of the workers of the country was such as to relieve the families of any acute distress, and to mitigate in great measure, if not entirely, the poverty attendant on scarcity of labour.* J. A.

(3) THE PHASES OF LIFE STUDIED

We have been unable to include in our survey a study of the size of the child at birth because the records from Maternity Hospitals do not give sufficiently detailed and accurate information as to the social position, or as to the environment and health of the mother during pregnancy.

Three phases of life have been separately dealt with:

(i) Infant—up to one year.
(ii) Pre-school—from 1 to 5 years.
(iii) School age—from 6 to 14 years.

The reasons for this division are obvious.

In the *first months* of life the ante-natal conditions may be expected to manifest their most marked effect. In the *pre-school* age the home surroundings should be predominant and as yet uncomplicated by the influence of school life. It is the study of this pre-school period which should yield the most valuable information as to the effects, if any, of home conditions, and for this reason the present study has specially concentrated upon this period.

The *pre-school age* is the time of life on which it is most difficult to obtain information, since it necessitates house-to-house visitation, and it is probably for this reason that it has been largely neglected by previous investigators. Speaking of the lack of data on the first to the fifth years of child life, Brailsford Robertson (1923) says: 'It will be a surprise to many readers to know that there is a period in the development of children regarding which, until very recently, almost nothing was definitely known.' . . . 'These are most crucially important years for the future development of the child.' . . . 'The nutrition of the child is progressively changing from the infantile to the adult type and any step in this series of changes may become perchance an origin of disorder. . . . Not until 1921 was this gap adequately filled in the United States by the efforts of the Children's Bureau of the United States Bureau of the United States Department of Labour, under the direction of Dr. Woodbury.' . . . (1921) 'Of the two million cards which were received by the Bureau, representing one-seventh of all the children between one and six years of age in the United States, but a small proportion were found to fulfil every requirement, but even this small proportion represented an enormous total of children, no less than 172,000.'

Woodbury's results throw light chiefly upon the stature and weight of the average child at different ages, upon racial differences, upon the difference between town and country children and the comparative stature and weight of children with certain defects, and upon the previous investigations of Crum, Holt, and Bowditch. They do not touch the problem of the possible influence of environment.

In these investigations we have paid less attention to children of *school age* for the reasons already given, but in the intensive studies a considerable number were included, and these have been dealt with in the general report.

(4) METHOD OF COLLECTING INFORMATION

(i) Extensive Studies (Child Welfare Centres)

The approval of the Medical Officers of Health of the three cities—Glasgow, Edinburgh, and Dundee—having been secured, the co-operation of the Child Welfare Medical Officers was then obtained. Dr. T. Y. Finlay (Edinburgh) was already a member of the Child Life Investigation Committee, and Dr. Barbara Sutherland (Glasgow) and Dr. Scott Dickson (Dundee) joined a sub-committee on this part of the investigation. In consultation with these officers, a schedule was prepared for use in the Child Welfare Centres. (See Appendix I.) This schedule was drawn up in such a form as to make it suitable not only for the collection of data for the present inquiry, but for routine use in the work of the centres. Hence many of the questions are not relevant to the present investigation.

Since the number of cases to be dealt with at each clinic was so large that it was impossible to secure a full and accurate record of every child which attended, it was arranged that the first three to present themselves each day should be fully investigated on the points desired and the particulars filled into the schedules. Thus any selection of cases was avoided and a fair sample was secured.

Naturally the facilities for work of this kind varied greatly at different centres. In some the rooms were altogether unsuitable, in some the number of cases was too large, while in some the nurses and doctors who made the records were more interested and better trained than in others.

The Child Welfare Medical Officers of Health who acted upon the sub-committee upon post-natal problems, and who supervised and assisted in the work, gave most valuable help both in assisting in drawing up the schedule used at the Welfare Centres and in the difficult task of organizing the work of making the records on these schedules. Our thanks are due to them and also to the overworked doctors and nurses who spared themselves no trouble to obtain the records.

It is necessary to consider how far the material at the different Welfare Centres is homogeneous. It has been urged that only the more careful mother brings her child to the centre, or again, that mothers tend to bring their children only when ailing and also, at least in certain districts, that the mothers attend only when they want free milk or Glaxo at a cheap rate. Miss Agnew makes the following report upon this subject:

The Types of Mothers and Infants attending different Centres

Taken as a whole, the mothers attending the Child Welfare Centres in Glasgow, Edinburgh, and Dundee belong to the working class. One very definite distinction, however, must be drawn. The mothers attending the centres in Glasgow and Dundee were of a poorer class than those attending the two centres in Edinburgh at which records were made—viz., Gorgie and Stockbridge. These two centres were attended largely by a superior working class, and, in the case of Gorgie Centre, by large numbers of the wives of artisans in addition to those of labourers.

Glasgow. In Glasgow the mothers attending the centres were distinctly poor, but they did not belong to the very poorest and lowest class, which presumably avoids centres altogether. The Child Welfare Medical Officer expressed the opinion that the centres did not reach the hopeless fringe of society. The fathers were mostly labourers or unskilled workmen. In Glasgow a very considerable amount of assistance was given to mothers in the form of milk, free or at a reduced rate, free meals, Glaxo, &c. In 1923 about 45 per cent. of the mothers received milk. A considerable proportion, which Dr. Barbara Sutherland was unable to estimate exactly, came to the centres because the children were ailing, minor rather than major ailments however predominating. The *very* young babies were brought for general advice or milk.

Edinburgh. As already stated the mothers attending the two centres in Edinburgh at which schedules were completed were of a quite definitely better class than the average mother attending the centres in Glasgow and Dundee. They were tidier, better mannered, and decidedly better clothed. Dr. T. Y. Finlay has steadily set himself to make the centres preventive rather than curative, so that it is reasonably certain that at his clinics a greater proportion of the babies were in a good state of health. Of course the mothers did tend to bring the babies with ailments to the centres, but Dr. Finlay instructed them either to call in a doctor or to take the ailing babies to the curative centres which he had instituted. The amount of free milk distributed in Edinburgh was relatively very small as compared with Glasgow; at the two centres in Edinburgh the amount given was practically negligible.

Dundee. At the Lochee and Blackness centres in Dundee the children at the clinics were from a very poor class. At the other four centres there was a fair proportion of the better working-class mother, but, as already stated, the average Dundee mother attending the centres compared unfavourably with the Edinburgh mothers, and resembled those attending the Glasgow centres. Children brought to the centres came for (*a*) general advice, and (*b*) consultation as to the infants' ailments. If malnutrition be included as an ailment, about 75 per cent. of the children under one year were brought to the centres owing to defective health. It is thus clear that the records made at the Dundee centres must include records of a considerable number of ailing infants, though the great majority of the ailments were of a minor character. Dr. Scott Dickson, in her annual report of 1920, stated that only 16 per cent. of the infants attending were absolutely healthy. Where the Health Visitors in Dundee find serious cases of child neglect they try to get the mother to bring the babies regularly to the centres. The attendance at the centres was little affected by the giving of free milk, &c., as this relief work was carried out by a separate staff at different hours from those of the clinics. In 1924 about from 3 to 5 per cent. of the mothers attending the clinics were in receipt of such relief. J. A.

Environmental Factors recorded at the Welfare Centres

The conditions which it was found possible to have recorded with any degree of accuracy at the Child Welfare Centres were:

(*a*) Health of mother during pregnancy.
(*b*) Suckling during pregnancy.
(*c*) Employment of mother, if any, during pregnancy, and its duration.
(*d*) Size of parents. Tall, medium, short; heavy, medium, light.
(*e*) Birthplace of parents.
(*f*) Regular or irregular employment of father during mother's pregnancy.
(*g*) Age of mother.
(*h*) Position of child in family.

(*i*) Size of family.
(*k*) Number of persons per room in home.
(*l*) State of mother's teeth.
(*m*) Congenital defects.
(*n*) Duration of breast-feeding.

Of the various factors tabulated many were left aside after trial correlations had shown them to have no manifest influence on the other factors. In this way ' condition of the mother's teeth ' to ' capacity to breast feed ', ' number of inmates per room ' to ' weight and height of the child ', ' employment or non-employment of the father during his wife's pregnancy ' to ' weight of the child ', were all discarded. ' Height ' and ' weight ' to ' stem length ' have been left for future study.

Grouping of Recorded Cases

The division into age groups is as follows :
Birth up to 2 weeks,
2 weeks to 5 weeks,
and so on in 4-weekly periods, the last period ranging from 51 to 53 weeks.

Since the infants examined at these Welfare Centres consisted of those brought for the first time and of those revisiting the centre, it was necessary to determine whether and to what extent these two groups corresponded with or differed from one another. It was possible either that the ' revisits ' consisted largely of infants which were not thriving, or that, as a result of the directions given, their rate of growth had been improved, or that they were slightly older, although still in the same month of age.

In order to test these points all the samples were divided into ' first visits.' and ' revisits ' at each month, and mean weight and height, with standard deviations, were worked out for each group. Where there was any significant difference shown, correlations were also worked out by MacKinlay for the groups separately.

To test for variation in age, the month groups are subdivided into weeks, and the *difference between the mean age of the infants brought for the first time and those brought on subsequent visits was found to be absolutely insignificant.* The Glasgow records had already been dealt with as ' first visits ' and ' revisits ' separately, but in Edinburgh and Dundee records were combined, with the exception of those of Dundee infants of both sexes of the age of 8 weeks, where the mean weight and height of ' first visits ' and ' revisits ' did not correspond with sufficient exactitude. The following tables give the results of these tests :

TABLE 12. *Means and Standard Deviations of Weights and Heights.*

GLASGOW GIRLS (FIRST VISITS).

Age. Weeks.	*Mean weight.* lb.	*Standard deviation.*	*Coefficient of variation.*	*Mean height.* in.	*Standard deviation.*	*Coefficient of variation.*
2	7·4000	1·2895	17·43	19·6125	0·7547	3·85
4	8·0621	1·4973	18·57	20·4274	1·2419	6·08
8	9·0246	1·7383	19·26	21·2113	1·2597	5·94
12	10·2105	1·9812	19·40	22·4316	1·2830	5·72
16	11·7378	1·6515	14·07	23·1829	0·9084	3·92
20	12·8176	2·3242	18·13	24·0000	1·2280	5·12
24	13·4185	2·1584	16·09	24·3043	1·3465	5·54
28	14·8281	1·8301	12·34	25·1823	1·2063	4·79
32	14·7733	2·1344	14·45	25·4070	1·1817	4·65
36	15·3365	2·1311	13·90	25·7019	1·1781	4·58
40	15·9397	1·9513	12·24	26·3534	1·4506	5·50
44	17·0900	2·5487	14·91	26·7400	1·2506	4·68
48	16·9348	2·3381	13·81	27·0978	1·3780	5·09

GLASGOW BOYS (FIRST VISITS).

Age. Weeks.	*Mean weight.* lb.	*Standard deviation.*	*Coefficient of variation.*	*Mean height.* in.	*Standard deviation.*	*Coefficient of variation.*
2	7·7177	1·2412	16·08	20·1290	1·4273	7·09
4	8·5685	1·5290	17·84	20·8129	1·1746	5·64
8	9·6590	1·9112	19·79	21·6393	1·3415	6·20
12	10·7500	2·0534	19·10	22·5408	1·2171	5·40
16	12·0758	1·9262	15·95	23·3258	1·1172	4·79
20	14·0060	2·6768	19·11	24·2083	1·5988	6·60
24	14·8673	2·3126	15·55	25·1684	1·1336	4·50
28	15·6410	2·2834	14·60	25·6410	1·0108	3·94
32	16·6196	2·5829	15·54	26·5543	1·2437	4·68
36	16·4531	2·7179	16·52	26·0078	1·4963	5·75
40	16·8583	2·2983	13·63	26·7583	0·9343	3·49
44	17·8958	2·3161	12·94	27·5000	1·1837	4·30
48	18·4808	3·4191	18·50	27·3846	1·1724	4·28

TABLE 13. *Means and Standard Deviations of Weights and Heights.*

GLASGOW GIRLS (REVISITS).

Age. Weeks.	*Mean weight.* lb.	*Standard deviation.*	*Coefficient of variation.*	*Mean height.* in.	*Standard deviation.*	*Coefficient of variation.*
16	11·8984	2·1391	17·98	23·3438	1·1898	5·10
20	12·6064	2·1699	17·21	23·8032	1·2544	5·27
24	13·6585	2·0754	15·19	24·5720	1·1789	4·80
28	14·4267	2·3770	16·48	24·8966	1·1796	4·74
32	15·0628	2·1942	14·57	25·4822	1·1796	4·63
36	15·9761	2·2451	14·05	26·0993	1·1576	4·44
40	16·2425	1·9888	12·24	26·2450	1·0182	3·88
44	17·0892	2·2055	12·90	26·7930	1·0518	3·93
48	17·3520	2·2827	13·16	27·0625	1·1478	4·24
52	18·0522	2·4175	13·39	27·4870	1·2825	4·67

GLASGOW BOYS (REVISITS).

Age. Weeks.	*Mean weight.* lb.	*Standard deviation.*	*Coefficient of variation.*	*Mean height.* in.	*Standard deviation.*	*Coefficient of variation.*
2	12·6382	2·1957	17·37	23·7852	1·2881	5·42
4	13·8115	2·1986	15·92	24·4620	1·1192	4·58
8	14·9773	2·5041	16·72	25·1432	1·2054	4·79
12	15·6574	2·4057	15·36	25·6853	1·1574	4·51
16	16·5075	2·3306	14·12	26·0800	1·1315	4·34
20	17·2933	2·5249	14·60	26·6369	1·0997	4·13
24	17·8396	2·6304	14·74	26·9811	1·1801	4·37
28	18·2888	2·6241	14·35	27·3385	1·1600	4·24
32	18·8403	2·6474	14·05	27·6597	1·1257	4·07
36	19·3611	2·5548	13·20	27·9907	1·1745	4·20

In Edinburgh all measurements were carried out by Dr. T. Y. Finlay and all weighings were done under his direct supervision, and their accuracy was thus guaranteed. In the other towns weight and height were recorded by several different nurses.

It seemed desirable to determine how far these latter records approached the former in accuracy, and to do so the correlations between weight and height in children in Edinburgh and Dundee are here given side by side.

Table 14. *Weight/Height Correlation in Edinburgh and in Dundee Infants.*

Age in weeks.	*W/H Correlation.*	
	Edinburgh.	*Dundee.*
12	0·768±·035	0·785±·022
16	0·747±·042	0·754±·026
20	0·827±·032	0·691±·034
24	0·673±·061	0·669±·042
28	0·795±·037	0·740±·032
32	0·792±·048	0·742±·037
36	0·694±·059	0·687±·045
40	0·702±·083	0·741±·044
44	0·710±·075	0·830±·032
48	0·322±·135 *	0·773±·048
52	0·744±·066	0·765±·056

* Only 20 cases.

These results show that, with the exception of an extraordinarily low correlation at forty-eight weeks in Edinburgh, which apparently is due to the small numbers, the concordance is very close.

(ii) Intensive Studies (House-to-House Visits)

This aspect of the work was carried out by trained social workers. Miss Margaret Ferguson, whose study of the Influence of Dietetic and Economic Conditions on Rickets (M.R.C. Special Report Series, No. 20, 1918) is well known, was the first investigator, and continuity of the work and homogeneity of the records was secured by each of the successive workers being associated for some time with her, or with their immediate predecessors.

The collection of material was carried out in Glasgow by Miss Ferguson, Miss Gribbon, Miss Tully, and Miss Urie ; in Edinburgh, principally by Miss Swanson ; in Dundee by Miss Clark, Miss MacNae, and Miss Crawford ; in the rural areas by Miss Urie, Miss MacNae, Miss Kerr, Miss Bryce Buchanan, Dr. Catherine Blair, Dr. Lilian Dickson, and Dr. Olive Somerville.

For recording the observations made, a booklet was prepared. (See Appendix II.)

The information collected by house-to-house visitation is of much greater statistical value than that obtained at Child Welfare Centres, as the observations were made without haste and corrected and amplified when necessary by repeated visits.

That the material dealt with at the Child Welfare Centres and in the house-to-house visitation was of the same type may be accepted. The families were of the same social class living in the same districts, and many of the families visited were, in fact, in the first instance, procured from the Welfare Centres.

(iii) Numbers dealt with

(*a*) From the Child Welfare Centres 10,619 recorded measurements of height and weight were of such a nature as to be suitable for statistical purposes. Inadequate information on many of the schedules unfortunately necessitated the rejection of these. The records used in the three towns, Glasgow, Edinburgh, and Dundee, are as follows:

Table 15. *Number of Cases recorded in Welfare Centres.*

Town.	*Boys.*	*Girls.*	*Total.*
Glasgow	3,401	3,342	6,743
Edinburgh	590	525	1,115
Dundee	1,492	1,269	2,761
Totals	5,483	5,136	10,619

(*b*) In the intensive studies 12,706 children under five years were examined, of which number 10,896 records were suitable for statistical analysis. In the following table the total numbers examined are given in brackets immediately after the numbers actually available for analysis.

Table 16. *Number of Cases of Statistical Examination and actual number studied of Children under Five Years.*

Town.	*Boys.*		*Girls.*		*Total.*	
Glasgow	784	(918)	827	(1,016)	1,611	(1,934)
Dundee	1,028	(1,042)	1,059	(1,075)	2,087	(2,117)
Edinburgh	512	(584)	645	(766)	1,157	(1,350)
Rural (agricultural)	1,413	(2,082)	1,370	(1,868)	2,783	(3,950)
,, (mining)	1,604	(1,686)	1,497	(1,560)	3,101	(3,246)
,, (Lewis)	60	(60)	49	(49)	109	(109)
Totals	5,401	(6,372)	5,447	(6,334)	10,848	(12,706)

(*c*) Above the age of five years, 1,578 measurements of height and weight were available.

Table 17. *Number of Children over Five Years.*

Town.	*Boys.*	*Girls.*	*Total.*
Glasgow	408	398	806
Edinburgh	195	193	388
Dundee	193	191	384
Totals	796	782	1,578

These children of school age were statistically dealt with by Miss Tully. On account of the comparatively small numbers and the equal distribution through the various years, Dr. Greenwood advised that the ages should be combined and the correlations worked out on the total figures.

Number of Children studied in Agricultural and Mining Areas

(*d*) The number of pre-school children studied in agricultural and rural mining areas was 5,884, as shown in Table 18.

TABLE 18. *Number of pre-School Children in Rural Areas.*

	Boys.	*Girls.*	*Total.*
Agricultural . .	1,413	1,370	2,783
Mining . . .	1,604	1,497	3,101
Totals . . .	3,017	2,867	5,884

(iv) METHODS OF WEIGHING AND MEASURING

Weight. The infants at the Child Welfare Centres were in all cases weighed in special scales and were naked. The younger children in the house-to-house studies were weighed by means of an ordinary spring balance which was previously checked in the laboratory, the child being slung from the balance by a band or scarf. Children under one year were weighed without clothes. In the case of children over one year it was found impossible to induce the mothers to allow them to be stripped for weighing. Hence they had to be weighed in indoor clothes without boots.

Children of school age were weighed by the investigators either at schools or, as in Edinburgh, at the various play centres. We are indebted to the school authorities for permission to use the weighing machines in the schools and also to the teachers for the invariable courtesy and readiness which they displayed to assist in the obtaining of the necessary measurements. In Dundee we were fortunate enough to have the assistance of Dr. Kidd, the Chief Medical Officer of the Dundee Education Authority, and in that town all the school children of the families studied were weighed and measured under Dr. Kidd's direction by his staff. Our thanks are due to him for the very valuable assistance.

Height. At the Welfare Centres infants were measured lying prone on a measuring board, as described by Dr. T. Y. Finlay in the *Edinburgh Medical Journal* (1924). In the intensive studies infants were measured lying flat on a table or other suitable flat surface. Older children were measured standing upright against a wall, without boots or shoes.

Unfortunately, at the beginning of the work in Glasgow the importance of ascertaining height as well as weight in young babies was not appreciated and, as a result of our not giving sufficiently definite instructions to the observers, a considerable number of infants were weighed in clothes, the fact being indicated in the records by a star. These starred records were at first rejected, and the number of observations on infants under a year in Glasgow was therefore very limited. In working some of the correlations the assumption has been made that the proportion of unclothed and clothed at the different ages is about the same and both classes have been dealt with together, but when this is done it is indicated. This undoubtedly reduces the value of these correlations for the first year of life in Glasgow.

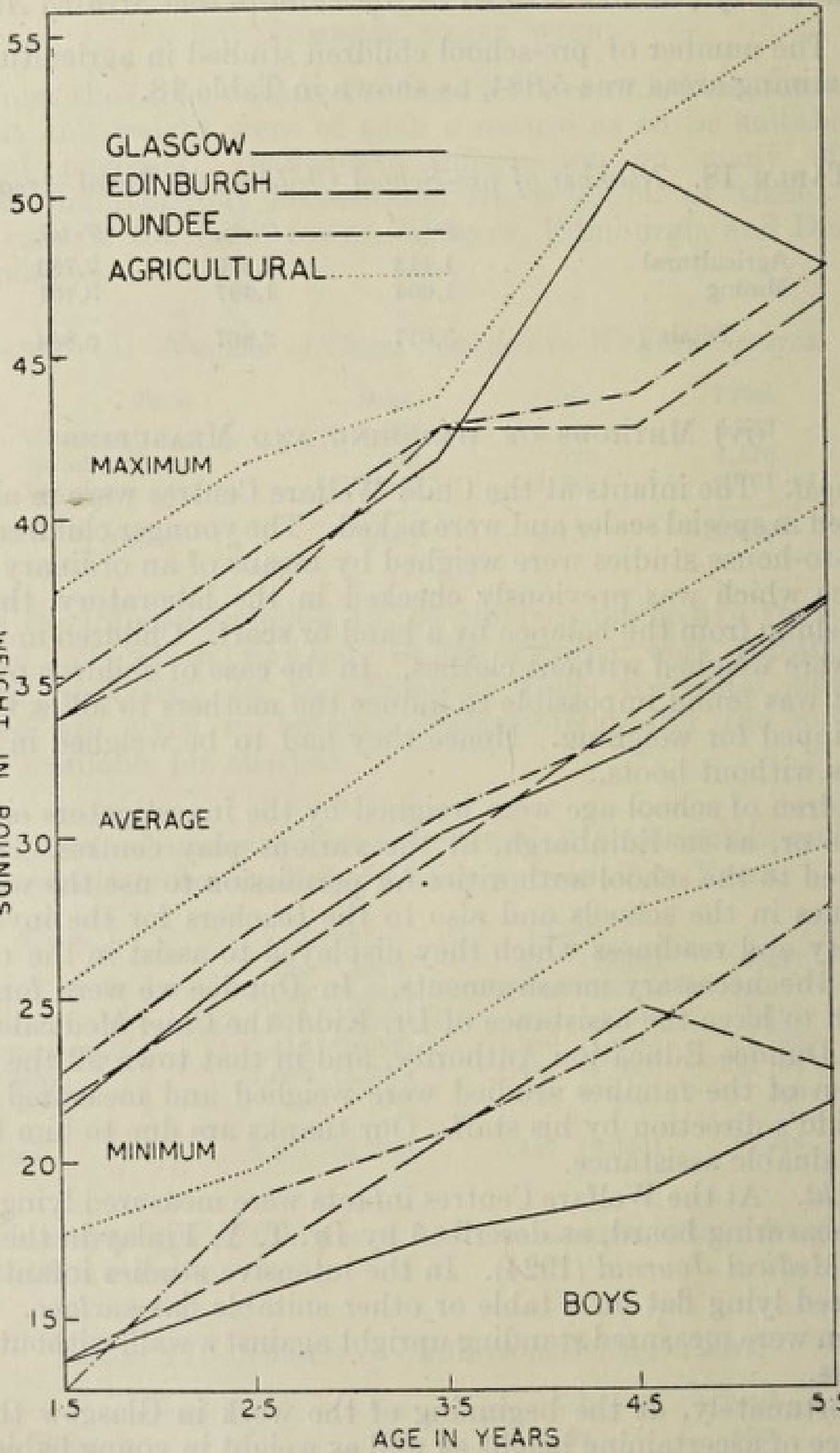


CHART II. Range of boys' weights in town and country.

(v) RANGE OF VARIATION IN WEIGHT AND HEIGHT

In studying the influence of environmental conditions on height and weight the possibility had to be considered that the divergences in these at different ages were not sufficient to allow of the effect of any environmental condition to be manifest.

The accompanying Charts II to V and Tables 19 and 20 show a wide dispersal, and indicate that among these poorer classes there are children as big and heavy as are to be found among the more favoured grades of the population.

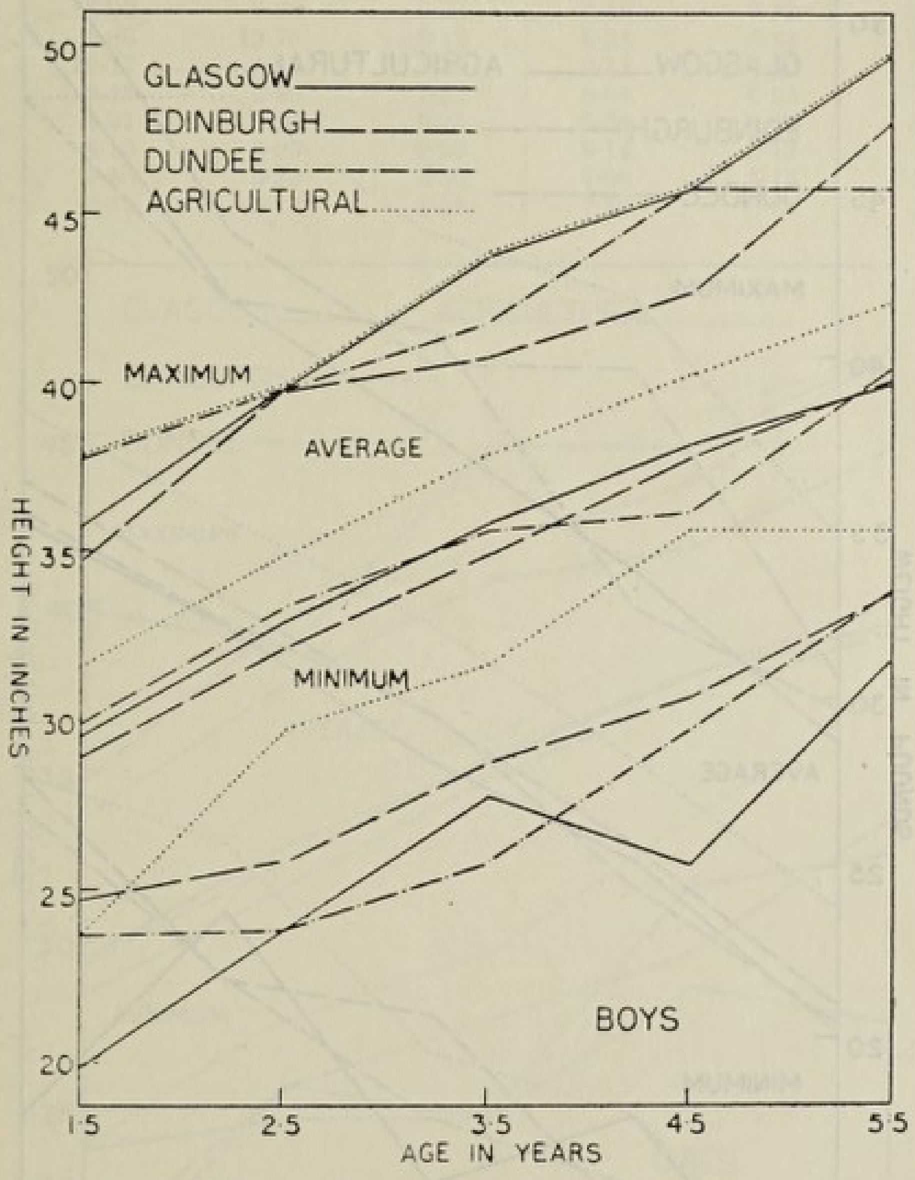


CHART III. Range of boys' heights in town and country.

TABLE 19. *Percentage Variation in Weight.*

(Coefficients of Variation.)

	MALES.			FEMALES.		
Age.	*Glasgow.*	*Edinburgh.*	*Dundee.*	*Glasgow.*	*Edinburgh.*	*Dundee.*
−3 m.	25·89	16·67	22·75	28·36	18·38	20·37
3+ „	19·94	18·13	19·14	19·42	18·39	18·31
6+ „	15·81	17·94	22·47	17·25	13·88	18·04
9+ „	17·32	14·88	12·70	18·85	12·09	16·49
1+ y.	17·33	13·84	15·44	15·61	14·79	16·78
2+ „	13·59	13·85	12·69	13·94	13·50	13·57
3+ „	13·19	11·96	12·21	13·00	12·88	11·67
4+ „	14·92	11·05	11·35	11·15	11·86	10·95
5+ „	13·61	10·86	9·31	13·89	11·94	11·94

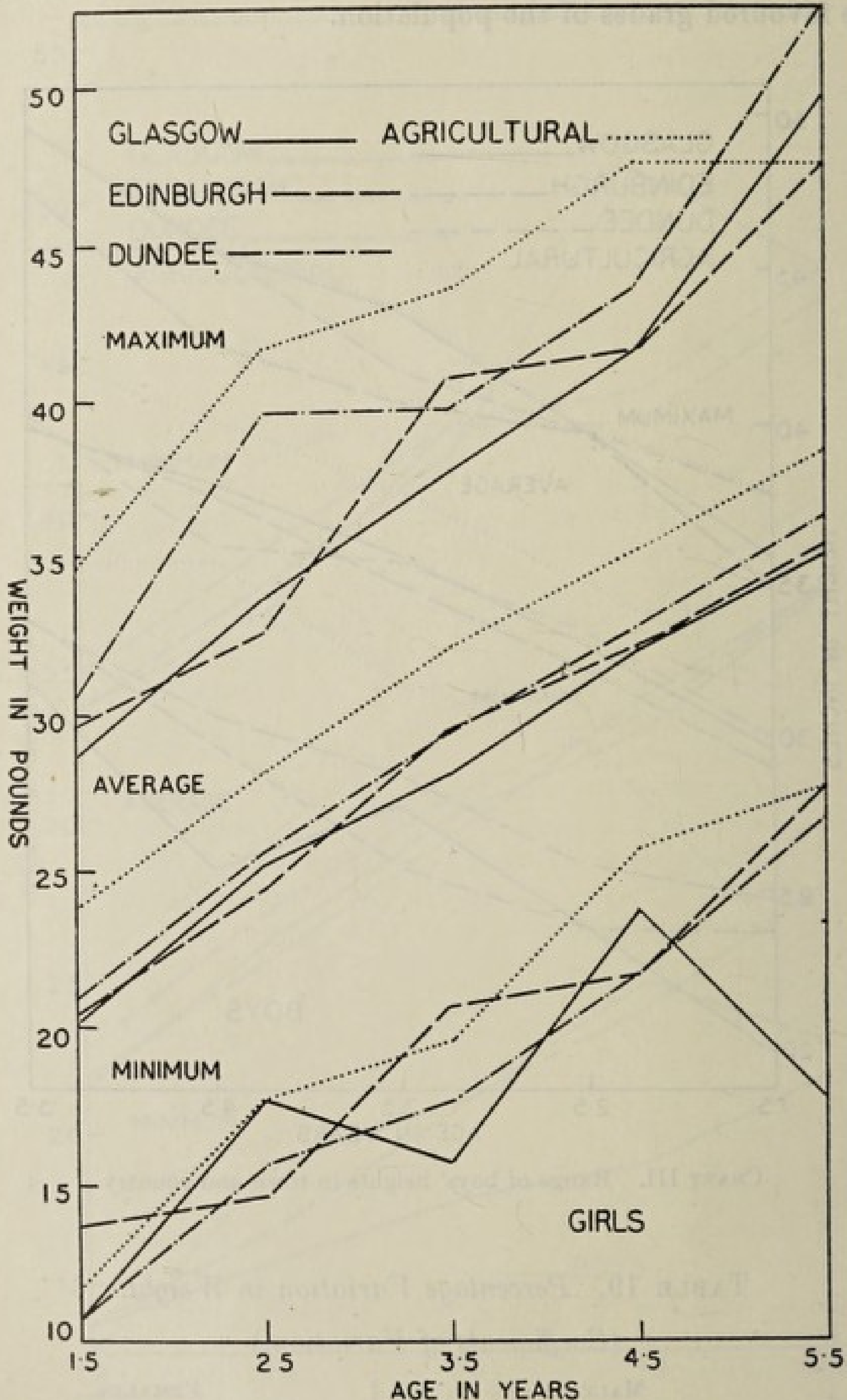


CHART IV. Range of girls' weights in town and country.

TABLE 20. *Percentage Variation in Height.*

(Coefficients of Variation.)

Age.	Males. *Glasgow.*	*Edinburgh.*	*Dundee.*	Females. *Glasgow.*	*Edinburgh.*	*Dundee.*
−3 m.	8·02	5·65	7·90	9·37	7·21	7·35
3+ ,,	8·92	7·28	6·90	6·56	6·12	8·27
6+ ,,	6·86	13·78	6·12	8·24	5·34	5·78
9+ ,,	10·17	4·69	5·37	9·11	6·12	5·15
1+ y.	8·55	6·46	7·52	8·09	6·38	7·52
2+ ,,	8·97	6·88	6·25	8·64	7·07	6·42
3+ ,,	8·10	6·05	6·99	8·14	6·42	4·85
4+ ,,	9·80	5·29	5·50	7·00	5·13	5·41
5+ ,,	6·34	5·14	4·58	7·82	5·34	5·98

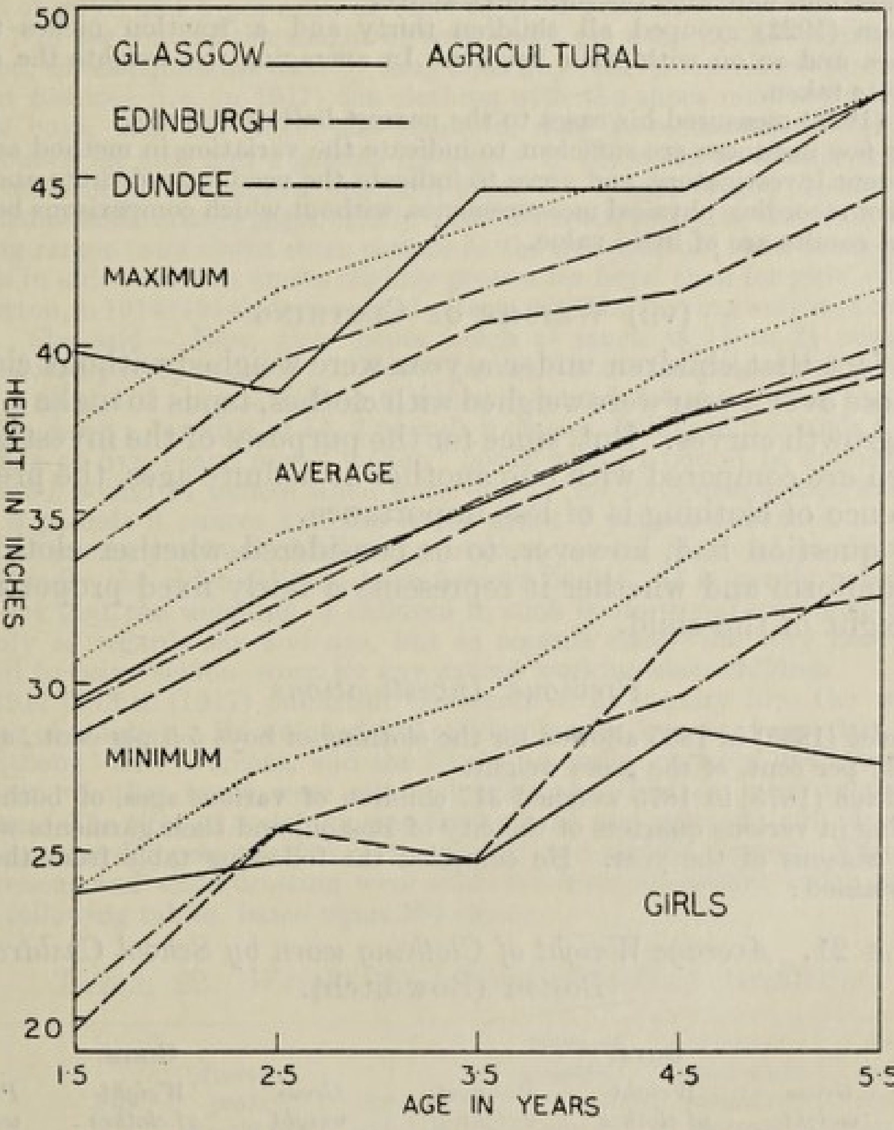


CHART V. Range of girls' heights in town and country.

(vi) Limit of Accuracy of Measuring and Weighing

In the present investigation *weight* was estimated to the nearest quarter pound. Since the weight varies with the condition of the stomach, rectum, and urinary bladder, any attempt at greater refinement of weighing is unnecessary. Infants under one year were weighed unclothed. Children from one to five years of age were weighed in indoor clothing without boots or shoes.

Height was calculated to the nearest quarter inch, without boots or shoes.

Few of the earlier investigators indicate in the reports of their work the limit of accuracy which they adopted. Among the more recent who do so the following may be cited :

Gray and Jacomb (1921) took height to the nearest quarter inch and weight to the nearest quarter pound, all measurements being made on children without clothes.

Woodbury (1921) gives heights to the nearest inch and weights to the nearest half-pound. Cases in which the stature fell on the even half-inch or on the dividing line between two groups were divided equally, and half were included in the group below and half in the group above the dividing line. Similarly for weights, cases in which the weight was stated with a fraction of one-fourth or three-fourths of a pound were divided equally, and half were included with the unit below and half with the unit next above.

Putnam (1922) grouped all children thirty and a fraction inches tall as 30 inches and so on with other heights. In averaging the weights the *nearest* ounce was taken.

Gray (1922) measured his cases to the nearest half-centimetre.

These few instances are sufficient to indicate the variation in method adopted by different investigators, and serve to indicate the need for a definite and fixed method of recording physical measurements, without which comparisons between different results are of little value.

(vii) Weight of Clothing

The fact that children under a year were weighed without clothes, and those over a year were weighed with clothes, tends to make a break in the growth curves. But, since for the purposes of the investigation children are compared with one another at definite ages, the presence or absence of clothing is of less importance.

The question had, however, to be considered whether clothing is fairly uniform and whether it represents a fairly fixed proportion of the weight of the child.

Previous Investigations

Quetelet (1835) in 1835 allowed for the clothing of boys 5·5 per cent., and for girls 4·17 per cent. of the gross weight.

Bowditch (1875) in 1875 weighed 317 children of various ages, of both sexes, and living in various quarters of the city of Boston, and their garments worn at various seasons of the year. He compiled the following table from the data thus obtained :

Table 21. *Average Weight of Clothing worn by School Children in Boston* (Bowditch).

Age last birth-day in years.	Boys.			Girls.		
	Gross weight in lb.	*Weight of clothes in lb.*	*Per cent. weight of clothes.*	*Gross weight in lb.*	*Weight of clothes in lb.*	*Per cent. weight of clothes.*
5	44·22	2·85	6·45	41·84	2·84	6·79
6	43·51	3·13	7·19	43·90	2·90	6·61
7	52·79	3·44	6·52	47·82	3·59	7·51
8	56·15	4·06	7·23	53·69	3·51	6·54
9	59·85	4·76	7·95	61·07	4·23	6·93
10	62·35	5·72	9·04	66·45	4·54	6·83
11	67·67	6·69	9·88	70·87	4·88	6·88
12	78·29	7·27	9·29	82·96	5·64	6·80
13	88·19	7·40	8·39	96·88	5·66	5·85
14	99·22	8·09	8·15	111·47	7·54	5·76
15	103·65	8·08	7·80	107·23	7·85	7·32
16	120·30	9·67	7·86	117·16	8·09	6·90

Bowditch suggested that his average weight of clothing was so much higher than Quetelet's because the children in his inquiry were of a better class and hence better clad. He did not include in his inquiry any children of the very poor. Unfortunately, it is not clear whether Bowditch or Quetelet included boots and shoes in the weight of clothing, though a comparison of Bowditch's results with those of the present investigation would seem to indicate that he did. His average percentage weight of clothing does not materially decrease with age, while, when boots and shoes are not included, there is a steady decrease in the average percentage weight of clothing. It seems possible that in Bowditch's records the increasing weight of boots and shoes with age is a factor which keeps the percentage weight at a steadily high level.

According to Barden (1921) Pirquet estimated light body clothing to increase the body weight by 3 per cent.

Schmidt Monnard in 1901 (1901) weighed a large number of children and concluded that the weight of clothes from three to six years was 7 per cent. of the weight of boys, and 6 per cent. of the weight of girls, and from six to fourteen years, 7·75 per cent. of the weight of boys and 8 per cent. of the weight of girls.

Wood, whose figures are used by Gray and Gray (1917), considered that with the present fashions (i.e. in 1917) the clothing with the shoes removed and, in the case of boys, with the jacket also removed, may be estimated on the average at 3 pounds for girls and 4 pounds for boys. If the child be measured in shoes he recommended subtracting one inch from the height to get the net height. In Benedict and Talbot's paper (1921) Wood is quoted as saying that the 'weight of clothing ranges from about three pounds in the five-year-old child to six or seven pounds in older children and is slightly greater for boys' than for girls' clothing'.

Elderton, in 1914 (1914), drew special attention to the varying weight of children's boots. She said—'Now, girls' boots weigh as much as $1\frac{1}{4}$ to $2\frac{1}{2}$ pounds and boys' boots $1\frac{3}{4}$ to $3\frac{1}{2}$ pounds. . . . New "tacket" boots for girls of five in Glasgow weigh 1 pound 5 ounces, falling to about 1 pound 3 ounces when the tackets are worn down; for girls of 14, 2 pounds 6 ounces, falling to 2 pounds 2 ounces. For boys of five years, new "tacket" boots weigh 1 pound 14 ounces, falling to about 1 pound 11 ounces when worn down; for boys of fourteen the former weigh 3 pounds 9 ounces and the latter about 3 pounds 3 ounces. . . . Many public elementary school children have great masses of metal in their boots. Undoubtedly the older children have heavier boots.' It is hardly necessary to point out that the weighing of children in such boots would introduce an error not only as regards sex and age, but as regards class—the very heavy boots referred to being seldom worn by any except working-class children.

In 1917 Griffith (1917) published the result of an inquiry into the weight of clothing of children. He weighed 222 children under 5 years of age, first, dressed but without 'hat, overcoat, and the like'; secondly, entirely unclothed. It is not clear whether boots were retained when the children were weighed with clothing. The time of weighing was the autumn and summer, and the children were considered representative of the poorer and middle classes. Extremes of overdressing and underdressing were excluded from the results which are given in the following tables, based upon 194 cases:

TABLE 22. *Weight of Children's Clothing* (Griffith).

Age.	*No. of cases.*	*Average gross weight of children.*		*Average weight of clothes.*		*Ratio of weight of clothes to gross weight.*	*Average mean gross weight of normal child.*		*Ratio of weight of clothes to gross normal weight.*
		lb.	oz.	lb.	oz.	%	lb.	oz.	%
Birth–3 m.	10	7	13	1	14	24·38	11	12	15·96
3 m.–6 m.	19	10	15	1	13	16·58	16	1	11·28
6 m.–9 m.	13	14	1	1	14	13·15	19	6	9·68
9 m.–12 m.	10	15	2	1	13	12·13	21	15	8·25
1 y.–2 y.	21	18	10	2	2	11·27	26	6	8·05
2 y.–3 y.	34	23	13	1	15	8·0	31	7	6·16
3 y.–4 y.	35	29	7	2	0	6·7	36	8	5·48
4 y.–5 y.	37	32	11	2	7	7·37	41	7	5·88
5 years	15	38	3	2	9	7·1	43	9	5·82

As approximate figures Griffith gives—

Clothing for first year	= $1\frac{3}{4}$ lb.
,, ,, 1–4 years	= 2 ,,
,, ,, 4–6 ,, ...	= $2\frac{1}{2}$,,
Weight ratio for first three months . .	= 16 per cent.
,, ,, 3 months to 2 years . .	= 8–10 per cent.
,, ,, 2 years to 5 or 6 years .	= 6 ,, ,,

He made an estimate of the variation in the weight of clothing of the two sexes in children of from 2 to 4 years of age. Up to 1 year the clothing is practically identical in the two sexes. His results do not agree with those of Bowditch as he found the absolute weight and the weight ratio of the girls' clothing to be greater than that of boys. He gives the following results:

TABLE 23. *Weight and Ratios of Clothing, ages 2, 3, and 4 years.*

	Average weight of clothing (ounces).		*Ratio of weight of clothing to normal clothed weight (per cent.).*	
Age.	*Boys.*	*Girls.*	*Boys.*	*Girls.*
2 years . .	29	31	5·79	6·56
3 ,, . .	30	31	5·15	5·47
4 ,, . .	33	39	5·02	6·03

In 1920 Porter (1920) concluded—he gives no actual weights of clothing to support his decision—that 'too much emphasis must not be laid on hypothetical differences in summer and winter clothing.' He considers that the indoor clothing of Boston public school children does not change during the school year as much as might be supposed.

In 1921 Baldwin (1921) says, 'Clothing for children below 12 years weighs, on an average, 0·75 kilo, and for children over 12 years, on an average 1·1 kilo'. In the tables of heights and weights of American school children which he and Wood prepared (1923) the following amounts representing clothing were added to the weights of nude children in order to make the figures comparable with clothed children:

For boys—

For weights from 35 to 63 lb. . . .	3·5 per cent. of net weight is added.
For weights 64 lb. and over	4 ,, ,, ,,

For girls—

For weights from 35 to 65 lb. . . .	3 ,, ,, ,,
For weights from 66 to 82 lb. . . .	2·5 ,, ,, ,,
For weights from 83 lb. and over . . .	2 ,, ,, ,,

(For boys, shoes, coats, and sweaters are not included in the clothing weights. For girls, shoes and sweaters are not included.)

Baldwin (1921) says, 'It has been found that the weight of children's clothing worn at the present day is considerably less than the earlier estimates by other investigators. Also the range of variation in the clothing of different children and at different seasons is not so wide as has been supposed.'

Bardeen has published two tables giving average weight of clothing calculated, not according to the age of the child, but according to the weight with clothing of the child. They are given here.

From these figures shoes appear to be about 2 per cent. and indoor clothes without shoes about 3 to 4 per cent. of the gross weight.

TABLE 24. *Weight of ordinary Indoor Winter Clothes of School Children* (Bardeen).

GIRLS.

Body weight with clothes (lb.).	*With shoes.* *Per cent. gross weight (%).*	*With shoes.* *Weight in lb.*	*Without shoes.* *Per cent. gross weight (%).*	*Without shoes.* *Weight in lb.*	*Without coat and shoes.* *Per cent. gross weight (%).*	*Without coat and shoes.* *Weight in lb.*
25–30	6	1·75	4	1	3	0·75
31–35	6	2	4	1·5	3	1
36–40	6·5	2·5	5	2	3·25	1·25
41–45	7	3	5	2·25	3·5	1·5
46–50	7	3	5	2·25	3·5	1·5
51–55	7	3·5	5	2·5	3·5	1·75
56–60	7	4	5	3	3·5	2
61–65	6·5	4	5	3	3·25	2
66–70	6·5	4·5	5	3·5	3·25	2·25
71–75	6·5	5	5	3·75	3·25	2·5
76–90	6	5	4	3·75	3	2·5
91–95	6	5	4	4·25	3	2·75
96–110	5·5	5	4	4·25	2·75	2·75
111–120	5·5	6	4	4·5	2·75	3
121–130	5	6	3·5	4·5	2·5	3
131–140	5	6·5	3·5	5	2·5	3·25
141–150	4·5	6·5	3·5	5	2·25	3·25

BOYS.

Body weight with clothes (lb.).	*With shoes.* *Per cent. gross weight (%).*	*With shoes.* *Weight in lb.*	*Without shoes.* *Per cent. gross weight (%).*	*Without shoes.* *Weight in lb.*	*Without coat and shoes.* *Per cent. gross weight (%).*	*Without coat and shoes.* *Weight in lb.*
25–30	6	1·75	4	1·25	3	0·75
31–35	6	2	4	1·5	3	1
36–40	6·5	2·5	5	2	3·25	1·25
41–45	7	3	5	2·25	3·5	1·5
46–50	7·5	3	5·5	2·5	3·7	1·75
51–55	8	4	6	3	4	2
56–60	8	4	6	3·5	4	2·25
61–65	8	5	6	3·75	4	2·5
66–70	8·5	5·75	6·5	4·5	4·25	3
71–75	9	6·5	7	5	4·5	3·25
76–90	8·5	7	6·5	5·5	4·25	3·5
91–95	8	7·5	6	5·5	4	3·75
96–110	8	8	6	6	4	4
111–120	7	8	5	6	3·5	4
121–130	6·5	8·5	5	6·25	3·25	4·25
131–140	6·5	8·5	5	6·25	3·25	4·25
141–150	6	9	4·5	6·75	3	4·5

Woodbury (1923) in his tables of weights and heights of children from birth to school age adds the following amount to the weights of children weighed nude, as being representative of average indoor clothing. (Shoes, coats, and sweaters not included.)

	Height. in.	*Amount added as weight of clothing.* lb.
For boys—		
	35–39	$1\frac{1}{4}$
	40–44	$1\frac{1}{2}$
	45–49	$1\frac{3}{4}$
For girls—		
	35–39	1
	40–44	$1\frac{1}{2}$
	45–49	$1\frac{3}{4}$

Holt and Fales (1923) give the following estimate of the weights of clothing of children in an institution. The weight is for indoor clothing without shoes, coats, and sweaters.

	Weight of clothing. Summer. lb.	Winter. lb.
Children over 60 lb. and over 50 in.	1½	2
Children 40–60 lb. and 35–50 in.	1	1½

Present Investigation

Clothing of children has been weighed in Glasgow, Edinburgh, and Dundee, and also in rural (agricultural and mining) areas in Scotland. The average weight of the clothing and the ratio of the weight of the clothing to the average gross clothed weight of the children at different ages is given in the following tables (see Tables 25 and 26). Where the data made this possible the results of other investigators have been estimated, and these are given along with the present results in Table 27.

Conclusions

The figures in these tables, probably from the fact that some of the age groups are small, are somewhat indeterminate in result, but the following conclusions are suggested:

(1) The range of variation in the weights of the clothing is much the same in all the districts, both urban and rural.

(2) The *average* weight of clothing ranges, during the first five years of life, from 1 to 2 lb. These figures agree on the whole with the results of most previous investigators who definitely state that the children were weighed without boots. Bowditch and Schmidt Monnard probably weighed with boots.

(3) Roughly, the average weight ranges from 1 lb. among infants to 2 lb. at five years of age.

(4) Though the actual weight of an infant's clothing is lighter than that worn by older children, infants are *proportionately to their weight* more heavily clad than the older children. The few figures available for children over 5 years of age tend to show that the lessening of the *relative* weight of the clothing continues till well on in school life. An infant under 1 year wears clothing equal to from 5·5 to 11·8 per cent. of its gross weight. In a child from 1 to 5 years of age the clothing averages from 4 to 7 per cent. of the gross weight. In a child of 8 to 10 years it averages from 1·4 to 2·3 per cent. of the gross weight.

(5) Variation in the weight of clothing of the two sexes is somewhat indeterminate, but, on the whole, girls are proportionately more heavily clad. The difference is not great, generally about 1 per cent. of the gross weight.

(6) The clothing is generally heavier in the winter time than in the summer—from 1 to 2 per cent. of the gross weight. Edinburgh winter-weight ratios are higher than Edinburgh summer-weight ratios. Glasgow winter-weight ratios are higher than Dundee summer ones. The agricultural winter-weight ratios are higher than the summer ratios. The winter-weight ratios in the mining areas are similar to those in winter in the agricultural areas

Table 25. *Weight of Clothing (Girls).*

District.	Sex.	Age. Years.	No. of cases.	Average gross weight (with indoor clothing). lb.	Weight of clothing. Summer. Average weight of clothes. lb.	Summer. Average percentage of gross weight.	Winter. Average weight of clothes. lb.	Winter. Average percentage of gross weight.	Summer and winter. Average weight of clothes. lb.	Summer and winter. Average percentage of gross weight.
Glasgow	Female	−1	15	15·1	—	—	1·1	7·3	1·1	7·3
,,	,,	1+	4	19·5	—	—	1·4	7·2	1·4	7·2
,,	,,	2+	5	24·2	—	—	1·9	7·9	1·9	7·9
,,	,,	3+	6	31·6	—	—	2·1	6·7	2·1	6·7
,,	,,	4+	—	—	—	—	—	—	—	—
,,	,,	5+	1	29·5	—	—	1·5	5·1	1·5	5·1
Edinburgh	,,	1+	1	22	—	—	2	9·1	2	9·1
,,	,,	2+	4	26·8	2	7·2	1·8	6·8	1·9	7
,,	,,	3+	15	31·1	1·4	4·6	1·8	5·5	1·5	4·8
,,	,,	4+	23	34·7	1·7	4·8	2·1	6·4	1·9	5·5
,,	,,	5+	2	39	1·6	4·4	2·7	6·6	2·2	5·6
,,	,,	6+	5	38·5	—	—	2	5·2	2	5·2
,,	,,	7+	2	42·1	—	—	1·8	4·3	1·8	4·3
Dundee	,,	−1	6	13	0·9	6·9	—	—	0·9	6·9
,,	,,	1+	4	21	1·4	6·7	—	—	1·4	6·7
,,	,,	2+	7	26·4	1·4	5·3	—	—	1·4	5·3
,,	,,	3+	6	29·3	1·4	4·8	—	—	1·4	4·8
,,	,,	4+	7	33·3	1·8	5·4	—	—	1·8	5·4
,,	,,	5+	4	39·2	2	5·1	—	—	2	5·1
Agricultural	,,	−1	20	16·3	—	—	1·1	6·7	1·1	6·7
,,	,,	1+	10	22·8	1	4·3	1·4	6·2	1·3	5·7
,,	,,	2+	5	31·9	1	3·6	1·9	6·1	1·7	5·6
,,	,,	3+	11	31·9	0·9	3·1	1·7	5·2	1·6	5
,,	,,	4+	7	35·5	1·8	4·8	2	5·7	1·9	5·4
,,	,,	5+	2	41·8	—	—	2·5	6	2·5	6
Mining	,,	−1	17	15·5	—	—	1·5	9·7	1·5	9·7
,,	,,	1+	3	24·3	—	—	1·7	7	1·7	7
,,	,,	2+	6	27·3	—	—	1·7	6·2	1·7	6·2
,,	,,	3+	5	32	—	—	2·1	6·2	2·1	6·2
,,	,,	4+	7	35·4	—	—	2	5·8	2	5·8
,,	,,	5+	2	38·5	—	—	2·1	5·5	2·1	5·5
School Children.										
Dundee	,,	10	1	55	2·3	4·2	—	—	2·3	4·2
,,	,,	12	1	64	2	3·1	—	—	2	3·1
,,	,,	13	1	78	2·7	3·5	—	—	2·7	3·5

TABLE 26. *Weight of Clothing (Boys).*

District.	Sex.	Age. Years.	No. of cases.	Average gross weight (with indoor clothing). lb.	Weight of clothing. Summer. Average weight of clothes. lb.	Summer. Average percentage of gross weight.	Winter. Average weight of clothes. lb.	Winter. Average percentage of gross weight.	Summer and winter. Average weight of clothes. lb.	Summer and winter. Average percentage of gross weight.
Glasgow	Male	−1	14	14·1	—	—	1·04	7·4	1·04	7·4
"	"	1+	3	23·5	—	—	1·5	6·6	1·5	6·6
"	"	2+	2	26·6	—	—	2	7·5	2	7·5
"	"	3+	3	30·6	—	—	2	6·4	2	6·4
"	"	4+	5	33·9	—	—	1·7	5·1	1·7	5·1
"	"	5+	3	38	—	—	2	5·3	2	5·3
Edinburgh	"	1+	—	—	—	—	—	—	—	—
"	"	2+	10	30·5	1·7	5·7	2·1	7	2·08	6·8
"	"	3+	19	31·8	1·7	5·2	1·8	5·6	1·7	5·3
"	"	4+	15	35·4	1·7	4·7	1·8	4·9	1·8	4·8
"	"	5+	4	39·5	1·8	4·3	1·5	4·1	1·8	4·2
"	"	6+	2	48·6	—	—	2·1	4·4	2·1	4·4
"	"	7+	3	41·8	—	—	1·9	4·6	1·9	4·6
Dundee	"	−1	3	9·1	1·1	11·8	—	—	1·1	11·8
"	"	1+	6	20·5	1·1	5·4	—	—	1·1	5·4
"	"	2+	7	29·6	1·6	5·4	—	—	1·6	5·4
"	"	3+	5	28·6	1·4	4·9	—	—	1·4	4·9
"	"	4+	6	32·9	1·8	5·5	—	—	1·8	5·5
"	"	5+	2	37·1	2	5·4	—	—	2	5·4
Agricultural	"	−1	19	18·9	—	—	1	5·3	1	5·3
"	"	1+	15	26·1	1	3·8	1·3	5	1·2	4·6
"	"	2+	10	29·3	1·1	3·9	1·6	5·4	1·5	5·1
"	"	3+	10	34·1	1·8	5·2	1·7	5	1·7	5
"	"	4+	6	37·3	2·5	7·6	1·7	4·5	1·8	4·8
"	"	5+	3	40·8	2·5	6	1·8	4·4	2	4·9
Mining	"	−1	16	17·2	—	—	1·5	8·7	1·5	8·7
"	"	1+	4	28·1	—	—	1·6	5·7	1·6	5·7
"	"	2+	6	28·3	—	—	1·4	4·9	1·4	4·9
"	"	3+	3	30·8	—	—	2	6·5	2	6·5
"	"	4+	4	35·4	—	—	1·8	5·1	1·8	5·1
"	"	5+	1	37	—	—	2	5·4	2	5·4
School Children.										
Dundee	"	8	1	52	1·4	2·7	—	—	1·4	2·7
"	"	10	1	55	1·6	2·9	—	—	1·6	2·9

TABLE 27. *Ratio of Weight of Child's Clothing to Gross Weight of Child* (per cent.).

Age.	*Present investigation.*					*Previous Investigations.*										
	Glasgow.	*Edinburgh.*	*Dundee.*	*Agricultural.*	*Mining.*	*Quetelet (Belgian).*	*Pirquet (Austrian).*	*Griffiths (i. American).*	*Griffiths (ii. American).*	*Baldwin & Wood (American).**	*Woodbury (American).**	*Holt & Fales (American).**	*Bardeen (American).**	*Wood (American).**	*Bowditch (American).*	*Schmidt-Monard (German.)*
MALES.																
−1	7·4	—	11·8	5·3	8·7	—	—	—	—	—	—	—	—	—	—	—
1	6·6	—	5·4	4·6	5·7	—	3	8·1	—	—	—	—	—	—	—	—
2	7·5	6·8	5·4	5·1	4·9	—	3	6·2	5·8	—	—	—	3	—	—	—
3	6·4	5·3	4·9	5·0	6·5	5·5	3	5·5	5·2	—	3·8	—	3	—	—	7
4	5·1	4·8	5·5	4·8	5·1	5·5	3	5·9	5·0	—	3·8	4	3	—	—	7
5	5·3	4·2	5·4	4·9	5·4	5·5	3	5·8	—	3·5	3·6	4	3·25	8	6·5	7
6	—	4·4	—	—	—	5·5	3	—	—	3·5	3·6	4	3·25	—	7·2	7
7	—	4·6	—	—	—	5·5	3	—	—	3·5	3·3	4	3·25	—	6·5	7·8
8	—	—	2·7	—	—	5·5	3	—	—	3·5	3·3	4	—	—	7·2	7·8
9	—	—	—	—	—	5·5	3	—	—	3·5	3·3	4	—	—	7·9	7·8
10	—	—	2·9	—	—	5·5	3	—	—	3·5	3·3	4	—	—	9·0	7·8
11	—	—	—	—	—	5·5	3	—	—	3·5	—	—	—	—	9·9	7·8
12	—	—	—	—	—	5·5	3	—	—	3·5	—	—	—	—	9·3	7·8
13	—	—	—	—	—	5·5	3	—	—	4·0	—	—	—	—	8·4	7·8
FEMALES.																
−1	7·3	—	6·9	6·7	9·7	—	—	—	—	—	—	—	—	—	—	—
1	7·2	9·1	6·7	5·7	7·0	—	3	8·1	—	—	—	—	—	—	—	—
2	7·9	7·0	5·3	5·6	6·2	—	3	6·2	6·6	—	—	—	3	—	—	—
3	6·7	4·8	4·8	5·0	6·2	4·17	3	5·5	5·5	—	3·2	—	3	—	—	6
4	—	5·5	5·4	5·4	5·8	4·17	3	5·9	6·0	—	3·2	4	3	—	—	6
5	5·1	5·6	5·1	6·0	5·5	4·17	3	5·8	—	3	3·6	4	3·25	8	6·8	6
6	—	5·2	—	—	—	4·17	3	—	—	3	3·6	4	3·25	—	6·6	6
7	—	4·3	—	—	—	4·17	3	—	—	3	3·3	4	3·25	—	7·5	8
8	—	—	—	—	—	4·17	3	—	—	3	3·3	4	—	—	6·5	8
9	—	—	—	—	—	4·17	3	—	—	3	3·3	4	—	—	6·9	8
10	—	—	4·2	—	—	4·17	3	—	—	3	3·3	4	—	—	6·8	8
11	—	—	—	—	—	4·17	3	—	—	3	—	—	—	—	6·9	8
12	—	—	3·1	—	—	4·17	3	—	—	3	—	—	—	—	6·9	8
13	—	—	3·5	—	—	4·17	3	—	—	2·5	—	—	—	—	5·9	8

* Estimated.

The different results obtained by different investigators serve to emphasize the need for care in any comparisons drawn between data from different sources. Differences apparently quite significant may very well be due merely to differences in weights of clothing worn at the time of weighing. J. A.

(5) ASSESSMENT OF GROWTH

There seems little doubt that the best assessment of growth in a homogeneous race is height for age. In the case of individual children the initial size of the child, whether determined by race, or by the size of the parents, or by any other factor, must be taken into account. A brief summary of the more important work upon this subject may be given.

Previous Investigations

Crampton (1908), Foster (1910–11), and Variot (1906) have written on the close relationship between height and physical development, and have shown that height affords probably the best single index of the standard of growth and development. The investigations of such workers as given on p. 66, Putnam (1922), Gray and Jacomb (1921), and Benedict and Talbot (1921), agree in their findings that good environmental conditions are correlated with increase in both weight and height. The converse of this finding—that poor environment is associated with decreased height—leads to the consideration of just which parts of the bodily frame manifest alterations.

The relative growth of trunk and limb in the young has been examined by many investigators. West (1894) gives figures showing that 'the greater part of the growth in stature, up to the 12th year in girls and until the 15th year in boys, is made in the lower limbs, while after these ages it is made in the trunk'. Hrdlicka (1899) says, 'In children of small age the proportion of the length of the lower limbs to the total length of the body is comparatively small and increases with considerable . . . regularity during all the years up to and possibly even beyond the age of puberty. This means that as a child advances in life its limbs are growing in proportion somewhat more rapidly than its body'. Holt (1916) states that at birth the measurement from the anterior spine of the ilium to the sole is 43 per cent. of the total body length, while at five years it is 54 per cent., and at fifteen years 60 per cent. Bardeen (1920) points out that the changes in the proportions of the body are far greater during the first five years after birth, while the child is growing 21 inches in height, than during the next ten years when he grows another 21 inches, the most striking features of these changes being the decrease in the relative volume of the head and the increase in the relative volume of the inferior extremities. He summarizes the changes in proportion as follows: (*a*) First half-year after birth, rapid growth but relatively slight change in the bodily proportions. (*b*) From this period to puberty, growth of limbs rapid, head slow, trunk intermediate, height/weight index greatly reduced. (*c*) Puberty to maturity, more rapid growth of trunk. He gives the relative volume of the lower extremities at different stages of growth as:

Infant = 13·5 per cent. of whole.
Child = 22·6 ,, ,,
Youth = 29·2 ,, ,,

Boas (1912) gives figures (see Table 28) showing the relatively greater increase in the length of the lower limbs during childhood, leading to a lowering of the ratio between height and sitting height.

TABLE 28. *Height and Sitting Height* (Boas).

Age.	*No. of cases.*	*Height (cm.).*	*Sitting height (cm.).*	*Ratio between height and sitting height.*
6	4	1,099	605	55
7	13	1,143	609	53·4
8	25	1,180	621	52·6
9	21	1,243	664	53·5
10	34	1,276	664	51·9
11	28	1,308	681	52
12	30	1,367	709	51·8
13	36	1,384	712	51·6
14	44	1,467	752	51·1

Attention will later have to be drawn to the relationship of total height and of stem height to weight.

Bean (1922), from an examination of 1,445 white children (British, American, and German American) and 776 Filipino children, came to the conclusion that the sitting-height index varied with race, type, stature, and sex. He gives figures to show that sitting height is inverse to stature ; while with a small stature the sitting height is relatively great, with a large stature the sitting height is relatively less, within the race. Between races this is not true. The negro, regardless of stature, has a lower sitting height than any other people. The sitting height is greater in the female than in the male, even when they are of the same type and stature. He states also that the lower extremities are seen to grow more rapidly than the torso up to the following ages :

British-American girls	11 years
German-American girls	13 ,,
Filipino girls	13 ,,
British-American boys	15 ,,
German-American boys	16 ,,
Filipino boys	14 ,,

After the ages given above, the torso grows more rapidly than the lower extremities.

Gray (1922) differentiates sharply between sitting height and stem length, the latter measurement being, in his opinion, more accurate and reliable. He gives data in support of this view and also figures showing that he found the same relatively greater growth of the lower extremities as earlier investigators. (See Table 29.)

TABLE 29. *Stem Length Percentage of Height* (Gray).

Age.	*Stem/Height.*
6	53·7
7	53·7
8	52·1
9	51·1
10	51
11	50·7
12	49·9
13	50
14	48·4
15	49·8
16	49

Baldwin (1921) gives the sitting-height index of children at 6 years as 55·7, and at 13 years as 52.

Such results as are available indicate that faulty environmental conditions are more markedly related to the growth of the lower limbs. Hrdlicka (1899), in comparing children of an orphan asylum with those from a private practice record of Dr. West, found that the lower extremities of the asylum children were relatively shorter and concluded, 'These figures make me think that it is in the lower extremities where lies the principal defect in the growth of badly nourished children'. Gray (1922) found that the sitting height/height index was less in the case of boarding-school children who were living under very good conditions than the indices of other investigators who had studied children under average conditions, i. e. he found that the lower extremities of the boys reared in favourable environment were relatively longer. Gray gives his data and compares it with Hrdlicka's. Hrdlicka's indices of poor children are higher than Gray's, i. e. the legs of the poor children show a greater degree of stunting than their bodies.

The relatively greater growth of the lower limbs in very young children and the relatively greater correlation of that growth with environmental conditions make the consideration of Gray's paper (1923) on a proposed Stem to Stature Index specially interesting. This may possibly be of value as an index of the development of young children and the effect of various factors on the development (as apart from nutrition). Gray considers that the ratio of the stem length to the total length may be worth the consideration of clinicians. He also tests the index as a possible measure of stamina, with inconclusive results.

(6) ASSESSMENT OF NUTRITION

Before discussing the assessment of nutrition it must be clearly understood what is implied exactly by the term. Nutrition does not refer to the height of the child, to the state of his health, or to his muscular activity. A child with a small store of fat and good muscular development may be perfectly healthy and yet not considered well nourished. A lethargic child with little manifestation of muscular activity and a disproportionate amount of fat may, on the other hand, be considered well nourished. Nor has nutrition anything to do with growth—a dwarfed individual may be well nourished and an unusually tall individual poorly nourished. Nutrition simply refers to the manner in which an individual absorbs and assimilates his food, in short, increases his bulk. Hence weight must be the chief factor in assessing it, but the possibility of part of the weight being due to pathological conditions, e. g. dropsy, tumour formation, &c., must not be lost sight of.

The most obvious method of assessing nutrition would be to assume that at each age a well-nourished child should be above some minimum weight and to accept weight for age as the index. But, as previously mentioned, nutrition is a state quite apart from growth, though, naturally, weight will depend on height. It has been shown, as a matter of fact, that the weight of a child depends more upon its height than upon its age, and the high correlation between these variables—weight and height—reached in our analysis supports this. Nevertheless, when dealing with large numbers of a homogeneous race in which the average height at each age is dealt with, there would seem to be less objection to the use of weight for age as a simple and ready index of nutrition. This question we refer to again.

In all indices of nutrition, and their number is considerable, weight is one of the factors employed, but the other factors which have been used in order to obtain some *constant* to indicate the same state of nutrition at different ages and under different conditions of height, race, &c. are very different. Many of the indices depend on the relationship of weight to height alone, but some refer to weight and body length or to weight and body circumference, while others again refer to weight and the circumference of the arm, or some other body measurement, such as the thickness of the abdominal fold. In some cases the index is obtained simply by dividing the height by the weight with or without reference to age, in other instances the weight has been divided by the square or the cube of the height, but, as a matter of fact, all sorts of conceivable multiples, divisions, or additions have been devised to obtain a factor which would apply to the generality of normal children.

One objection to the majority of previous investigations of indices, with few exceptions (e. g. Tuxford, p. 52), is that no differentiation is made between the sexes, although the varying relationship between height and weight in the two sexes is a characteristic feature of growth. During the whole period of development, too, the relationship between weight and height is constantly changing, so that any one weight/height index cannot apply to the whole period of growth.

(i) Previous Investigations

Towards the end of the eighteenth century Buffon (1829) proposed the formula W/H^3, and in 1836 Quetelet (1836) suggested W/H^3, or perhaps better $W/H^{2\frac{1}{2}}$, as an index of the build of the body. Quetelet stated that 'during the period of development the squares of the weights of different ages are as the fifth power of the stature'. These simple factors held sway for many years, and even yet it is doubtful if any of their successors possess any advantage over them. In considering the best indices for varying ages, Davenport (1920) says, 'For the first 30 months of development it is doubtful whether the best index of build is that proposed by Quetelet (weight divided by height to the $2\frac{1}{2}$ power) or the weight divided by the square of the height. For the entire developmental period from birth to 30 years it is doubtful whether weight divided by the square or the 5/2 power of the height gives the most satisfactory index of the build. . . . But for young adult males the best index of build is apparently obtained by dividing weight by the square of the stature.'

In 1886 an epoch of complexity dawned, each succeeding year vying with its predecessor in the production of a more complicated mathematical calculation. In 1886 Bernhardt evolved the formula:

$$\text{Weight in kilos} = \frac{\text{Height in cm.} \times \text{Chest measurement in cm.}}{240}$$

This formula has been critically examined by Gray and Mayall (1920), who state that 'just as his rule (based upon height and chest girth) as a rough measure of surface seems both theoretically and empirically the best guide so far (i.e. in 1920) offered for assessing weight, so we expect that experiments would discover an even better rule (based upon height, chest, and a third factor) expressing a rough measure of volume. For, fundamentally, weight must be proportional, not to length or surface, but to cubic mass.'

In 1899 Livi (1899) put forward the formula:

$$\frac{100 \times \sqrt[3]{\text{Weight}}}{\text{Height}}$$

which he termed the 'index ponderalis'.

In 1901 Pignet (1901) used chest measurement in conjunction with weight and height, and on these three measurements based his 'coefficient de robusticité'. His formula is:

$$N = H - (B + W), \text{ i.e.,}$$

*N*umerical Index = *H*eight − (*B*reast circumference in cm. + *W*eight in kilos).

This index has been largely used in the German and French Armies, and was also applied by Mayet (1906) to children from 7 to 14 years. Mayet found that the condition of the children varied directly with the index, the constitution being proportionately worse as the coefficient rises. Much has been written on Pignet's index. Baldwin (1921) instances Simon (1912) as finding it useful; Eulenberg (1910) as considering it unsuitable; Seyfarth (1911) and Ott (1911) as classing it as good; Schiotz (1916) as considering it to be fair; and Schweining (1904) as condemning it as bad for individual cases.

In 1908 Rohrer suggested (1908) his 'Index für Körperfülle' as a measure of the state of nutrition. This index he obtained by dividing the weight in grammes, multiplied by 100, by the cube of the height in centimetres. During the war this formula was widely used in Germany in selecting those children whose state of nutrition called for assistance from the charitable Quakers.

Rohrer's 'Index für Körperfülle' has been adversely criticized by Matusiewicz (1914), Bachaurer and Lampert (1920), Davenport (1920), Hamburger and Jellenig (1920), Schlesinger (1920), Wagner (1921), Pfaundler (1921), Kaup (1921), and Huth (1921). Less adverse in their criticism are Bardeen (1920), Schiotz (1916), and Berliner (1921). Bardeen, in discussing the formula, says, 'The value of this is recognized by Martin in his "Anthropologie" (1914). This formula best represents the difference in the development of robustness.'

In 1909 Bobbitt (1909) suggested that the cube of the height divided by the weight offered a good index of the nutrition of the body.

From 1909 to 1920 Oeder published a long series of papers on nutritional indices. He stresses the importance of an index based upon the relation between weight and what he calls 'proportional length'. This proportional length is twice the distance from the top of the skull to the middle of the pubic bone. Gray and Edmands (1922) reported unfavourably on this index. Oeder, too, was the first to carry out systematic measurements of the abdominal fat layer. He stated that he found the variation in its measurement in the sexes and at different ages such that 'the normal state of nutrition generally can be defined fairly accurately for any subject by the same measurement, the "Indexfettpolsterdicke", alone'. The abdominal fold was also suggested as an index of nutrition by Neumann (1912) and Batkin (1915), but Peiser (1921) has pointed out that the results of the two latter investigators do not agree. Neumann found that the average abdominal fat layer for boys from 4 to 13 was 5 mm., while Batkin found for boys from 5 to 10 years an average measurement of 13 mm., or more than twice as great as Neumann's estimate. For the general applicability of this index Gray and Edmands (1922) raise the very important question of how great the error of measurement might be in the hands of a busy practitioner or school examiner. From the figures published by the three foregoing investigators it would at least appear that the abdominal fold is so variable at different ages, being e. g. in the child only one-quarter of what it is in the adult, that any use of the index would require a careful consideration of the relation between the age of the subject and the measurement obtained.

In 1917 Tuxford (1917) offered the following formulae as a measure of the physical development of school children—different indices being used for the two sexes.

For boys. $$\frac{\text{Weight in grm.}}{\text{Height in cm.}} \times \frac{381 - \text{age in months}}{54}$$

For girls. $$\frac{\text{Weight in grm.}}{\text{Height in cm.}} \times \frac{384 - \text{age in months}}{48}$$

These formulae he considered yielded reliable indices of nutrition for children, the average index for normal children falling between 990 and 1,010.

Bardeen (1920) discussed the changes in the weight/height relationship during bodily growth. He states that the weight/height index of build is affected by physiological age, sex, race, and changes due to habits or environment. In infancy (during the first six months, he found rapid growth in both height and weight, with little change in bodily proportions. From the 6th or 7th month to the 14th or 15th year the changing relationship between weight and height he found to be such that the weight/height index curve took the form of a simple parabola with its vertex (among boys) at 56 inches, the lowest weight/height index thus coming at about 12·25 years. Bardeen used as his formula, to express build of body, weight in pounds divided by height in inches, cubed, and multiplied by 1,000, and gave the following figures indicating the change in bodily form during development:

	Infant.	*Child.*	*Youth.*
Stature	21 in.	42 in.	63 in.
Weight	8·5 lb.	39·3 lb.	104·5 lb.
Index of build	0·918	0·530	0·418

Among other formulae those of Guthrie, Broca, and von Noorden are cited by Gray and Gray (1919). Guthrie's formula is: Weight in lb. = 100 + (5·5 × number of inches taller than 5 feet). Broca's formula is: Weight in kilos = Height in cm. − 100. Von Noorden's formula is: Weight in kilos = Height in cm. × 0·455.

From 1913 onwards, Pirquet (1913–20) published a series of papers in which he elaborated a new system of food values for infants, with a formula for determining their state of nutrition. This formula was based upon the relationship which he observed between stem length and the cube root of body weight. His formula, after various emendations, he gave in 1919 as:

$$\frac{\sqrt[3]{\text{Weight} \times 10}}{\text{Stem Length}} = 100$$

100 is considered the normal index for muscular adults and plump infants, and 94 in the case of growing children. Pirquet published a set of tables based upon his formula, intended to render any calculation unnecessary for obtaining the index—so-called 'pelidisi' or 'gelidusi'. A considerable literature has, during the past few years, grown up round Pirquet's work. Among various considerations of the work may be cited those of Gray (p. 55), and Brailsford Robertson, who in 1922, when discussing the value of Pirquet's stem/weight index, says, 'It is merely a less accurate variant of the ponderal index, or cube root of the weight divided by height. . . . There is no evidence to show that the same value (i.e. pelidisi) would be normal for children of other races. . . . Its variability is probably high because it involves the weight of the child . . . a still more serious defect is the inaccurate character of the measure involved in the estimation of sitting height.'

Gray and Edmands (1922), who refer to various discussions on Pirquet's index of nutrition, including Hamburger and Jellenig's conclusion that the pelidisi method yields an error of hardly less than 40 per cent., stated that on a series of 114 school children they found that the error of the pelidisi was 21·5 per cent.

Dreyer (1920) from a consideration of observed relationships between weight, sitting height, and chest circumference drafted tables which give the normal weight which he found associated with (i) sitting height, and with (ii) chest circumference. He gives the following instructions as to how his tables should be used in arriving at an assessment of the physical fitness of the subjects observed: 'Find (i. e. from his tables) the weight corresponding to the observed trunk length, then look up the weight for the observed chest measurement; add the two weights together and divide by two, and the normal weight for an individual of the observed trunk length and chest circumference will have been obtained. The weight derived from the tables is now compared with the actual weight observed, and the percentage deviation above or below normal is readily calculated. Dreyer's work has been discussed by various writers, among them being Gray and Root (see p. 55) and Clark *et al.* (see p. 56). Gray and Edmands (1922) report favourably on it. In 1923 Mumford and Young (1922) tested the value of Dreyer's method and concluded 'It would appear that, despite the definite tendency shown in recent work on the inter-relationships of the physical measurements to replace the full length by the stem length, the latter does not possess the many advantages over the former that have frequently been claimed or asserted'. In 1923 Rodgers (1923) came to a similar conclusion. He says, 'The correlation between stem height (Dreyer) and vital capacity was not significantly better than the correlation between standing height and vital capacity.' It is quite apparent, from reference to Charts XVI and XVII (p. 87), giving the average weight, average total height, and average sitting height of children under 1 year of age in our own study, that the use of the stem length as one of the factors in the computing of an index cannot give a constant for children of different ages. It will be seen from the chart that while total height and weight curves are more or less parallel, the weight and stem-length curves on the contrary steadily diverge.

Brailsford Robertson (1922) suggested two formulae,

$$(1) \qquad \frac{100 \times \sqrt[3]{\text{Weight}}}{\text{Height}}$$

and

$$(2) \qquad \frac{100 \times \text{Weight}}{\text{Height.}}$$

In addition to the foregoing indices, a considerable amount of work has been done on indices involving other bodily measurements. For instance, Oppenheimer's (1901) ‘ nutritional quotient ’ was the maximum girth of the relaxed arm multiplied by 100 and divided by the chest circumference at the end of expiration. Gray and Parmenter (1923) combined chest depth with height as an index of body weight and nutrition.

Numerous papers have appeared within recent years in which the different indices are contrasted one with another and also with ideas of the state of nutrition as estimated by simple ocular examination. Holt (1918 *a*), in considering the use of weight and of height as indications of the condition of the child, states, ‘ Weight to age variations are so wide as to make the relationship of little value when taken alone. The normal variations in the weight of healthy children of the same race are from 10 to 15 pounds between the 6th and 10th years, while between the 10th and 16th years the range is from 20 to 40 pounds. In a private school in New York for boys who come from the wealthiest homes, the weight range was, from the 12th to the 16th year, from 40 to 50 pounds, all weights being taken without clothes, and by the same physician. . . . The height to age variations are still less significant. Height is even more influenced by race and by family inheritance than is weight. Children of the well-to-do classes exceed those of the less favoured in height much more than they do in weight. . . . The relation of height to weight is the only one which is really important as indicating the state of nutrition, but here considerable variation exists also in healthy children. A child's nutrition may be considered below normal when he is 10 per cent. below weight for his height between his 6th and 10th years, or 12 per cent. below, from his 11th to his 16th year.’ In another place he says (1918 *b*), ‘ The determination of where a child stands in the relation of his height to his weight is undoubtedly the best simple guide in fixing his status as to his nutrition. This ratio expresses the general solidity or robustness of the body and is therefore significant. . . . This weight/height index increases steadily and quite uniformly from 5½ years up to 38 years.’

According to the observations of Baldwin (1921) the lowest weight/height index in boys is at 6 years, when it is 0·15, and the highest is at 17½ years, when it is 0·40. Holt emphasizes the fact that variation from the average weight/height ratio may take place without any defect in the nutrition of the child. He says, ‘ The normal is a zone, not a line.’

In a series of papers from 1894 to 1900 Ranke, and in 1896 Porter, both quoted by Baldwin (1921), used, among other formulae, the simple W/H ratio, the importance of which as an index of nutrition Porter emphasized.

Van der Loo (1919), quoted in the *Journal of the American Medical Association*, 1919, remarks that from his observations he found that as children grow taller they increase more proportionately in weight than in length, so that the weight divided by the square of the height gives a fairly good index for comparison of conditions in different children, or in the same child at different times.

Retan in 1920 (1920) states that ‘ The relation of age to weight does not separate the normally nourished children from the undernourished ’, and he gives charts to show that this is so. He also points out that height ‘ has naught to do with nutrition ’ and considers that in the relation of weight to height is to be found the correct standard for estimating nutrition. Like Holt, he emphasizes the fact that normal weight is a variable and should be represented by a zone.

Benedict and Talbot (1921), in discussing weight and height as indices of nutrition, say, ' It is clear that, as an index of the best proportional distribution of flesh to skeleton, the relationship of height and weight is most satisfactory.'

The formulae suggested by Bornhardt, Guthrie, Broca, and von Noorden, together with the United States Army figures and a set of medico-actuarial figures, have been critically examined by Gray and Gray (1917), with the following result:

Bornhardt's formula	error of	6	per cent.
U.S. Army figures	,,	7	,,
Medico-actuarial figures	,,	7	,,
Guthrie's formula	,,	10	,,
Broca's formula	,,	13	,,
Von Noorden's formula	,,	20	,,

Later, Gray and Root (1921 *b*) compared Bornhardt's (which of the above indices apparently gave the best results) with those of von Pirquet and of Dreyer, and the results of the examination were as follow:

Dreyer and Hanson's formula . .	error of	4·47	per cent.
Bornhardt's formula	,,	8	,,
Von Pirquet's formula	,,	17	,,

In 1921 Huth (1921), quoted by Gray and Edmands (1922) as trying to solve the question, ' Are body measurements a function of the state of nutrition, or not ? ' concluded that there existed no correlation between the state of nutrition and body measurement indices, and therefore no functional connexion. He goes on to say, ' Hence it is not permissible to try to establish the state of nutrition with the help of body measurement indices. . . . We ought to get a correlation of at least +0·6 in order to regard an index as half-way reliable.'

In 1906 Fleischner (1906) discussed the relation of weight and height in children, which he grouped into ' well-nourished ', ' fairly well nourished ', and ' poorly nourished ' classes. He stated that ' Height increases as weight in well-nourished children. Age plays some part in fairly well nourished children's measurements . . . and a great part in poorly nourished children's measurements. . . . When the weight is stationary the increase in the measurements is very small, depending on the slight influence which age has upon the growth of the infant, notwithstanding the weight.'

Manny (1918) in 1918 made a comparison between three methods of determining the state of nutrition of children, (i) the Dunfermline scale, or determination by visual examination, (ii) weight to age, and (iii) weight to height. He considers that either weight/age or weight/height taken alone lead to error, and says, ' It would seem from the data that any adequate system of diagnosis will make use of both weight relationships. The weight/age basis selects a group of underweight cases, but an application of the weight/height method to the over-weight and even-weight groups shows from 4 to 6 per cent. of the former and 12 per cent. of the latter under weight. . . . Too close devotion to the weight/height basis allows many of the underweight children on the age basis who are also under height to pass as well nourished. . . . It is evident that the problem is worthy of careful study in order to work out a system of diagnosis. The Dunfermline scale is an attempt in this direction.'

In 1923 Clark *et al.*[1] (1923) subjected 9,973 white children in New York to a careful physical examination, grading the children from the results of that examination into ' excellent ', ' good ', ' fair ', and ' poor ' nutrition groups. The children were then weighed and measured and the value of weight, height, and sitting height as indices of the actual state of nutrition considered. It was found that ' a large proportion of the children in the well-nourished groups weighed less than some in the "fair" or "poor" group, and a considerable proportion weighed less than the average weight of the "fair" and "poor" children. . . . Curves were constructed showing the percentage distribution of the children in each of the four nutrition groups according to the percentage deviation from the average weight of all children of the same age and sex. The curves showed that not only did some children of "good" nutrition weigh less than some children of "fair" nutrition, but that some of "excellent" nutrition actually weighed less than some of "poor" nutrition. . . . As regards standing and sitting heights the differences are not so clear . . . heights tend to be a little less in the "fair" and "poor"

[1] See Table 30, p. 58.

nutrition groups. This tendency seems to increase as age increases.' Clark was here showing what so many of the newer school of paediatrists—Holt (1919), Benedict (1919), Retan (1919), Emerson and Manny (1920), and Benedict and Talbot (1921)—had already formulated, that weight for age was at best an uncertain index of the state of nutrition of the individual child. He, however, gives graphs which show that, *when sufficiently large groups of children are taken*, their *average* weight for age, and to a less degree their *average* total height and sitting height, are less in poorly nourished than in well-nourished groups.

In 1923 Clark *et al.* (1923) also published the result of a critical examination of Wood's height and weight to age tables, Dreyer's method (p. 53), and Pirquet's method (p. 53). Five hundred and six white American children were taken, all without physical defects and all selected by a competent paediatrician as being of 'good' or 'excellent' nutrition as judged by careful clinical examination. The children were weighed and measured and the standard of their nutrition (already assessed as being very good) was compared with the standards given in Wood's tables. It was found that, using these tables as standard, 20·2 per cent. were under weight, and 4·3 per cent. were over weight. The writers say, 'This does not seem to be a sufficiently high correlation for weight to serve as a standard of nutrition.' By Dreyer's method 12·8 per cent. were over weight and 10 per cent. were under weight. By Pirquet's method 17·2 per cent. were under weight and 1·6 per cent. were over weight. The writers, in commenting on these results, say, 'It does not appear that the pelidisi method even approaches the degree of accuracy afforded by a physical examination. The results are even more unsatisfactory for young children than for adults. . . . Many individuals classed as under weight by one standard were classed as normal, or, in a few cases, over weight, by one or both of the other standards. Out of 506 children, 210 were classed as under weight by one or more of the three standards used ; of these 210 cases, all three standards agreed only on 15 cases as being under weight.' The children were selected as the best specimens of health that could be found, yet, in spite of this, one-fifth of them were under weight according to the standard most frequently used in the United States.

In the same year Dublin and Gebhart (1923), in seeking to determine if height and weight identify undernourished children, published the result of the examination of 1,878 boys and 2,169 girls of the poorer class in New York. The examination of these children was made by a competent physician, who divided the children into well and badly nourished groups, thereafter comparing the result of the clinical examination with the Wood-Woodbury standard height and weight tables, taking 7 per cent. to 10 per cent. below the standard line to mean badly nourished. The physician's careful examination gave 34 per cent. of the children, the standard with 7 per cent. below gave 12 per cent. of the children as badly nourished, and with 10 per cent. below gave only 8·2 per cent. of the children as badly nourished. The youngest children were least well selected by the standards. Among the youngest children 7 per cent. of the badly nourished, aged 3, were indicated by the 7 per cent. limit and 2 per cent., aged 5, by the 10 per cent. limit. To some extent the failure of the weight/height tables to identify malnutrition was due to the fact that the children examined were of Italian extraction and stocky in build, but even when tables were prepared based on the average weights and heights of these Italian children, they failed to identify more than from 32 to 60 per cent. of the cases diagnosed by the doctor as being badly nourished. The investigation is of special interest as showing the need of standards for each race, and even within each race for special localities.

In 1923 Baker (1923), in comparing the results of a physical examination of children and those obtained by weighing the children, found that, among the younger members of the New York children examined, approximately twice as many cases requiring intensive treatment for malnutrition were detected by the physical examination as were detected on the score of their weight alone.

In 1924 Clark *et al.* (1924) tested the value of the new standards for height and weight of normal children given in the recently published Baldwin-Wood Weight/Height/Age tables. As in the studies already cited, they selected children who were as ideally fit as possible. All children who, even without physical defect or evidence of disease, were graded upon the basis of clinical evidence as 'fair', 'poor', and 'very poor' in nutrition, were excluded. The weight and height of the remaining children (graded as 'good' and 'excellent' in nutrition) were compared with these new American standard weight and height tables, and it was found that 22 per cent. of the 'good' nutrition group were under weight and 2 per cent. of the 'excellent' group were under weight. Both groups together had 16 per cent. under weight, according to the tables. Both of these groups, it must be remembered, were much above the average as measured by clinical evidence. Clark, discussing the results, says, 'Three possible errors may arise. (i) The average may not be applicable, that is, they may represent children of some special class or type different from the general child population; (ii) the variation from this average may be improperly fixed—perhaps 10 per cent. is too narrow a limit, or perhaps the limit should be a changing one for different ages and sexes; (iii) it may be that deviation from the average weight for sex, age, and height is not a criterion of physical fitness—that is, within broad limits a deviation from the average may not be a matter of ill health or malnutrition.'

A study of previous work on the subject thus tends to make clear the fact that weight/age and height/age are in many cases ineffectual as indices of the nutrition of the individual child, but Clark *et al.* in the paper cited earlier (p. 55) show that, after they had made a very careful grouping of their cases into two nutrition groups, both sexes showed, *on the average*, that weight is directly associated with nutritional condition, and, to a much less extent height also is associated. Their 'good' nutrition groups are from 4 lb. (at 6 years of age) to 22 lb. (at 16 years of age) in boys, and from 3½ lb. (at 6 years of age) to 15 lb. (at 16 years of age) in girls, heavier than the poorly nourished group. The difference in height is much less marked, but it ranges from about a quarter inch taller in the well-nourished girls group at 6 years of age to 3½ inches taller in the well-nourished boys group at 16 years of age. The table given below (see Table 30) gives the full results and the number of cases on which the results are based.

In 1922 Gray and Edmands (1922) gave a good historical survey of much of the work done on indices, especially in connexion with children.

J. A.

The question of what is the best index of nutrition, in spite of the large amount of work recorded, is thus left unanswered.

(ii) Present Investigation upon different Indices of Nutrition

For the purpose of the present investigation, which deals with average heights and weights of considerable numbers of children, much of the work is not applicable, seeing that it is concerned more especially with the determination of the place on the nutritional scale which any single child should occupy. But, as Clark's results show (p. 58), '*on the average,* weight is directly associated with nutritional condition.' We were forced to investigate for ourselves the significance of some of the more generally adopted indices, as expressions of the nutrition of groups of children, and the following report by Dr. MacKinlay gives the results of this investigation:

As indicated in the previous section, various ratios expressing the relationship between two physical characters have been suggested as more truly representing nutritional states than weight. It is the object of this study to evaluate some of the suggested indices. The data used for this purpose were collected from the case sheets of the children admitted to the Royal Hospital for Sick Children, Glasgow, in 1922 and 1923, and kindly lent for the purposes of this study by Professor Leonard Findlay. Only children under five years of age of both sexes are dealt with, since the material relative to children over five years was too scanty to admit of treatment by appropriate statistical methods without introducing errors which

TABLE 30. *Heights and Weights of 9,973 White American Children in Relation to Nutrition* (Clark *et al.*)

	Age in years.										
	6	7	8	9	10	11	12	13	14	15	16
Weights (lb.).											
Boys.											
Good nutrition .	47·12	51·99	55·26	60·95	66·11	72·54	79·75	86·45	96·43	110·00	116·75
Poor ,, . .	43·17	47·04	51·67	55·86	60·13	64·51	71·78	77·10	83·32	87·18	94·83
Girls.											
Good ,, . .	45·00	49·18	53·90	59·00	64·73	71·84	82·38	91·33	102·19	109·12	114·76
Poor ,, . .	41·50	44·72	48·76	52·17	57·08	62·26	68·19	75·15	86·73	91·46	99·56
Heights (in.).											
Boys.											
Good ,, . .	45·22	47·46	49·35	51·18	53·02	54·57	56·59	58·18	60·20	63·20	64·88
Poor ,, . .	44·76	46·51	48·77	50·55	51·83	53·78	55·77	57·46	58·11	59·82	61·36
Girls.											
Good ,, . .	44·72	46·85	49·01	51·02	52·76	55·10	57·41	59·43	61·42	62·61	63·28
Poor ,, . .	44·50	46·30	48·50	50·02	51·98	53·84	55·91	57·93	60·58	60·94	61·86
No. of cases in each age and sex group.											
Boys, good nutrition	183	402	470	520	573	494	479	425	326	199	98
,, poor ,, .	43	101	133	114	118	116	94	64	43	28	9
Girls, good ,, .	186	393	462	512	480	460	490	448	348	216	136
,, poor ,, .	37	96	110	125	113	107	79	64	52	13	9

would be so large as to negative any direct conclusions which might be drawn.

The infants were all measured in centimetres, the weighings were, in most cases, in kilos. In one ward, however, the only available apparatus was graduated in the English system. These weighings were converted into the metric system (1 lb. = ·45359 kilo). The weights were taken correct to 1/10 kilo; the heights and sitting heights correct to ·5 cm. These weighings were done by special nurses with considerable experience in this branch of the work, the infants being weighed nude. Measurements were made by resident and assistant physicians.

On each case sheet is an estimate of the infant's state of nutrition, given by the senior physicians in the ward. These estimates might be objected to on the grounds that different observers might place the same infant in different nutritional groups, and that the material is thus depreciated in value by not having all the children examined by the same physician. That the latter method would be preferable is undoubted, but the objection appears to carry little weight, since it is mainly, if not solely, in regard to the fat flabby babies that serious difference of opinion is likely to occur among experienced clinicians. From the physician's point of view such infants may be unhealthy; from the physiologist's standpoint they are well nourished, in that they have a large supply of available energy in the form of fat. Since we are not here concerned with health or vigour, but simply with nutrition (although these may be highly intercorrelated), children classified as 'obese' or 'fat and flabby' have been included in the well-nourished group, there being, in any case, an insufficiency of observations on fat flabby babies to justify the formation of a separate group.

The value to be placed on estimates of nutrition given by the physicians might, we think, be subject to the same criticism as, for instance, estimates of intelligence given by school teachers. The results of this study, in fact, are based on the assumption that the state of nutrition, as given by these physicians, is the correct one. It is interesting to note the results of a study by Jones (1909–10) on the value to be placed on a teacher's estimate of a scholar's intelligence. The correlation between teacher's estimate and examinational place for constant age and standard is as high as $\cdot 99 \pm \cdot 01$ and $\cdot 70 \pm \cdot 02$. The conclusion that 'the teacher's appreciation of intelligence does mean something and has a very direct and practical value when properly registered and handled' may warrant an analogous assumption in respect of the physician's estimate of nutrition, since it is but reasonable to suppose that the latter is as capable of assessing nutrition in his patients, as the teacher is of judging the intelligence of members of his class. The fact that a physician may have a too optimistic view of the state of nutrition would only raise the average, but would in no way affect the stringency of the correlation.

The children were grouped in four nutritional categories as follows:

(1) Well nourished (WN), which includes the obese children.
(2) Moderately well nourished (M).
(3) Poorly nourished (PN), children in whom there was some depletion of tissues, but who were not emaciated.

(4) Emaciated (E), those with tissues much depleted or with other evidence of extreme malnutrition.

The number of cases is given in Table 32.

In assessing the state of nutrition, the observers took into account not only the state of the subcutaneous tissues as regards deposit of fat, but also the colour of the mucous membranes and conjunctiva, and the tone of the muscles.

The primary object of this inquiry was to determine (if possible) which of the simpler indices which have been suggested is the best measure of an infant's state of nutrition; in other words, to determine the intensity of association between these and an observer's estimate of nutrition.

The following indices have been tested:

Weight alone for constant age.
Weight for constant height and age.
Weight for constant sitting height.
Height.
Sitting-height.
W/H ratio.
W/H^2.
W/H^3 and W/Sit H.

The arithmetical labour involved in the computation of the latter four ratios was to a great extent simplified by the construction of nomographs—diagrams giving a graphical solution to the above indices. The values found by nomography were partially checked by calculation and the results given by the diagramatic method were found sufficiently accurate for practical purposes.

The estimates of nutrition being grouped categorically, we have used the correlation ratio (η) as the best measure of the association between nutrition and the various indices considered. The means of the whole series of these Hospital children have been reproduced for comparison with the other Glasgow children, and are given in Table 31.

TABLE 31. *Hospital Children.*

Mean Weights, Heights, and Sitting Height.

MALES.

Age. Months.	*Weight in pounds.*	*Height in inches.*	*Stem in inches.*
2	7·6442	20·8404	13·2696
6	11·0810	23·7774	14·8793
10	14·9086	26·3188	16·3074
14	16·8253	28·0403	17·3790
18	18·4768	29·0032	18·0747
22	19·4642	30·2839	18·7992
26	20·9186	31·2097	18·9423
30	22·5136	32·1700	19·8222
34	24·7693	33·4993	19·3955
38	26·4552	34·8425	20·0873
42	28·4594	36·2024	20·7051
46	28·6598	35·1799	20·7255
50	29·7621	37·4999	21·7027
54	27·7411	36·7453	21·2598
58	34·1713	39·0944	21·6929

FEMALES.

Age. Months.	*Weight in pounds.*	*Height in inches.*	*Stem in inches.*
2	6·7741	20·2111	12·8979
6	10·0929	23·1544	14·5734
10	13·2847	25·5702	16·1596
14	14·6013	26·9927	16·5626
18	18·1293	28·8951	17·9217
22	18·7667	30·1377	18·5728
26	20·0332	30·7001	18·4782
30	21·9935	31·9554	18·7382
34	24·6181	32·6114	19·7506
38	24·8018	33·7795	19·9803
42	23·9356	33·0426	19·5163
46	25·7204	35·1050	19·0289
50	25·9828	35·2924	19·8256
54	27·5575	37·5984	20·8661
58	29·2110	36·6141	20·5216

The children were primarily divided into four groups with respect to age—under 1 year, 1–2, 2–3, and 3–5 years. The groups, however, are sufficiently wide to allow the age factor upsetting the results to some extent. Since it is at such periods that growth is occurring so rapidly, it was necessary, first of all, to inquire if there was any special age selection within the groups themselves, i. e. to find if the mean age of the children in the various nutritional categories is approximately equal. The correlation ratios (age—nutrition) are given below (corrected for grouping):

	0–1	1–2	2–3	3–5
Boys	·2649±·038	·0188±·051	indeterminate	indeterminate
Girls	·1285±·050	·1070±·054	indeterminate	indeterminate

In only one case, that of boys under one year, does there seem to be any selection, the other correlations being either insignificant with regard to their probable errors, or indeterminate. In boys under one year the correlation is clearly positive, the mean age being,

For WN = 7·05 months.
For M = 6·13 months.
For PN = 5·45 months.
For E = 4·65 months.

The correlations between the various indices and the nutritional estimates are given in Table 32.

TABLE 32. *Correlation Ratios of Indices with Nutritional Estimate.*

BOYS.

Age in years.	*0–1*	*1–2*	*2–3*	*3–5*
Weight–nutrition	·6503±·024	·6010±·033	·4578±·055	·3764±·071
Weight–nutrition for constant height	·5865±·027	·6014±·033	·4616±·055	—
Weight–nutrition for constant sitting height	·4743±·033	·5736±·035	·3984±·059	·3537±·073
W/H–nutrition	·6898±·022	·6375±·030	·4995±·052	·5076±·062
W/H^2–nutrition	·6940±·021	·5993±·033	·4429±·056	·5289±·060
W/H^3–nutrition	·4721±·032	·4300±·042	·2715±·064	·3997±·070
Height–nutrition	·4651±·032	·2706±·048	·1870±·067	(indeterminate)
Sitting height–nutrition	·5276±·031	·2577±·049	·2468±·065	·1479±·081
No. of cases	267	173	94	66

GIRLS.

Age in years.	*0–1*	*1–2*	*2–3*	*3–5*
Weight–nutrition	·7399 ± ·023	·6174 ± ·034	·6030 ± ·057	·0698 ± ·087
Weight–nutrition for constant height	·6374 ± ·030	·6002 ± ·035	·6039 ± ·057	·0059 ± ·088
Weight–nutrition for constant sitting height	·5815 ± ·035	·6159 ± ·034	·6040 ± ·057	—
W/H–nutrition	·7648 ± ·021	·6321 ± ·033	·6787 ± ·060	·3785 ± ·075
W/H^2–nutrition	·6264 ± ·031	·5503 ± ·038	·5089 ± ·067	·4676 ± ·069
W/H^3–nutrition	·4489 ± ·040	·3719 ± ·047	·2586 ± ·084	·3828 ± ·075
Height–nutrition	·5249 ± ·037	·2945 ± ·050	·2601 ± ·084	·0987 ± ·090
Sitting height–nutrition	·5168 ± ·039	·2315 ± ·052	·2024 ± ·086	(indeterminate)
No. of cases	177	152	56	59

In infants under one year the degree of association is greater than in older children, there being an almost continuous decrease in the magnitude of the coefficients with advance of age in both sexes. This may be due to the fact that the younger the infant the more can its state of nutrition be assessed by any of the physical factors considered here, when judged according to some standard scale.

It would appear that weight and the W/H ratio were less closely associated with nutrition in boys under one year than in girls, but in boys there was some selection with respect to age. The correlation ratio was $\eta = \cdot 2648 \pm \cdot 038$. The mean ages for arrays of nutrition show that the regression is approximately linear, and the ratio η may be safely taken to measure r. Replacing η by r and correlating wt. (1), Nutrition (2), and W/H (3) for constant age (4) we get the correlation wt.-nutrition $r_{12\cdot 4} = \cdot 7084 \pm \cdot 0206$ and W/H-nutrition $r_{13\cdot 4} = \cdot 7209 \pm \cdot 0198$. It thus seems that there is no real difference between the sexes with regard to the degree of association between the indices and the nutritional estimates.

TABLE 33. *Correlation Ratios of Indices with Nutritional Estimate* (All Ages).

	Weight.	*Weight for constant height.*	*Weight for constant stem.*	*W/H ratio.*	*W/H^2 ratio.*	*W/H^3 ratio.*	*W/SH ratio.*	*Height.*	*Sitting height.*
Boys	·4266 ± ·0225	·2708 ± ·0255	·4516 ± ·0223	·6489 ± ·0159	·6160 ± ·0171	·4993 ± ·0207	·6007 ± ·0179	·3956 ± ·0232	·3686 ± ·0242
No.	600	600	578	600	600	600	578	600	578
Girls	·6105 ± ·0201	·5807 ± ·0212	·5069 ± ·0242	·6469 ± ·0186	·5522 ± ·0222	·4049 ± ·0268	·5809 ± ·0216	·3015 ± ·0291	·1159 ± ·0322
No.	444	444	428	444	444	444	428	444	428

Regarding the relative degree of correlation between nutrition and the various indices, it appears that the W/H ratio is more closely correlated than any of the others. Only in one instance does weight give a higher correlation than does the W/H ratio.

W/H^2 is also a good index, but, on the whole, is not so good as the simpler ratio.

The differences, however, between the correlations of nutrition with weight, W/H, and W/H^2 are statistically insignificant. The general tendency is for the W/H ratio to show a higher degree of association. Whether it represents a real distinction or not is difficult to judge from these results. By taking all male children together, irrespective of age, and, similarly, females, the necessary correction being made for age (provided the regression be sufficiently linear) (see Charts VI and VII) by the method of partial correlation, a more definite result may be reached. For purpose of graphical representation of the results we have assumed a normal distribution for nutrition. The constants (boundaries and means) of the various categories are given in Tables 34 and 35. The mean weights, ages, and W/H ratios for the various arrays of nutrition (see Table 36), plotted at the mid points of the areas, show that (except in the case of age in boys) the regression is sufficiently linear to admit of treatment by the ordinary formula for partial correlation.

TABLE 34. *Means of Nutritional Categories.*

		Age in months.	*Weight in kilos.*	*Height in cm.*	*Sitting Height in cm.*	*W/H.*	*W/H².*	*W/H³.*	*W/SH.*
Boys	WN	19·86	9·26	74·80	46·07	1·22	1·62	2·21	2·00
	M	19·18	8·03	73·00	44·90	1·06	1·45	2·03	1·79
	PN	14·90	6·23	66·97	41·03	0·89	1·32	2·01	1·46
	E	10·56	5·02	62·41	38·71	0·76	1·19	1·94	1·25
Girls	WN	23·23	9·28	75·20	45·73	1·22	1·63	2·23	2·02
	M	18·40	7·61	71·77	44·12	1·04	1·44	2·04	1·69
	PN	16·52	6·22	67·73	40·97	0·88	1·30	1·97	1·49
	E	9·18	4·12	59·12	39·09	0·67	1·16	1·92	1·10

TABLE 35. *Means and Limits on the Gaussian Scale.*

	BOYS. x/σ	BOYS. $\bar{x}/\sigma$	GIRLS. x/σ	GIRLS. $\bar{x}/\sigma$
E . .	$-\infty \rightarrow -72{\cdot}25$	$-109{\cdot}41$	$-\infty \rightarrow -68{\cdot}90$	$-104{\cdot}00$
PN . .	$-72{\cdot}25 \rightarrow -19{\cdot}56$	$-43{\cdot}86$	$-68{\cdot}90 \rightarrow -11{\cdot}47$	$-37{\cdot}36$
M . .	$-19{\cdot}56 \rightarrow 27{\cdot}75$	3·94	$-11{\cdot}47 \rightarrow 31{\cdot}11$	9·50
WN . .	$27{\cdot}75 \rightarrow 219{\cdot}93$	74·86	$31{\cdot}11 \rightarrow 208{\cdot}16$	74·29
↓ . .	$219{\cdot}93 \rightarrow +\infty$	239·66	$208{\cdot}16 \rightarrow +\infty$	226·83

The correlations (Table 33) show some significant difference between the sexes. Thus, for weight-nutrition the difference is $\cdot 1839 \pm \cdot 030$; for weight-nutrition for constant height the difference is $\cdot 3099 \pm \cdot 033$; for stem-nutrition the difference is $\cdot 2527 \pm \cdot 040$; and for height-nutrition the difference is $\cdot 0944 \pm \cdot 034$ (significant ?).

The precise meaning of these findings is obscure. It may be that there is some difference between the sexes in regard to the response of the body to disease. Pathological factors leading to appearances of malnutrition or emaciation may be associated with a greater loss in weight, but with less retardation in height and stem length in females than in males. Whatever the explanation, there is less association between weight and nutrition in males than in females, but the reverse is the case with height and sitting height.

The various ratios (W/H, W/H², W/H³, &c.) have the same degree of association in the two sexes. With regard to the relative intensity of association between the various indices considered equivocal results again are obtained.

The W/H ratio is definitely more closely associated with nutrition than is weight among males, the difference being $\cdot 2223 \pm \cdot 028$. In females there is no distinct difference. W/H^2 is also a good index, but shows less association than does W/H, only significantly so, however, in the case of females, the difference being $\cdot 0947 \pm \cdot 029$. W/H^3 is of

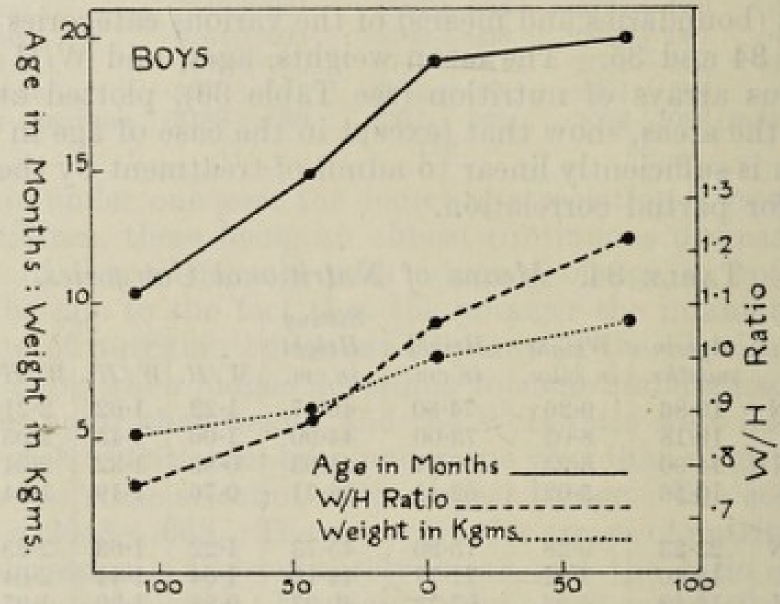


CHART VI. Mean weights, ages, and W/H ratios of nutritional categories. (Boys.)

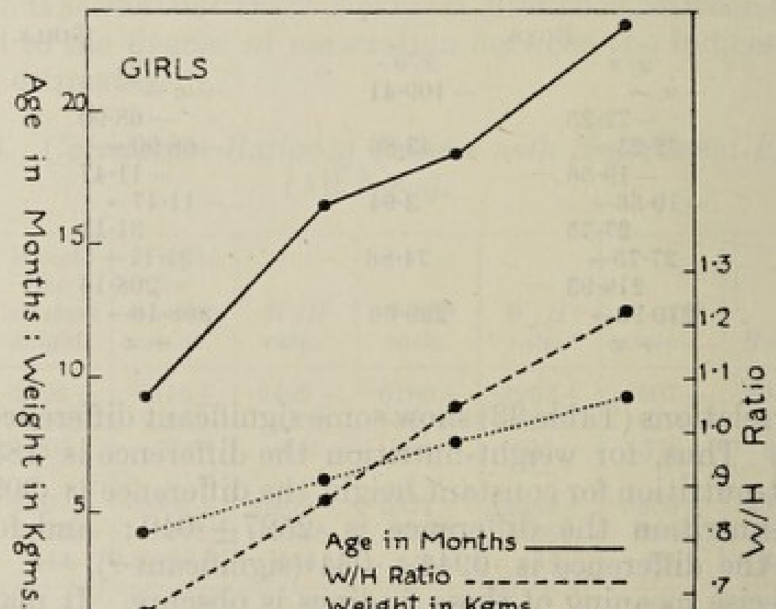


CHART VII. Mean weights, ages, and W/H ratios of nutritional categories. (Girls.)

definitely lower order than either of the above. W/SH is slightly less correlated with nutrition than W/H, the differences, however, being insignificant.

Height and sitting height, as would be expected, are much less closely correlated with nutrition. If the infant loses weight quickly on the appearance of disease, height and sitting height are only slowly affected.

Conclusions

In view of the apparently equivocal results, we are unable to make dogmatic assertions with respect to the relative values of the indices considered. It would appear, however, that W/H gives a slightly better idea of an infant's state of nutrition than weight at constant age. This conclusion cannot, however, be statistically proved in the case of females.

There seems little necessity for the more complicated ratios, W/H^2 and W/H^3. In ease of determination and in value as nutritional indices they are inferior to the simpler ratio. W/S is slightly less associated with nutritional estimate than W/H, and in view of the difficulty of making the exact measurement of sitting height (due to the varying amount of fat round the buttocks) its use as an index of nutrition cannot be advised. P. L. MACK.

Since in most previous investigations Weight for Age has been taken as the measure of nutrition and since the statistical analyses which have been made show that no great advantage is to be gained in taking W/H or any other modification of this ratio, and since, also, previous work has clearly shown (see p. 58) *that, when dealing with considerable groups of children, the average weight does give a reasonably sound index of nutrition, it has been decided in the present study to adhere to this index.*

A further justification of the index weight to age is afforded by the close similarity of the correlations weight to height and weight to age in the following groups of children investigated by us (see Table 36).

TABLE 36. *Correlations of Weight, Height, and Age.*

		Country.	*Mining.*	*Glasgow.*
Boys	Wt.-Ht.	·8828±·004	·8740±·004	·8336±·008
	Wt.-Age	·8371±·006	·8263±·006	·7954±·010
	Ht.-Age	·9158±·003	·8963±·004	·7824±·011
	Number	1,173	1,276	594
		Country.	*Mining.*	*Glasgow.*
Girls	Wt.-Ht.	·8960±·004	·8852±·004	·8327±·008
	Wt.-Age	·8334±·006	·8412±·006	·8270±·008
	Ht.-Age	·9037±·004	·6237±·012	·9560±·002
	Number	1,109	1,229	652

(7) STANDARDS OF GROWTH AND NUTRITION

Innumerable attempts have been made to arrive at normal standards of growth (height) and nutrition (weight). A discussion has been carried on as to whether the *average* height and weight of a community should be taken as the standard of comparison, or whether it is more correct to compare with an *ideal* standard, such as the best possible height and weight obtained under the best possible conditions.

It has been pointed out that, inasmuch as a larger proportion of the population is undernourished as compared with the proportion which is overnourished, an average of the general population does not represent the normal weight, i. e. neither over- nor undernourished.

Retan (1920) says, with regard to children, 'Inasmuch as 20 per cent. of all children have been found to be undernourished and but 2 per cent. have been found to be overnourished, the average of all children would not be the average of normally nourished children.'

What may be considered the 'ideal' standard of the development and nutrition of children has been studied by various investigators, with results which are practically uniform. Without exception, these investigations have shown that children of better social class (see pp. 117 to 125) are both taller and heavier for their age than those of a poorer class. But, in addition, various writers have pointed out that not only is increase in weight and height obtained when children are reared in good surroundings, but a change in the proportions of the body is also observed, the better-class children being, though heavier for their age, lighter for their height than poorer children reared in faulty surroundings. Gray and Jacomb (1921) from a study of 136 boys from well-to-do homes who were being brought up at a country boarding school under specially good conditions found that while the boys were definitely tall and heavy for their age, the relative lightness for height was very noticeable among these very well-developed boys. Benedict and Talbot (1921) compared the development of children attending private schools and children attending their laboratory, i. e. poor children. They say—'. . . in all our earlier comparisons on the charts indicating the ratios of height to age and weight to age it appears as if the private-school children enjoy a marked superiority over the laboratory children. They are taller for the same age and heavier for the same age. When, however, we compare the height to weight, irrespective of age, we find that our laboratory children of both sexes are slightly heavier for the same height than are our private-school children. Thus the seeming superiority of the private-school children may to a large extent be questioned as not truly so great as at first sight appears. . . . The striking superiority in height to age and weight to age of our private-school children is in part at the sacrifice of what is commonly considered the most advantageous relationship between height and weight.'

Putnam (1922) published the results of a study of children clinically normal and brought up in surroundings as nearly ideal as possible, both socially and hygienically. His figures show that these children are tall and heavy for their age, but also indicate that they are relatively lighter for their height than children of less development for age.

We have thus before us the fact that a relatively low standard of nutrition, *as indicated by the relationship of weight and height*, does not necessarily indicate development under faulty conditions, and any comparison of the nutritional conditions among differing classes by the use of the weight/height ratio may yield an incorrect picture of the effect of good as compared with faulty conditions, unless the relative development in weight and in height were also taken into account.

Fortunately in this investigation we are not concerned with a standard, since our object is to determine what divergence, if any, from the average of the population investigated is related to the various environmental conditions and not to demonstrate that the children of the poor urban classes are less well grown and less well nourished than those of the more favoured classes. This has already been amply established. We have to study, *within the definite group*, the influence of various factors.

(8) ASSESSMENT OF VIGOUR

It must be recognized that the weight and height are not necessarily correlated with vigour and vitality. The small light child may be physiologically superior to the large and heavy one of the same age. Every worker among children has observed this. In her report of the examination of 4,000 Glasgow school children, Miss Tully (1924 *b*) observes, 'With regard to classification according to build, it was found that many children were naturally slight and wiry. Of this class a particularly noticeable feature in the case of the girls in school A was that although they were vivacious and had no illness, they appeared to be below the normal standard both in weight and in height.' But the investigations of Baldwin (1914) on American children show that, on the average, the well-grown well-nourished child is generally superior to the smaller child of the same age in its school record.

Some simple physiological test of vigour is greatly needed. Observations of the behaviour of the child when unconscious of observation may be valuable, but they are not sufficiently precise.

A determination of the basal metabolism would probably afford the best criterion, but the technical difficulties in carrying this out and the difficulties in the interpretation of the results would seem to render the method unsuitable.

The pulse-rate, although closely correlated with the basal metabolism, is modified by so many factors that it can hardly be used.

It is possible that the circulation and respiratory response to effort in the case of children of over four years might prove of use, but, so far, it has not been systematically investigated.

The vital capacity appears to be correlated with weight and height rather than with physiological activity, and with young children reliable results cannot be expected, unless after many determinations on each individual.

(9) THE STATISTICAL TREATMENT OF THE DATA

For the non-statistical reader it will suffice to regard a correlation coefficient as an arithmetic measure of the degree of association between two variables. The values of the coefficients range between 0 and $\pm$ 1, and the nearer the latter value the more close is the relationship. If the coefficient is positive, the variables increase concomitantly; if negative, as one variable increases the other decreases. The fraction in the tables following each coefficient and preceded by $\pm$ is the 'probable error', and a coefficient which is not greater than three times the probable error is to be regarded as insignificant.

Where the two variables are expressed quantitatively (as in weight, height, income per person, and air-space per person) the coefficients have been calculated by the product-moment method.

Where one variable is quantitative and the other qualitative, as, for example, in correlating weight with maternal health, we have had recourse to the biserial r method described by Pearson (1909); where both variables are qualitative, the fourfold method has been adopted.

There is some doubt as to the exact magnitude of the probable error involved in using the biserial r method, but the error is greater than in the case of the product-moment method. If we take it as twice[1] this value then the coefficient should be roughly six times the

[1] This probably over-estimates the values of the probable errors of most of the biserial r's found in this study. For a discussion of this subject, see Soper (1914).

probable error appended to these coefficients. The probable error of a fourfold correlation is roughly three times that of the product-moment coefficient, so that in these cases the coefficient should be nine times the error given in the tables to be reasonably significant.

Instead of, or in addition to, calculating the coefficient of correlation, in some instances the relationship has been measured by the correlation ratio (η). Where one of the variables to be correlated is quantitative and the other qualitative (categorical) this is the best measure of the association between them. Where both variables are quantitative and when there is no *a priori* justification for regarding the regression as linear, it is also advisable to calculate η, as otherwise we might conclude from the values of r that no relationship exists between the two factors. An example of this will explain. The correlation between age of mother and nutrition of offspring, as measured by the coefficients of correlation, is practically zero, while the values of the correlation ratios, although very small, are quite significant with regard to the probable error. In this case the weights of the offspring increase with the age of the mother up to a certain point and then decrease.

Where, as in the mining and agricultural studies, the percentages of inefficient mothers and of children in poor general condition were small, it was decided not to attempt more than a comparison of the averages. With extreme dichotomies the coefficient of correlation may be very misleading.

In cases where several variables each show some association with the factor under discussion, and where the variables themselves show some interrelationship, it is desirable to get some measure of the relative importance of each of these, independently of the other variables. It may be found that factors such as air-space per person and maternal efficiency each show some correlation with nutrition and stature of the child and that these themselves are interrelated to a great extent. The question thus becomes—what is the degree of association of nutrition with maternal efficiency wholly apart from variations in air-space per person, or how much does nutrition depend on one or other of the variants ? To determine this, the hypothetical case where the air-space is the same but where the maternal efficiency varies must be investigated. A roughly approximate measure of the desired result is found by calculating the coefficients of partial correlation between nutrition and maternal efficiency with air-space constant. The method adopted is fully described by Yule (1922). This is only an approximate measure because unless the relations between the varying quantities taken in pairs fulfil certain conditions, it is not possible to give a simple and definite meaning to the coefficient of partial correlation. It is not, however, possible in the present state of knowledge to employ any more adequate test to material of the kind here in question.

In weighing the statistical results the following points must be borne in mind. (i) Computed 'probable errors', even when it is a question of statistical constants fulfilling the conditions implied in the formulae by which the probable errors were computed, measure nothing but the range of fluctuation associated with sampling ; they are guarantees of nothing else. If two constants differ significantly with respect to their probable errors it does not necessarily follow that the difference has a biological significance. In work of this kind it has frequently been necessary to use coefficients of correlation deduced from fourfold tables based upon data so categorized that one, and only one, fourfold division could be formed. When this is the case and it is not possible to make several groupings of the data into a fourfold table and to re-calculate the coefficient in order to test its steadiness, great reserve in interpretation must be exercised, particularly when the data are very unevenly distributed. Especially is this the case in the rural and mining parts of this investigation with regard to such a factor as health of mother, which was recorded as either good or bad and where the line of cleavage lies far from the mean value. (ii) Much more weight attaches to consistence between a series of coefficients than to the discovery of any large individual values. A uniform series of coefficients is much more trustworthy evidence of the presence or absence of real association than is a series of widely fluctuant values giving perhaps the same average value.

PART II. TOWN AND COUNTRY.

CONTENTS

COMPARISON OF THE CHILDREN OF THE POORER CLASSES IN TOWN AND IN COUNTRY

BEFORE proceeding to consider the factors which may possibly prejudicially affect the physique of the children in the slums of our great industrial cities, it appeared desirable, for comparison, to study the condition and surroundings of country children of the same, or as nearly as possible the same, social class living under very similar economic conditions. For this reason, as already indicated in the introduction, our investigations were extended to the families of agricultural labourers and of rural coal-miners. These are dealt with in detail in two separate reports (pp. 253 and 279).

Much has been spoken and written about the poverty of these classes, but it may at once be said that our studies revealed nothing approaching the penury, squalor, and misery of the city slums. The standard of living, especially among the agricultural labourers, is totally different. The actual money wages earned may be small, but the possession of a cottage in the open country, rent free, and the supply of such perquisites as potatoes, meal, and milk, ensure at least an adequate supply of air and food.

The rural miners' families undoubtedly live in surroundings which are far from picturesque and which in many cases may be called squalid ; the cottages may be small, but they are generally of one story and open directly to the air. The household income, even when only one member of the family is employed, is larger than the average income of the city slum dwellers.

The following table may serve to indicate some of the differences :

TABLE 37. *Comparison of Conditions in Families studied.*

	City slum.		*Rural miners.*	*Agricultural labourers.*
Income per person per week	Glasgow	9·32*s.*	9·95*s.*	8·9*s.*
	Edinburgh	8·24*s.*		
	Dundee	7·58*s.*		
Air-space per person in cubic feet	Glasgow	404·5	531·86	750
	Edinburgh	401·4		
	Dundee	400·8		
Average number of persons living in the home . .	Glasgow	5·3	6·2	5·5
	Edinburgh	5·8		
	Dundee	5·5		
Maternal care good Percentage	Glasgow	68·3	92·8	90·6
	Edinburgh	87·5		
	Dundee	66·8		
Maternal health good Percentage	Glasgow	75·4	91·0	95·5
	Edinburgh	85·7		
	Dundee	61·3		

A very large number of investigations of the differences in the physical condition of town and country dwellers has already been made, but in few of these is due consideration given to the question of the relative social class to which they belong and to the possible social differences which may exist. Many of the towns dealt with are small and non-industrial, and are not comparable with the great cities specially studied in the present report.

(i) PREVIOUS INVESTIGATIONS

Villermé (1829) and Quetelet (1830 and 1835) found that the heights of town dwellers in France and in Belgium were greater than those of dwellers in the country. Quetelet's figures are as follows :

TABLE 38. *Height of Town and Country Dwellers* (Quetelet).

Year . .	1823	1824	1825	1826	1827	*Average.*
Towns . .	165·14	164·78	165·37	164·97	163·89	164·85 cm.
Country . .	162·95	162·69	162·80	163·09	162·25	162·75 ,,

In 1876 Galton (1876) basing his results on measurements of 509 boys in town schools and 296 boys in country schools in Britain, found that the country school boys (aged 14) were 1¼ inches taller and 7 pounds heavier than the boys in the town schools. In the pre-eminently town school of the City of London, the boys' stature was smallest.

In 1888 Geissler and Uhlitsch (1888), quoted by Macdonald (1897–8), from a survey of 21,173 children varying from 6½ to 14½ years of age, concluded that the children in the common schools of the town of Freiburg have a higher average height than the children of farmers in the surrounding country.

In 1892 Schmidt (1892), in a study of 9,506 German children, gives the following table, showing the relationship of the size of children to town and to country life respectively:

TABLE 39. *Town and Country Children. Differences in Weight and Height* (Schmidt).

	The town children taller (+) or shorter (−) than the country children, in cm.		*The town children heavier (+) or lighter (−) than the country children, in kilos.*	
Age.	*Boys.*	*Girls.*	*Boys.*	*Girls.*
7	−0·6	−1·7	−0·3	−0·2
8	−2·1	−1·2	−0·5	−0·3
9	−2·6	−2·3	−0·5	−0·5
10	−1·7	−1·2	−0·8	−0·5
11	−2·8	−2·1	−0·6	−0·9
12	−2·5	−0·4	−0·5	−0·6
13	−1·6	−1·2	−1·5	−1·5
14	−2·7	−1·8	−1·2	−1·3

He also gives the following figures (quoted by Macdonald (1897–8)):

TABLE 40. *Growth of Town and Country Dwellers compared* (Schmidt).

	Town. cm.	*Country.* cm.
Height in 7th year	109·0	109·6
Height in 14th year	140·7	143·3
Height in 21st year	165·3	166·5
Growth from birth to 7th year	59·0	59·6
Growth from 7th year to 14th year	31·7	33·8

In 1894 Holmes (1894) discussed the effect of town life as shown by the results of Porter's (1894) investigation of the growth of 34,354 American children. Holmes says: 'When we compare the average stature and weight of the school children of various cities with that of the average population, we find striking differences. The Worcester, Mass., children are markedly below the average in stature, while the Toronto and Boston children are almost as markedly at the opposite extreme. The Oakland, California, and the St. Louis children also show opposite characteristics; the former starting at 5 years of age below the general average rise above it at the end of the period of growth, while the St. Louis children, starting above, fall below the average. The Milwaukee children represent more nearly the general average. There is also to be remarked a striking difference between the curves of comparative stature of the two sexes in the various cities. In Toronto, Milwaukee, and Boston the comparative curves in the two sexes are near together. In St. Louis they are quite markedly separated after the 15th year, while in Oakland, and especially in Worcester, the difference reaches its maximum. The variations in weight are much more strongly marked than are those of stature. Here again we find the Toronto children are least well developed and the Worcester children the best developed. Milwaukee and St. Louis show opposite tendencies, the former increasing in weight with respect to the average and the latter decreasing in weight with respect to the average. Boston occupies with respect to weight about the same position that Milwaukee does to stature. They approach to the general average.' The variations in development among children in American cities indicated by Holmes certainly seem to indicate that urban environment is not of necessity a factor inhibiting growth.

Caill in 1903 (1903) indicated that country children grew more rapidly than those in towns.

In 1911 Tuxford and Glegg (1911) published a series of figures based on measurements and weighings made on 583,640 school children in England. These they grouped according to whether the children attended school in Country Education Areas or in Urban Education Areas. The following table gives the average weights and heights for each year (3 years to 14 years) for both boys and girls in the two areas—rural and urban. In comparing these rural and urban figures it should be borne in mind that the rural education areas contain a considerable urban population. The results show a definitely greater height and weight in favour of the children in the country districts.

TABLE 41. *Heights and Weights of Children in Country and Urban Education Areas* (Tuxford and Glegg).

BOYS.

	Country Education Areas.			*Urban Education Areas.*		
Age.	*No. of cases.*	*Height. cm.*	*Weight. kilos.*	*No. of cases.*	*Height. cm.*	*Weight. kilos.*
3	5,793	93·1	14·93	3,595	91·3	14·74
4	12,898	98·5	16·44	11,149	97·7	16·10
5	32,390	103·2	17·71	35,048	102·7	17·34
6	9,469	108·6	19·35	11,085	107·5	19·31
7	14,784	115·3	21·47	22,731	114·3	21·01
8	1,940	119·5	23·30	7,744	119·0	22·75
9	2,699	126·6	25·86	5,174	123·7	24·73
10	8,234	130·0	27·75	13,345	129·1	27·22
11	1,775	135·2	30·78	3,309	133·7	29·47
12	25,933	140·2	33·31	11,297	138·9	32·45
13	21,632	142·6	35·32	30,600	142·4	35·03
14	1,381	147·8	38·34	2,961	146·8	38·06

GIRLS.

3	5,343	91·9	14·52	3,135	90·9	14·29
4	11,695	99·2	15·92	9,667	96·7	15·69
5	31,464	103·1	17·22	32,361	102·0	16·92
6	10,101	108·0	18·74	11,137	107·2	18·44
7	14,570	114·6	20·64	21,907	113·4	20·40
8	4,639	117·8	22·22	7,375	117·5	22·18
9	2,886	125·6	25·10	5,252	122·6	24·56
10	8,126	130·2	26·94	12,891	129·4	26·57
11	1,913	135·6	30·31	3,216	132·3	29·16
12	24,909	138·5	33·84	11,668	139·3	32·79
13	21,771	145·1	36·79	28,946	144·0	35·94
14	1,269	149·8	40·12	2,433	148·7	39·65

Peiper (1912), in 1911, measured the height, weight, and chest circumference of 14,194 city children and of 28,334 country children in Germany. Country boys were found to be better developed with respect to all three measurements.

In 1916 Baldwin (1916) found that among American boys those living in the country matured earlier than those living in the towns.

In 1918 Pyle and Collings (1918) made a study of the entire rural school population of a Missouri county—over 2,000 children in all, aged 8 to 18 years. These they compared with measurements obtained from school children in small cities, chiefly in Missouri. They found, from their results, that there was practically no difference in height between country and city children. Taking all the ages together, the country boys were 7 per cent. below and the country girls 2 per cent. below the average of the town boys and girls. The weight of the country boys was 3 per cent. and the country girls 1·4 per cent. below the average town child. In general, however, they found the physical differences between country and city children to be very slight. This inferiority found in the physique of the country children is probably explained by the fact that, as stated in their report, 'The city children were, on the average, of better stock than the country children studied.'

The Principal Medical Officer of New South Wales in his Annual Report for the year 1918–19 (1921) gives a series of tables based upon weighings and measurements of 112,359 boys and 104,211 girls attending schools in Australia. The children are grouped according to whether they live (i) in the metropolitan area, (ii) in large towns, or (iii) in rural districts. The tables have been arranged to show the average height and weight of the children in half-yearly periods, ranging from 5 years to 16 years of age. The author's conclusion is that 'The investigation into the anthropometric condition of children residing in country and metropolitan districts furnishes conclusive evidence that the fresh air and free life of the country child assists materially in the building of children of the largest physique. This fact is very strikingly emphasized when the tables are examined, for it is there shown that boys and girls residing in country districts are both heavier and taller than children reared in the city and crowded suburban areas. More forcibly is this fact brought home when it is revealed that children living in rural districts, while of a bigger physique than metropolitan children, are at the same time bigger all round than children assembled in large country towns.'

In 1921 Woodbury (1921) published the result of an examination of the heights and weights of a large number of country and urban children. In order to eliminate, as far as possible, racial differences, only children whose parents were native born (United States) were examined. He found that both in stature and in weight the averages for children in the rural areas were above those for children in urban areas, and the difference was found in both sexes. Woodbury points out that, so far as the evidence goes, it would seem to indicate that individuals of (tall) Scandinavian descent are found more largely in the cities than in the country districts of the areas studied. This, if correct, makes even more striking the evidence which he produces of the difference in average weight and height in favour of the country-bred children. It will be seen later, however, that Wissler (1924) very definitely disagrees with Woodbury's suggestion that the town dwellers in America are, to some extent, descended from a taller race than are the country dwellers.

In 1923 Schiötz (1923), quoted in the *Journal of the American Medical Association*, found that in Norway country children were of lesser height than town children. But in Norway there are no large towns.

In the Annual Report of the Forfarshire Education Authority for the year ending 1924, the heights and weights of the children attending burgh schools in towns of Forfarshire, excluding Dundee the only large town, and rural schools are given separately, and show a superiority in weight and in height of the children attending the rural schools, though no large towns are included. The following figures have been extracted from the report:

TABLE 42. *Heights and Weights of Forfarshire Children.*

Age last birth-day.	*Heights (inches).*				*Weights (pounds).*			
	Boys.		*Girls.*		*Boys.*		*Girls.*	
	Burgh schools.	*Country schools.*	*Burgh schools.*	*Country schools.*	*Burgh schools.*	*Country schools.*	*Burgh schools.*	*Country schools.*
5	42·6	43·2	42·5	42·6	41·9	43·4	41·1	42·3
6	44·8	45·0	44·2	44·6	46·3	45·9	43·4	45·1
7	46·6	47·0	46·5	46·5	50·6	51·3	48·6	48·5
8	48·4	49·0	48·9	48·9	52·9	56·3	53·7	53·6
9	50·5	51·4	50·2	51·3	59·6	62·6	57·0	59·9
10	51·8	52·9	51·6	53·1	62·5	66·9	61·8	66·2
11	54·2	54·8	53·3	53·7	73·0	74·5	64·8	69·5
12	59·2	56·9	55·2	57·3	74·5	81·9	75·2	79·9
13	57·4	58·3	57·9	59·1	82·5	86·5	85·5	90·7

In the Reports of the Education Authority for Dumfriesshire for the year ending July 1923 the children attending burgh and rural schools are similarly grouped, but the heights and weights do not show the regular variation in weight and height between burgh and rural children which is, in general, indicated in the Forfarshire report. Here, too, no large industrial town is included.

The accompanying charts have been drawn (Charts VIII, IX, X, XI) from data regarding the heights and weights of boys and girls taken from the reports of various Education Authorities in Scotland. They show an apparently significant difference in height and weight between children in rural areas in Scotland and children in Scotland's largest town—Glasgow. They also show the closely similar lines of the growth curves in different rural areas of the country. The results cited tend to show that generally the rural child is better grown than the town child, but that the difference is not invariable.

Ripley (1900) gives a series of references to observations on the variation in size among the *adult* town and rural populations of various countries, and these also show that in different countries different results have been observed, as indicated in the following notes. His references are summarized in paragraphs i, ii, and iii.

(i) Town dweller taller than country dweller. Besides Villermé (1829) and Quetelet (1830) already quoted, Ammon, in 1894 (1894), found a higher average stature in the larger towns of the Duchy of Baden. In Switzerland (1892) the

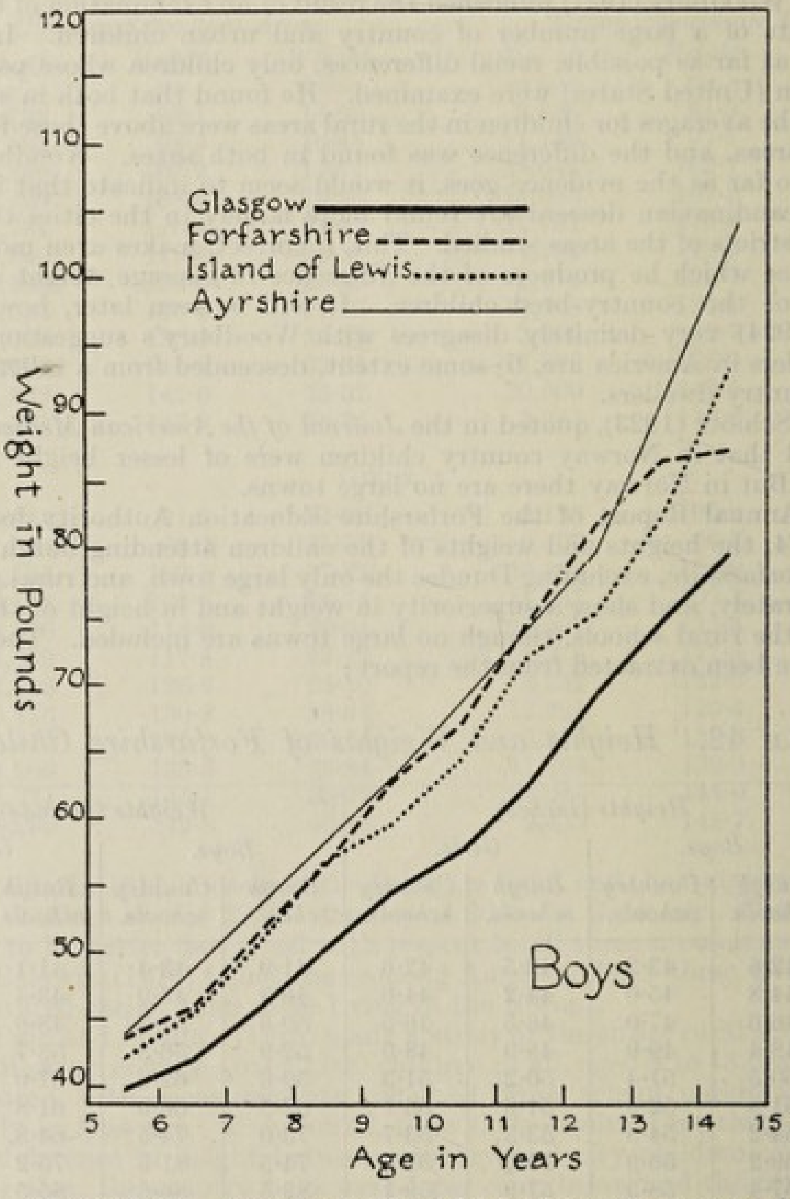


Chart VIII. Average weights of school boys in town and country in Scotland (constructed from figures given in reports of education authorities.

town dwellers are found to be taller. Scheiber (1881) found the dwellers in three of the larger Hungarian towns taller than the country folk of the neighbourhood.

(ii) Country dweller taller than town dweller. On the other hand, Meisner in Hamburg (1889), Dunant in Geneva (1867), Pagliani (1876) in Turin, Oloriz (1896) in Madrid, Ranke (1881) in Bavaria, Brandt (1898) in Alsace-Lorraine, and Beddoe (1870) in Britain all found town dwellers shorter than country dwellers.

(iii) Indefinite results. In Saxony Levasseur (1889), and in France Carlier (1892), found little or no difference between the stature of town dwellers and that of country dwellers.

Dealing with the relationship of stature to town or country life, Park Harrison (1883) in 1883 stated that the examination of the figures of the Anthropometric

Committee of the British Association on stature in towns of over 5,000 inhabitants showed that stature was less correlated with town life than was supposed, the height of adult males being only 0·092 in. in favour of country folk. The average height in London was higher than Herts., Middlesex, and Surrey, and lower than Essex and Kent.

Villermé and Beddoe, quoted by Ripley (1900), found that the average stature in rural districts round Paris and London, respectively, was lower than in the two capital cities.

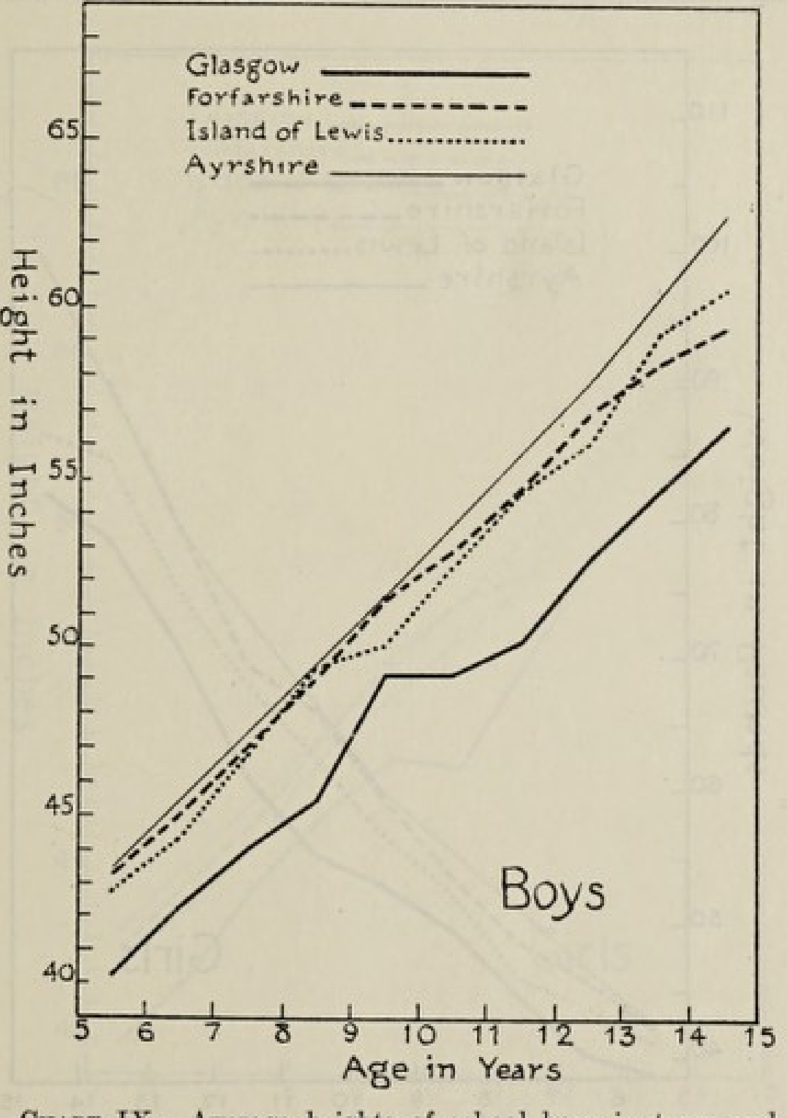


CHART IX. Average heights of school boys in town and country in Scotland (constructed from figures given in reports of education authorities).

There is some evidence that in other physical characters town and country dwellers in Europe show definite differences. Ripley (1900) states that the first physical character of urban population as contrasted with that of the country is a tendency towards that shape of head characteristic of two of our racial types—Teutonic and Mediterranean. It seems as if for some reason the broad-headed Alpine stock is distinctly a rural type, while the restless, enterprising long-headed Teutonic type migrates in disproportionately large numbers to the towns. Ammon's law (1893) postulates that the Teutonic race betrays almost everywhere a marked preference for city life. The Alpine type is largely absent from Britain, so that, according to Ripley, this law is not seen in operation there, but it is possible that its action accounts to some extent for the larger race in some of the continental towns.

Another physical character which prevails in towns is the greater proportion of brunettes as compared with the country. Ripley (1900) points out that it is not merely the pure long-headed tall Teutonic type which inhabits towns, and suggests that something more than mere migration is affecting the racial stock in cities—'a process of physiological and social rather than of ethnic selection seems to be at work in addition.' Gray (1907) states that from the data collected in a pigmentation survey of school children in Scotland, it would appear that industrial towns like Glasgow and Dundee are unhealthy for the blonde type. The existence of a selective death-rate among fair types in towns has been considered by various writers. Darwin is quoted by MacDonald (1911–12) as stating that complexion and liability to certain diseases are believed to run

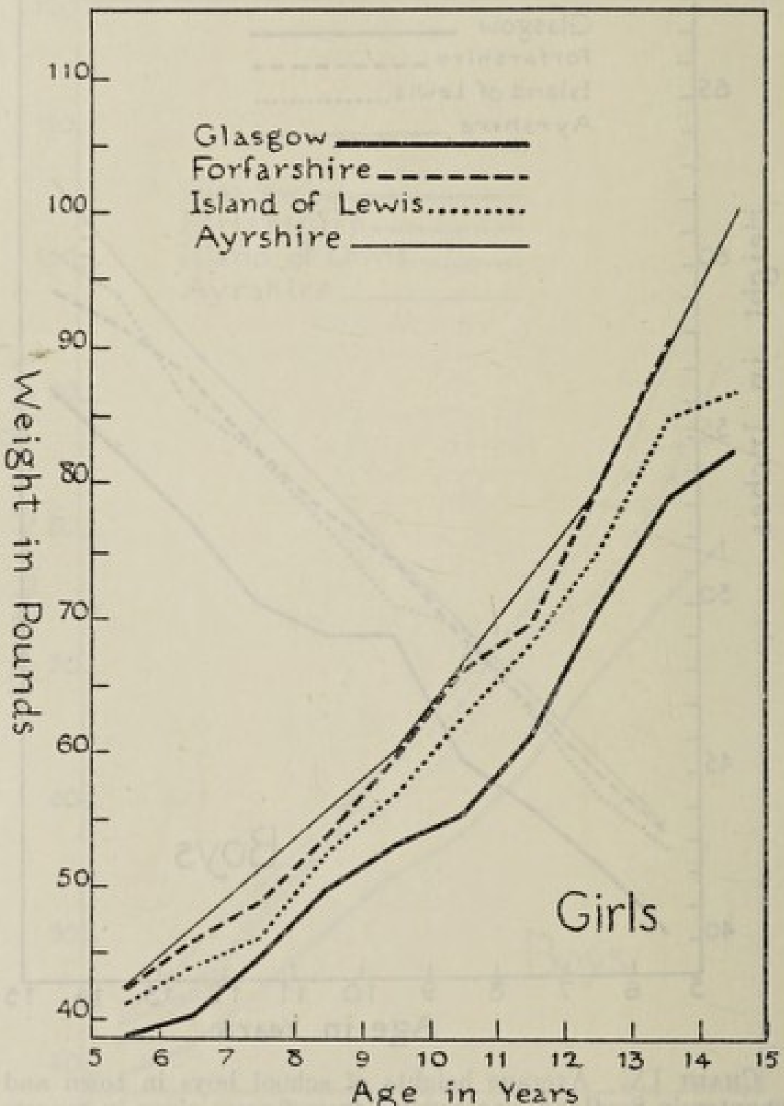


CHART X. Average weights of school girls in town and country in Scotland (constructed from figures given in reports of education authorities).

together in man and the lower animals. Baxter (1875) is quoted by Beddoe (1885) as finding that disease was more rife among the light complexioned recruits of the American army than among the dark complexioned. Beddoe (1870) asserts a distinct superiority of the brunette type in the severe competition induced by urban life. Ripley (1900) suggests that there may be in the dark hair and eye some indication of vital superiority, and he quotes Havelock Ellis (1896) as finding a greater power of resistance in the matter of disease among the darker complexioned. MacDonald (1911–12) from a study of the child patients in Belvidere and Ruchill Hospitals, Glasgow, concluded that 'in scarlet fever, diphtheria, measles, and whooping-cough the medium-haired child is more liable to become infected than the red-haired, and much more so than the dark and jet-black-haired, the fair-haired child occupying an intermediate position as regards infection. . . . In each of the diseases considered the fair-haired children show the greatest percentage of severe cases and of deaths, and not only is this so, but the greater severity and higher mortality in fair-haired children is marked and constant. . . . To sum up, the dark and jet-black-haired child occupies one pole, the pole of less severity and mortality, the fair-haired and, to a less degree, the red-haired child occupies the other pole, the pole of greater severity and mortality, while the mean is represented by the medium-haired child.'

Carr Saunders (1911–12) from a pigmentation survey of Birmingham children concluded that his results indicated that pigmentation was not a factor in selection.

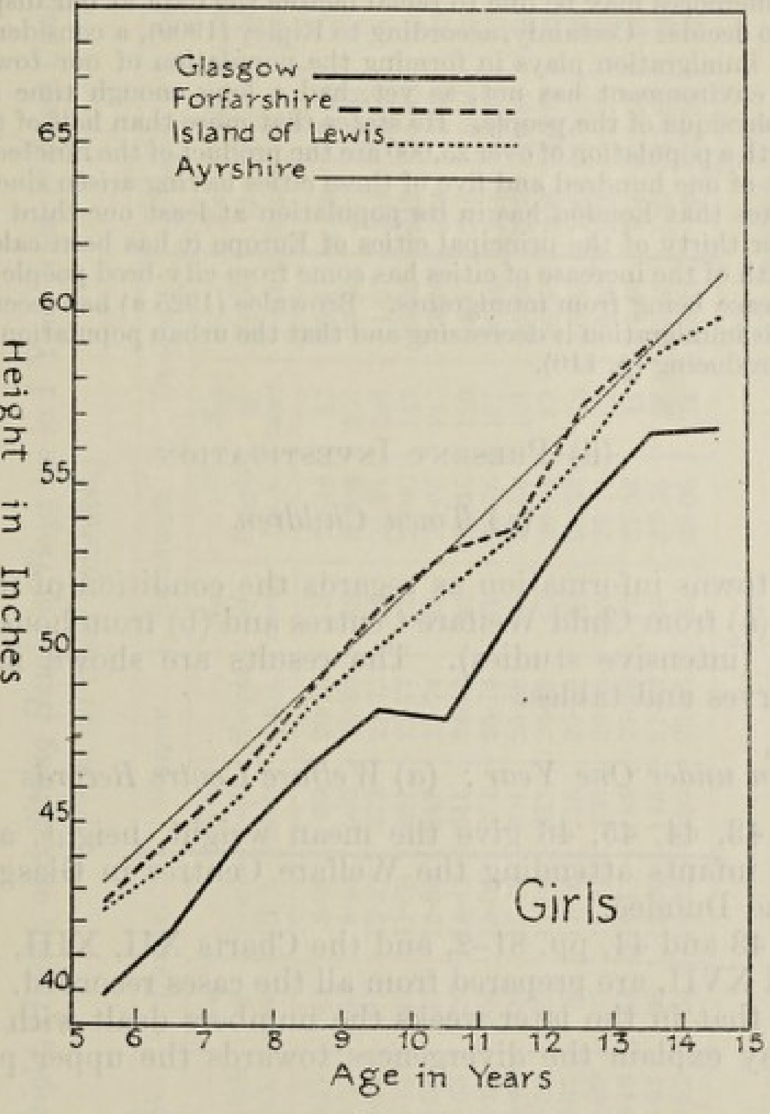


Chart XI. Average heights of school girls in town and country in Scotland (constructed from figures given in reports of education authorities).

Wissler (1924) found that in the United States stature was greatest in the country districts and lowest in the towns. In the towns he found that low stature was closely associated with density of population, as with increase of density of population there was lessening of stature. He found in cities a definite tendency to the segregation of the short as opposed to the tall, and he considers the differences noticed in stature to be racial—the oldest colonists who populated the country districts belonging to tall races and the later colonists who are taking up their abode in towns belonging to shorter races. He points to the already discussed fact that it is not a universal rule for town dwellers to be shorter than country dwellers, instancing Sweden, where the average stature for the country is 170·8 cm. and for Stockholm province 172·9 cm. Almost all Swedish towns are above the average for the whole country. For Italy he gives an average height of 164·5 cm., while Milan has an average height of 165·7 cm. He states that cities tend to draw foreign stock, and that where, as in Italy, the race is a short one, the foreign stock in the towns is likely to *raise* the average town height. Where the race is a tall one, as in Britain, the foreign element in the towns would tend to *lower* the average town height.

The differences in stature found by Beddoe (1870) in the rural and town areas studied in this investigation, and the marked differences in pigmentation noted in the same areas by Gray (1907) and Tocher (1908–9), are given on pp. 18 to 23. They emphasize the necessity for care in ascribing differences in physique among the different groups of children studied to environmental factors only. Just how far these differences may be due to racial factors the data at our disposal do not enable us to decide. Certainly, according to Ripley (1900), a consideration of the part which immigration plays in forming the population of our towns suggests that town environment has not, as yet, had a long enough time in which to affect the physique of the people. He states that more than half of the towns of England with a population of over 25,000 are the product of the nineteenth century—sixty out of one hundred and five of these cities having arisen since 1825. He further states that London has in its population at least one-third immigrants, and that for thirty of the principal cities of Europe it has been calculated that only one-fifth of the increase of cities has come from city-bred people—four-fifths of the increase being from immigrants. Brownlee (1925 *a*) has recently pointed out that this immigration is decreasing and that the urban population is becoming more self-producing (p. 110). J. A.

(ii) Present Investigation

(a) *Town Children*

In the towns information as regards the condition of infants was procured (a) from Child Welfare Centres and (b) from house-to-house visitation (intensive studies). The results are shown in the subjoined curves and tables.

i. *Children under One Year ;* (*a*) *Welfare Centre Records*

Tables 43, 44, 45, 46 give the mean weight, height, and sitting height of infants attending the Welfare Centres in Glasgow, Edinburgh, and Dundee.

Tables 43 and 44, pp. 81–2, and the Charts XII, XIII, XIV, XV, XVI, and XVII, are prepared from all the cases recorded. It should be noted that in the later weeks the numbers dealt with are small, which may explain the divergences towards the upper part of the curves.

Tables 45 and 46, pp. 83–4, include only the cases with complete records of all the variables which were used for the correlations given later in this study.

Charts XII, XIII, XIV, and XV give the heights and weights of infants for the three towns. They show a striking similarity. Charts XVI and XVII show the mean height, weight, and stem length (sitting height) for the three towns combined.

TABLE 43. *Mean Weight, Height, and Sitting Height of Boys up to 1 Year from Welfare Centre Records.*
(From all cases recorded.)

Age (mths.).	Glasgow.		Edinburgh.		Dundee.		Glasgow.		Edinburgh.		Dundee.		Glasgow.		Edinburgh.		Dundee.	
	No. of cases.	*Weight* (lb.).	*No. of cases.*	*Weight* (lb.).	*No. of cases.*	*Weight* (lb.).	*No. of cases.*	*Height* (in.).	*No. of cases.*	*Height* (in.).	*No. of cases.*	*Height* (in.).	*No. of cases.*	*Sit. height* (in.).	*No. of cases.*	*Sit. height* (in.).	*No. of cases.*	*Sit. height* (in.).
−1	30	7·75	3	8·17	41	8·09	30	20·15	3	20·58	41	20·41	29	13·25	3	13·42	26	13·59
1	503	8·59	82	8·32	305	8·88	502	20·86	82	20·68	305	20·96	462	13·91	70	13·41	232	13·85
2	378	9·85	86	9·74	201	10·27	378	21·75	86	21·84	201	21·97	341	14·39	76	14·03	140	14·66
3	281	11·19	71	11·14	147	11·69	281	22·77	71	22·90	147	23·05	247	14·95	62	14·69	89	15·17
4	247	12·66	65	12·35	147	12·95	247	23·74	65	23·65	147	23·78	224	15·51	53	15·17	102	15·60
5	241	13·92	40	13·53	120	14·42	241	24·43	40	24·35	120	24·47	216	15·94	35	15·43	69	16·04
6	271	14·95	41	14·24	101	15·04	271	25·14	41	24·76	101	25·09	244	16·33	37	15·74	67	16·41
7	301	15·70	36	15·48	101	15·79	301	25·68	36	25·60	101	25·66	273	16·51	36	15·74	65	16·71
8	233	16·58	43	16·69	83	17·09	233	26·12	43	26·14	83	26·30	206	16·77	43	16·62	53	17·17
9	218	17·29	29	17·07	78	17·56	218	26·56	29	26·58	78	26·68	190	17·11	29	16·57	53	17·04
10	250	17·79	25	17·99	67	18·21	250	26·98	25	27·14	67	26·95	221	17·23	25	16·92	44	17·28
11	185	18·24	22	18·49	41	19·13	185	27·38	22	27·52	41	27·40	164	17·57	22	17·14	23	17·52
12	143	18·78	24	18·61	36	18·59	143	27·62	24	27·55	36	27·52	130	17·67	21	17·30	24	17·85
1 year	120	19·49	23	19·82	24	18·32	120	29·05	23	28·08	24	27·33	99	17·91	22	17·52	22	17·69

TABLE 44. *Mean Weight, Height, and Sitting Height of Girls up to 1 Year from Welfare Centre Records.*
(From all cases recorded.)

Age (mths.).	Glasgow.		Edinburgh.		Dundee.		Glasgow.		Edinburgh.		Dundee.		Glasgow.		Edinburgh.		Dundee.	
	No. of cases.	*Weight* (lb.).	*No. of cases.*	*Weight* (lb.).	*No. of cases.*	*Weight* (lb.).	*No. of cases.*	*Height* (in.).	*No. of cases.*	*Height* (in.).	*No. of cases.*	*Height* (in.).	*No. of cases.*	*Sit. height* (in.).	*No. of cases.*	*Sit. height* (in.).	*No. of cases.*	*Sit. height* (in.).
−1	20	7·40	—	—	27	7·54	20	19·61	—	—	27	19·99	16	12·97	—	—	17	13·43
1	434	8·08	72	7·98	245	8·37	434	20·44	72	20·58	245	20·57	379	13·62	65	13·48	167	13·67
2	356	9·17	74	8·67	182	9·55	356	21·32	74	21·30	182	21·51	308	14·13	65	13·76	140	14·51
3	298	10·54	61	9·82	136	10·72	298	22·48	61	22·24	136	22·47	259	14·69	57	14·27	88	14·59
4	240	11·90	51	10·77	125	11·96	240	23·29	51	23·01	125	23·33	215	15·22	51	14·54	92	15·30
5	228	12·68	45	12·21	108	13·07	228	23·88	45	23·68	108	23·97	200	15·49	43	15·02	75	15·63
6	263	13·68	37	13·47	80	14·16	263	24·56	37	24·47	80	24·67	232	15·91	36	15·56	52	16·10
7	314	14·57	44	14·36	90	15·24	314	24·97	44	24·82	90	24·95	284	16·16	42	15·71	60	16·14
8	226	15·13	28	15·50	67	15·42	226	25·50	28	25·60	67	25·72	203	16·30	27	16·10	44	16·53
9	235	15·99	35	16·42	62	16·49	235	26·08	35	25·82	62	26·02	202	16·64	35	16·25	40	16·78
10	236	16·22	17	17·49	47	17·12	236	26·30	17	26·87	47	26·31	213	16·71	17	16·62	32	17·07
11	190	17·05	20	18·06	43	16·99	190	26·75	20	27·01	43	26·81	166	17·13	20	16·79	32	17·05
12	179	17·30	20	19·00	32	17·27	179	27·06	20	27·51	32	26·86	149	17·16	19	17·16	20	16·81
1 year	123	17·80	21	18·96	25	17·44	123	27·44	21	27·49	25	27·03	98	17·49	21	17·18	20	17·40

TABLE 45. *Mean Weight, Height, and Standard Deviations of Boys up to 1 Year from Welfare Centre Records. (Glasgow—Original Visits only. Dundee and Edinburgh—Original and Revisits combined.)*

	Glasgow.					Edinburgh.					Dundee.				
Age (mths.).	*No. of cases.*	*Mean weight* (lb.).	*Standard deviation.*	*Mean height* (in.).	*Standard deviation.*	*No. of cases.*	*Mean weight* (lb.).	*Standard deviation.*	*Mean height* (in.).	*Standard deviation.*	*No. of cases.*	*Mean weight* (lb.).	*Standard deviation.*	*Mean height* (in.).	*Standard deviation.*
−1	31	7·7177	1·241	20·1290	1·427	—	—	—	—	—	41	8·0854	1·322	20·4085	0·938
1	489	8·5685	1·529	20·8129	1·175	82	8·3415	1·603	20·6646	1·062	294	8·7840	1·679	20·8724	1·335
2	305	9·6590	1·911	21·6393	1·342	86	9·7907	1·772	21·8605	1·121	149	10·1007	1·740	21·9128	1·160
3	98	10·7500	2·053	22·5408	1·217	71	11·1549	1·762	22·8803	1·072	148	11·6757	1·878	23·0811	1·090
4	33	12·0757	1·926	23·3259	1·117	65	12·3231	2·090	23·6462	1·126	148	12·9291	2·344	23·7770	1·192
5	42	14·0060	2·677	24·2083	1·599	40	13·5313	2·456	24·3500	1·098	118	14·3856	2·481	24·4958	1·271
6	49	14·8673	2·313	25·1683	1·134	41	14·2439	3·308	24·7561	1·252	101	15·0149	2·696	25·0990	1·341
7	39	15·6410	2·283	25·6410	1·011	36	15·4792	2·523	25·6042	1·140	100	15·7400	2·577	25·6950	1·311
8	23	16·6196	2·583	26·5543	1·244	43	16·6860	2·560	26·1395	1·118	82	17·0854	2·493	26·2927	1·200
9	32	16·4531	2·718	26·0078	1·496	29	17·0690	2·822	26·5776	1·201	78	17·5192	3·216	26·6731	1·440
10	30	16·8583	2·148	26·7583	0·934	25	17·9900	2·489	27·1400	0·947	69	18·1449	2·995	26·9855	1·347
11	24	17·8958	2·316	27·5000	1·184	22	18·4886	1·806	27·5227	0·784	43	18·7733	3·149	27·2151	1·585
12	13	18·4808	3·419	27·3846	1·172	24	18·6146	1·831	27·5521	1·068	36	18·8819	2·392	27·8542	1·045
1 year	—	—	—	—	—	23	19·8152	1·917	28·0761	0·857	24	18·5313	2·769	27·3333	1·251

TABLE 46. *Mean Weight, Height, and Standard Deviations of Girls up to 1 Year from Welfare Centre Records. (Glasgow—Original Visits only. Dundee and Edinburgh—Original and Revisits combined.)*

	Glasgow.					Edinburgh.					Dundee.				
Age (mths.).	*No. of cases.*	*Mean weight* (lb.).	*Standard deviation.*	*Mean height* (in.).	*Standard deviation.*	*No. of cases.*	*Mean weight* (lb.).	*Standard deviation.*	*Mean height* (in.).	*Standard deviation.*	*No. of cases.*	*Mean weight* (lb.).	*Standard deviation.*	*Mean height* (in.).	*Standard deviation.*
−1	20	7·4000	1·290	19·6125	0·755	—	—	—	—	—	27	7·5370	0·935	19·9907	0·629
1	427	8·0621	1·497	20·4274	1·242	72	7·9514	1·238	20·5833	1·051	245	8·3408	1·656	20·5796	1·278
2	284	9·0246	1·738	21·2113	1·260	74	8·7432	1·688	21·2770	1·234	140	9·4250	1·591	21·4214	1·040
3	95	10·2105	1·981	22·4316	1·283	61	9·8197	1·996	22·2541	1·177	136	10·7243	1·994	22·4412	1·337
4	41	11·7378	1·652	23·1829	0·908	51	11·1078	2·615	23·0392	1·649	123	11·9268	2·276	23·3211	1·410
5	37	12·8176	2·324	24·0000	1·228	45	12·2000	2·440	23·6833	1·301	110	13·0591	2·067	23·9591	1·244
6	46	13·4185	2·158	24·3043	1·347	37	13·4730	1·995	24·4662	0·750	80	14·0938	2·148	24·7000	1·163
7	48	14·8281	1·830	25·1823	1·206	44	14·3580	2·199	24·8239	0·990	90	14·8667	2·569	24·9444	1·383
8	43	14·7733	2·134	25·4070	1·182	27	15·5556	2·423	25·6111	1·061	67	15·4030	2·080	25·7164	1·216
9	26	15·3365	2·131	25·7019	1·178	35	16·4214	2·616	25·8214	0·899	62	16·5161	2·692	26·0403	1·179
10	29	15·9397	1·951	26·3534	1·451	17	17·4853	2·106	26·8676	0·886	47	17·1170	2·486	26·3564	1·481
11	25	17·0900	2·549	26·7400	1·251	20	18·0625	2·818	27·0125	0·751	43	16·9942	2·775	26·8081	1·489
12	23	16·9348	2·538	27·0978	1·378	20	19·0000	2·137	27·5125	0·759	32	17·2734	2·624	26·8594	1·065
1 year	—	—	—	—	—	21	18·8690	2·734	27·4762	1·041	25	17·4400	2·608	27·0100	1·007

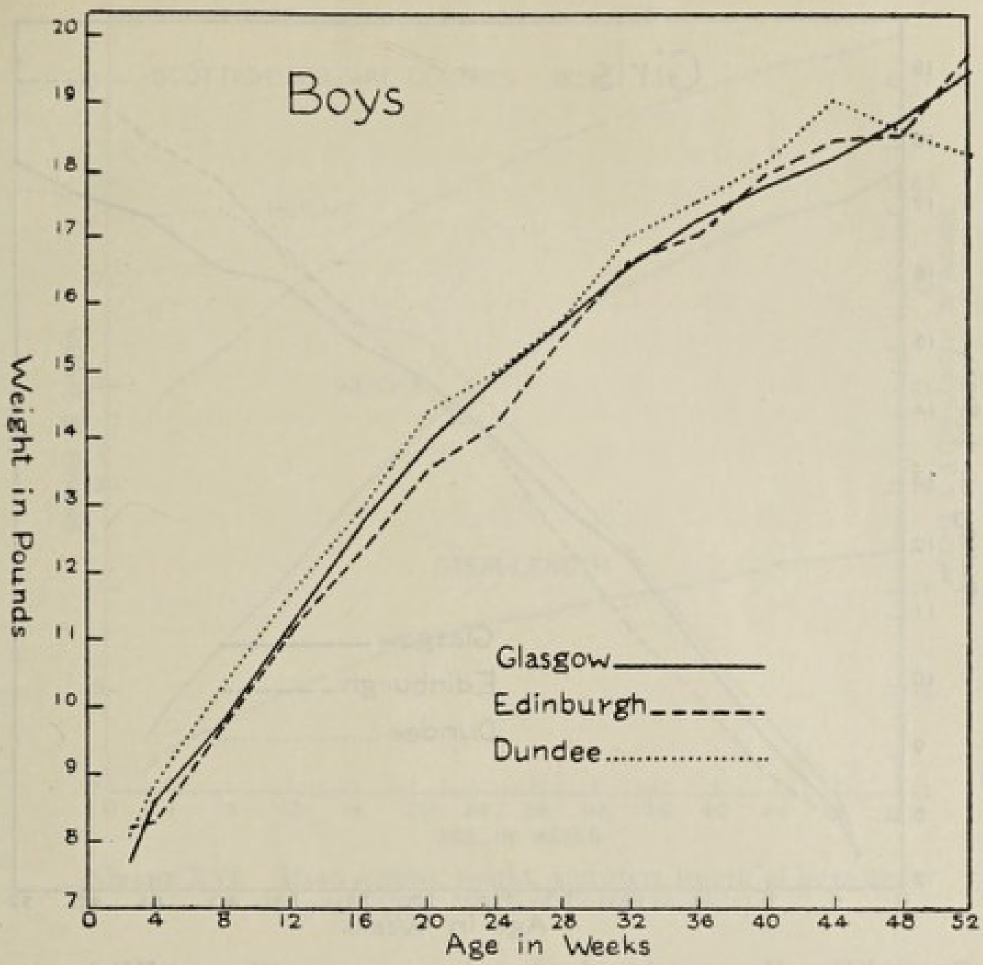


CHART XII. Mean weights of boys under one year in Glasgow, Edinburgh, and Dundee (Child Welfare Centre records).

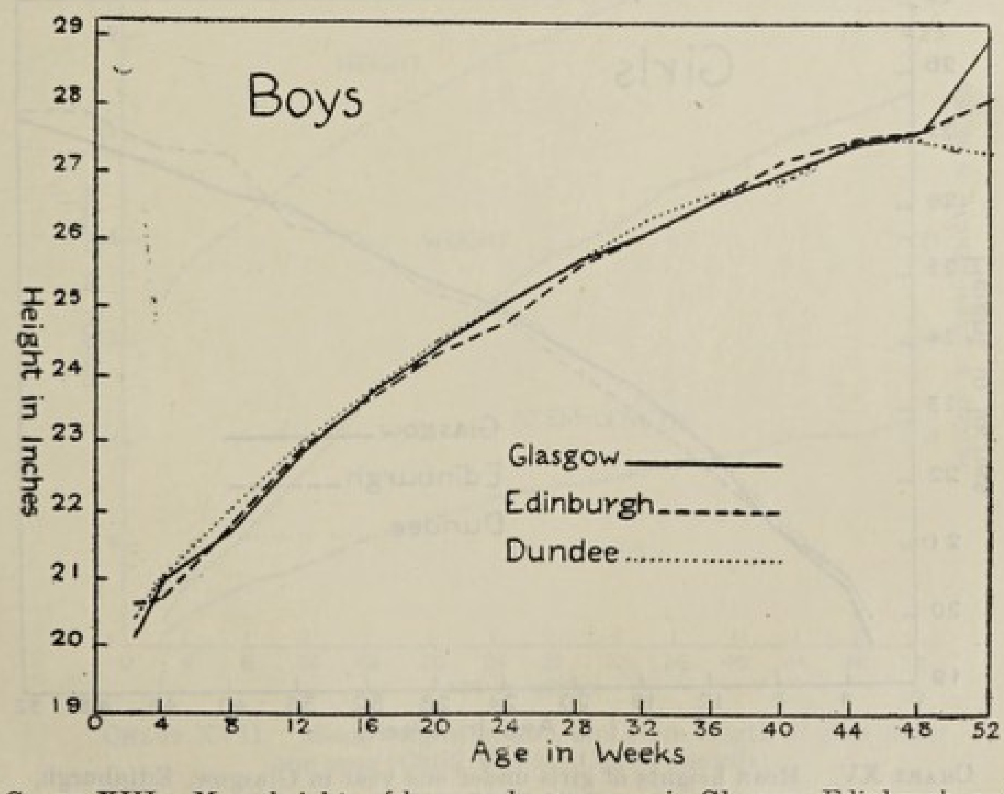


CHART XIII. Mean heights of boys under one year in Glasgow, Edinburgh, and Dundee (Child Welfare Centre records).

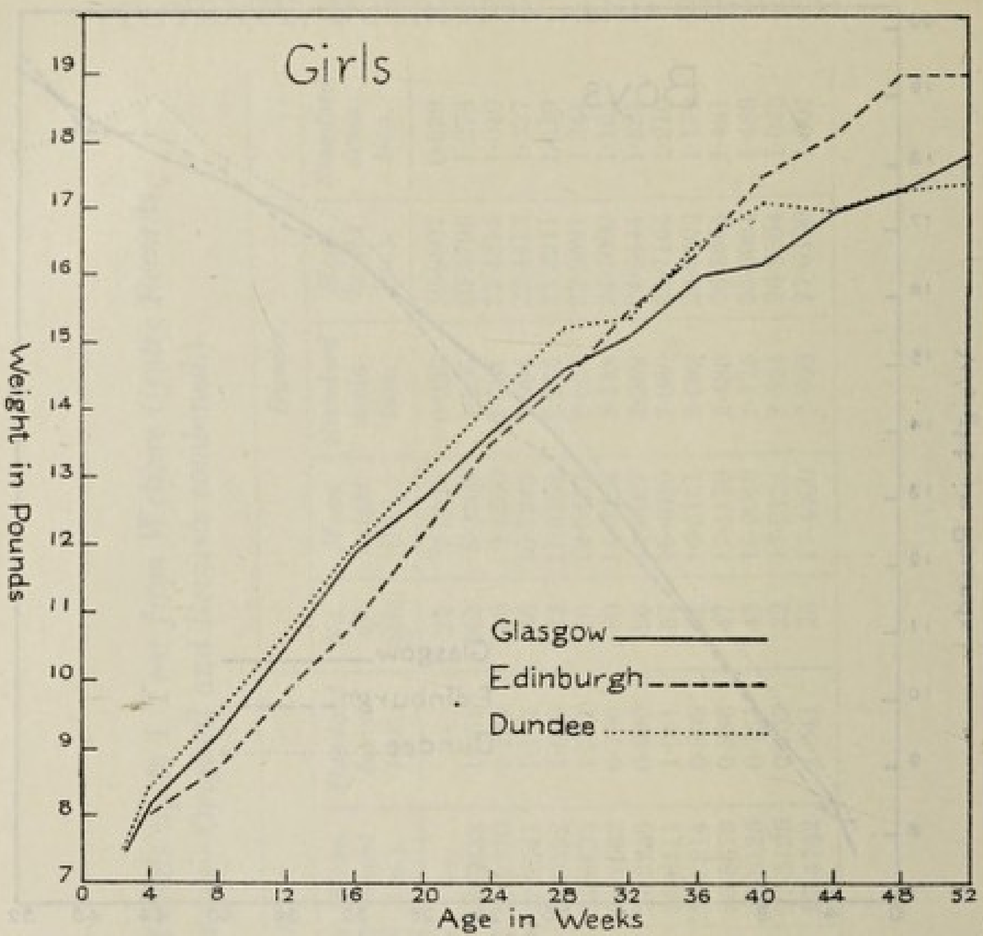


Chart XIV. Mean weights of girls under one year in Glasgow, Edinburgh, and Dundee (Child Welfare Centre records).

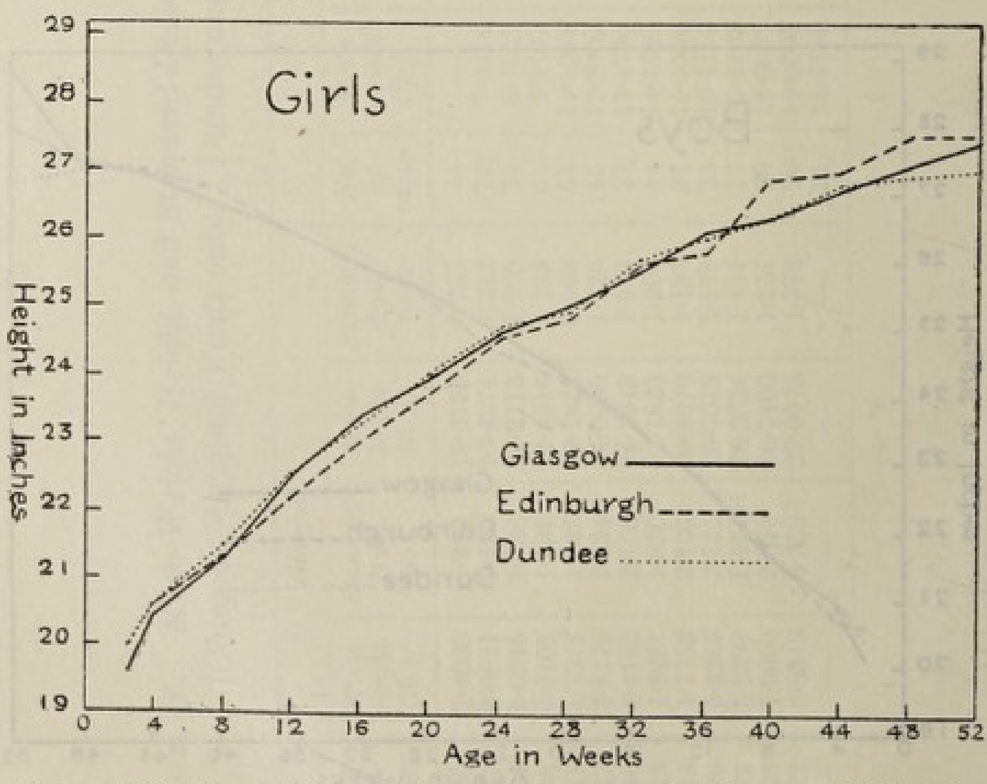


Chart XV. Mean heights of girls under one year in Glasgow, Edinburgh, and Dundee (Child Welfare Centre records).

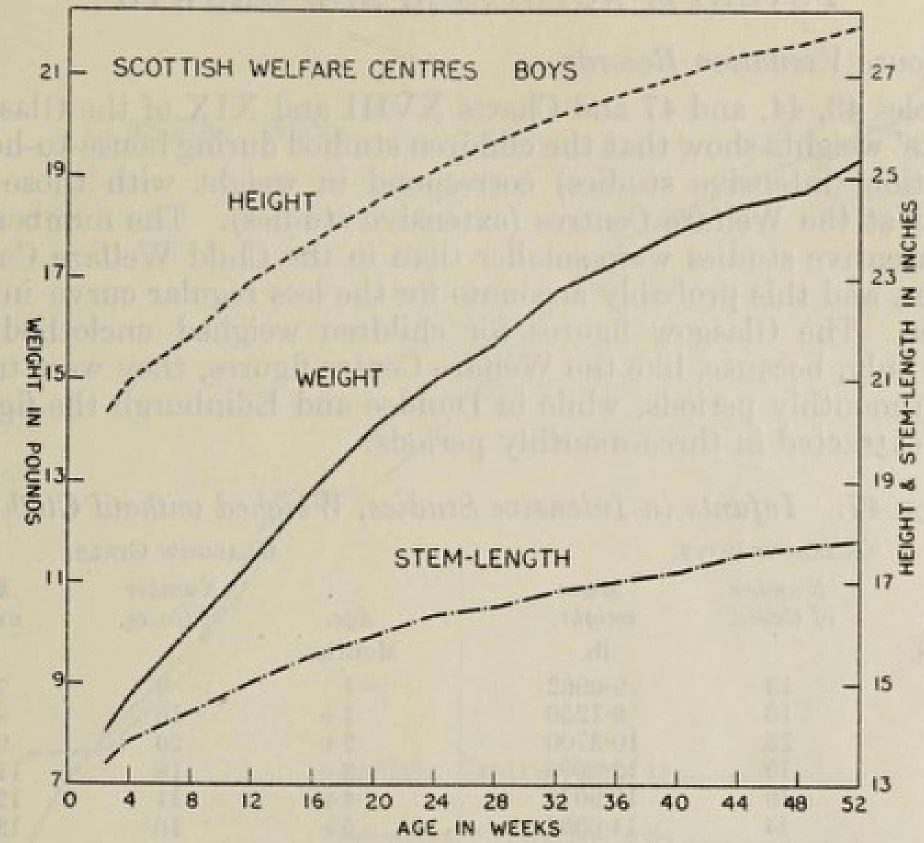


Chart XVI. Mean weight, height, and stem length of boys under one year (Child Welfare Centre records).

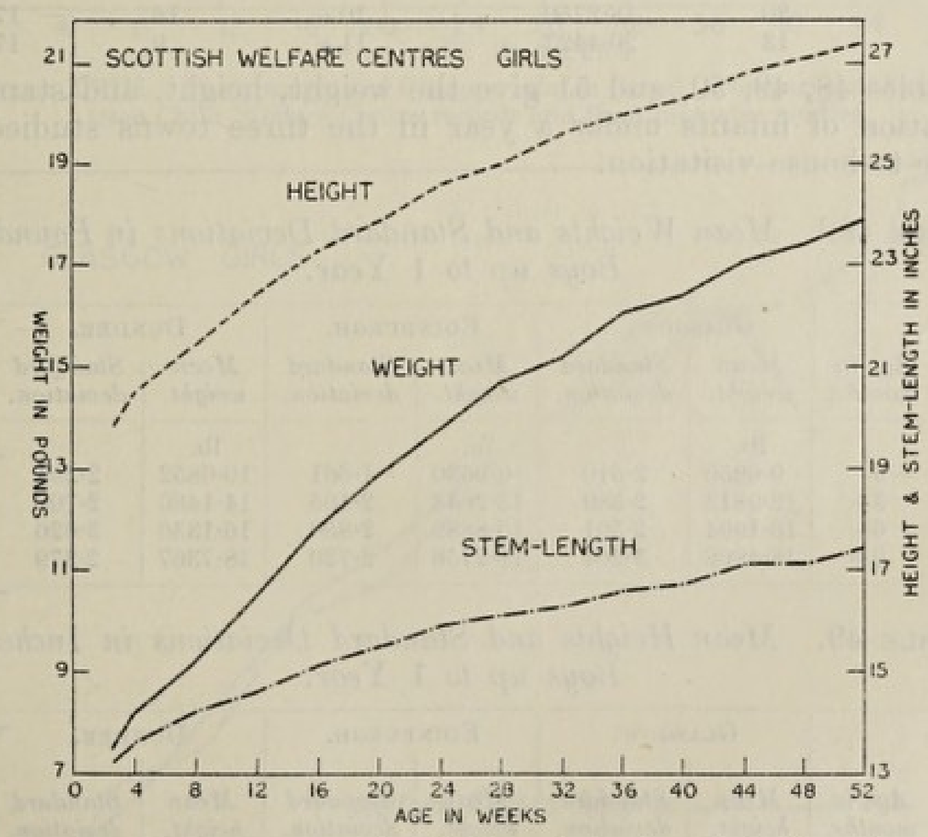


Chart XVII. Mean weight, height, and stem length of girls under one year (Child Welfare Centre records).

(*b*) *House Visitation Records*

Tables 43, 44, and 47 and Charts XVIII and XIX of the Glasgow infants' weights show that the children studied during house-to-house visitation (intensive studies) correspond in weight with those observed at the Welfare Centres (extensive studies). The numbers in the intensive studies were smaller than in the Child Welfare Centre studies, and this probably accounts for the less regular curve in the former. The Glasgow figures for children weighed unclothed are given only, because, like the Welfare Centre figures, they were taken out in monthly periods, while in Dundee and Edinburgh the figures were extracted in three-monthly periods.

TABLE 47. *Infants in Intensive Studies, Weighed without Clothing.*

Glasgow Boys.			Glasgow Girls.		
Age. Months.	*Number of Cases.*	*Mean weight.* lb.	*Age.* Months.	*Number of Cases.*	*Mean weight.* lb.
−1	13	9·0962	−1	9	7·2500
1+	16	9·1250	1+	16	9·1563
2+	25	10·3700	2+	20	9·5750
3+	19	12·9605	3+	18	11·5278
4+	19	12·9079	4+	11	12·0682
5+	14	14·0357	5+	16	13·3125
6+	22	15·5000	6+	14	14·2143
7+	7	16·3929	7+	18	16·0833
8+	21	17·3214	8+	13	16·1346
9+	12	18·6250	9+	11	14·2045
10+	20	18·2750	10+	16	17·9687
11+	13	20·4423	11+	9	17·9167

Tables 48, 49, 50, and 51 give the weight, height, and standard deviation of infants under a year in the three towns studied by house-to-house visitation.

TABLE 48.[1] *Mean Weights and Standard Deviations in Pounds of Boys up to 1 Year.*

	Glasgow.		Edinburgh.		Dundee.	
Age in months.	*Mean weight.*	*Standard deviation.*	*Mean weight.*	*Standard deviation.*	*Mean weight.*	*Standard deviation.*
	lb.		lb.		lb.	
−3	9·6950	2·510	9·9630	1·661	10·0852	2·294
3+	12·9812	2·589	13·2643	2·405	14·1486	2·708
6+	16·1994	2·561	15·8889	2·850	16·1336	3·626
9+	18·4808	3·201	18·2756	2·720	18·7367	2·379

TABLE 49. *Mean Heights and Standard Deviations in Inches of Boys up to 1 Year.*

	Glasgow.		Edinburgh.		Dundee.	
Age in months.	*Mean height.*	*Standard deviation.*	*Mean height.*	*Standard deviation.*	*Mean height.*	*Standard deviation.*
	in.		in.		in.	
−3	22·3963	1·797	21·6481	1·223	21·3489	1·686
3+	24·2722	2·166	23·9714	1·746	23·7905	1·641
6+	26·4682	1·817	25·4375	3·506	25·3801	1·554
9+	27·4118	2·787	26·3910	1·239	27·0967	1·454

[1] In this table, and in subsequent tables, −3 m. covers children less than 3 months old, 3+ m. covers those aged 3 months or more but less than 6 months; similarly 1+ y. covers ages 1 and under 2 years, &c.

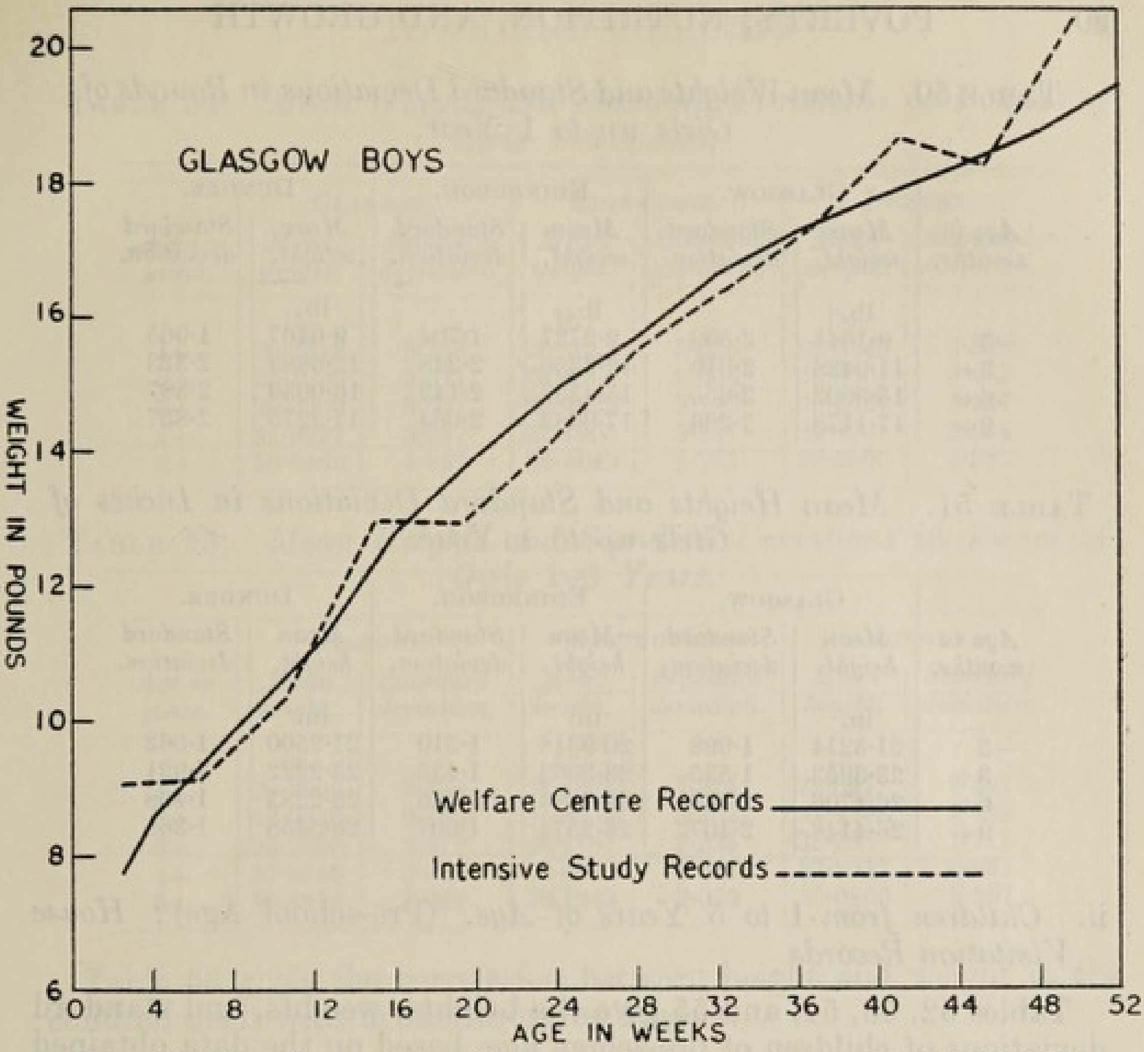


CHART XVIII. Mean weights of Glasgow infants (boys): comparison of results from Child Welfare Centre records and from intensive studies.

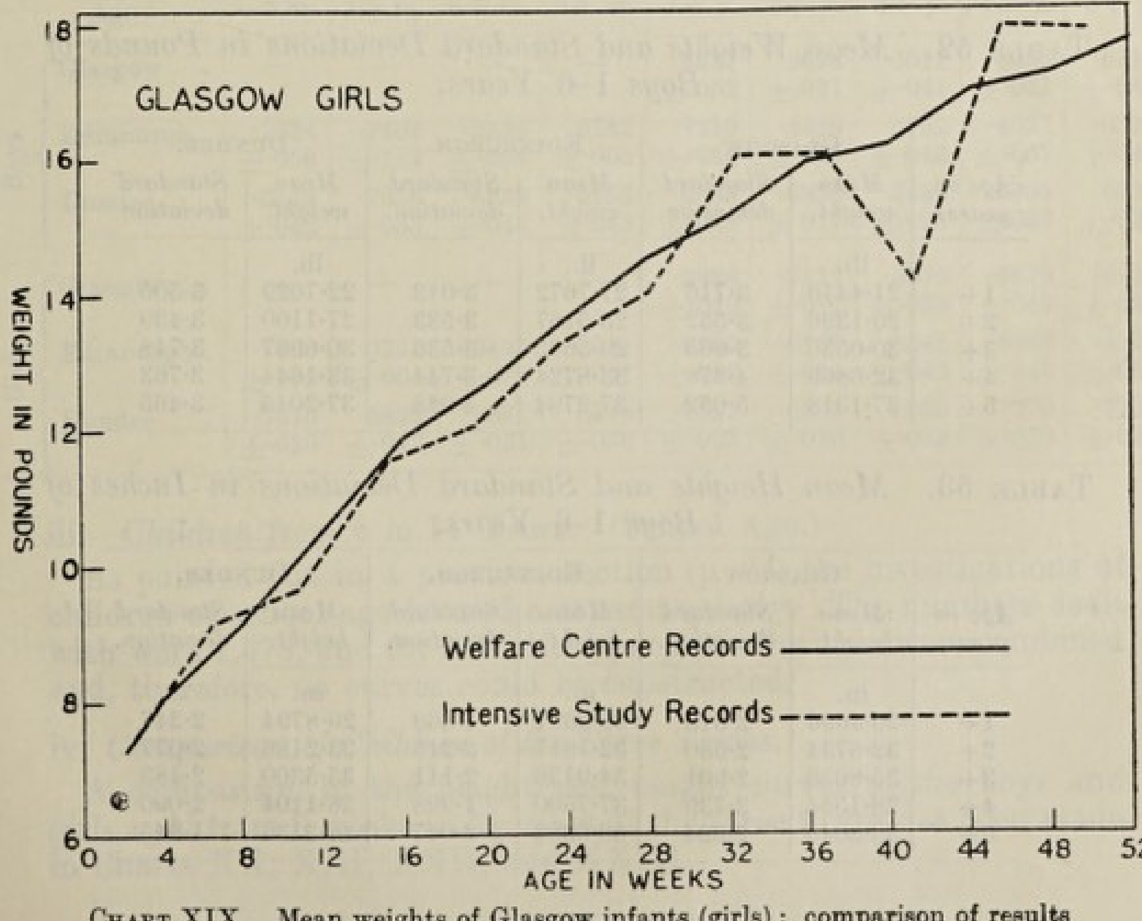


CHART XIX. Mean weights of Glasgow infants (girls): comparison of results from Child Welfare Centre records and from intensive studies.

TABLE 50. *Mean Weights and Standard Deviations in Pounds of Girls up to 1 Year.*

Age in months.	Glasgow. Mean weight.	Glasgow. Standard deviation.	Edinburgh. Mean weight.	Edinburgh. Standard deviation.	Dundee. Mean weight.	Dundee. Standard deviation.
	lb.		lb.		lb.	
−3	9·1641	2·599	9·2727	1·704	9·6467	1·965
3+	11·9438	2·319	12·2256	2·248	12·6889	2·323
6+	15·3902	2·655	15·4333	2·142	16·0036	2·887
9+	17·1173	3·226	17·0662	2·064	17·3275	2·857

TABLE 51. *Mean Heights and Standard Deviations in Inches of Girls up to 1 Year.*

Age in months.	Glasgow. Mean height.	Glasgow. Standard deviation.	Edinburgh. Mean height.	Edinburgh. Standard deviation.	Dundee. Mean height.	Dundee. Standard deviation.
	in.		in.		in.	
−3	21·3214	1·998	20·9318	1·510	21·2500	1·562
3+	23·3953	1·535	23·3963	1·433	23·2222	1·921
6+	26·4706	2·182	24·8083	1·326	25·2283	1·458
9+	26·4148	2·407	26·2574	1·607	26·5458	1·368

ii. *Children from* 1 *to* 5 *Years of Age.* (Pre-school Age); *House Visitation Records*

Tables 52, 53, 54, and 55 give the heights, weights, and standard deviations of children of pre-school age, based on the data obtained by house-to-house visitation: 4,855 children are dealt with in this group.

TABLE 52. *Mean Weights and Standard Deviations in Pounds of Boys 1–6 Years.*

Age in years.	Glasgow. Mean weight.	Glasgow. Standard deviation.	Edinburgh. Mean weight.	Edinburgh. Standard deviation.	Dundee. Mean weight.	Dundee. Standard deviation.
	lb.		lb.		lb.	
1+	21·4416	3·716	21·7672	3·013	22·7029	3·505
2+	26·1396	3·552	25·5167	3·533	27·1100	3·439
3+	30·0536	3·965	29·5682	3·536	30·6967	3·748
4+	32·6869	4·878	33·8724	3·744	33·1644	3·763
5+	37·1318	5·052	37·2794	4·048	37·2045	3·465

TABLE 53. *Mean Heights and Standard Deviations in Inches of Boys 1–6 Years.*

Age in years.	Glasgow. Mean height.	Glasgow. Standard deviation.	Edinburgh. Mean height.	Edinburgh. Standard deviation.	Dundee. Mean height.	Dundee. Standard deviation.
	in.		in.		in.	
1+	29·4696	2·519	28·9397	1·869	29·8794	2·247
2+	32·8734	2·950	32·1917	2·215	33·2186	2·077
3+	35·8036	2·901	34·9136	2·111	35·5300	2·483
4+	38·1554	3·739	37·7500	1·998	38·1104	2·096
5+	39·8045	2·524	39·8382	2·047	40·3136	1·845

TABLE 54. *Mean Weights and Standard Deviations in Pounds of Girls 1–6 Years.*

Age in years.	Glasgow. Mean weight.	Glasgow. Standard deviation.	Edinburgh. Mean weight.	Edinburgh. Standard deviation.	Dundee. Mean weight.	Dundee. Standard deviation.
	lb.		lb.		lb.	
1+	20·2318	3·158	20·4643	3·026	20·9625	3·517
2+	25·1930	3·511	24·4684	3·304	25·6601	3·481
3+	28·0969	3·652	29·4525	3·793	29·4524	3·437
4+	31·9927	3·567	32·1955	3·817	32·8287	3·594
5+	35·6466	4·952	35·4643	3·751	36·2500	4·327

TABLE 55. *Mean Heights and Standard Deviations in Inches of Girls 1–6 Years.*

Age in years.	Glasgow. Mean height.	Glasgow. Standard deviation.	Edinburgh. Mean height.	Edinburgh. Standard deviation.	Dundee. Mean height.	Dundee. Standard deviation.
	in.		in.		in.	
1+	29·3996	2·378	28·4464	1·814	29·0813	2·187
2+	32·9648	2·848	31·5655	2·232	32·4298	2·083
3+	35·2806	2·872	34·8161	2·234	35·2857	1·711
4+	37·9248	2·656	37·4332	1·922	37·8917	2·051
5+	39·4914	3·087	39·1643	2·093	40·0865	2·397

Table 56 gives the correlation between height and weight in the children dealt with in the foregoing studies.

TABLE 56. *Weight and Height Correlations.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y
Boys	Glasgow	—	—	—	—	·4481 ±·052	·5698 ±·037	·6011 ±·041	·6055 ±·041	·6214 ±·040
Boys	Edinburgh	·7524 ±·056	·1404 ±·112	·3534 ±·098	·6782 ±·058	·7219 ±·030	·5458 ±·043	·5762 ±·043	·4037 ±·057	·6299 ±·049
Boys	Dundee	·6415 ±·042	·7636 ±·033	·6253 ±·048	·6153 ±·048	·6833 ±·029	·6850 ±·027	·7430 ±·025	·6984 ±·033	·6625 ±·036
Girls	Glasgow	—	—	—	—	·3838 ±·049	·7113 ±·027	·5675 ±·038	·5879 ±·043	·6129 ±·039
Girls	Edinburgh	·7866 ±·045	·6241 ±·064	·6435 ±·072	·8014 ±·041	·6285 ±·039	·6262 ±·040	·5542 ±·042	·6049 ±·043	·4827 ±·062
Girls	Dundee	·7615 ±·030	·6439 ±·042	·6081 ±·051	·5473 ±·056	·7587 ±·023	·6351 ±·030	·6020 ±·033	·7270 ±·028	·7792 ±·026

iii. *Children from* 6 *to* 14 *Years.* (School Age.)

As pointed out in a previous section (p. 34) the investigations of children of school age formed a separate study. The numbers dealt with were 1,578, and for statistical purposes the ages were combined and, therefore, no curves could be constructed.

iv. *Comparison of Children of the Three Towns.*

A comparison of the height and weight curves of the boys and girls aged from 6 weeks to 5½ years of the three towns has been made in Charts XX, XXI, XXII, and XXIII.

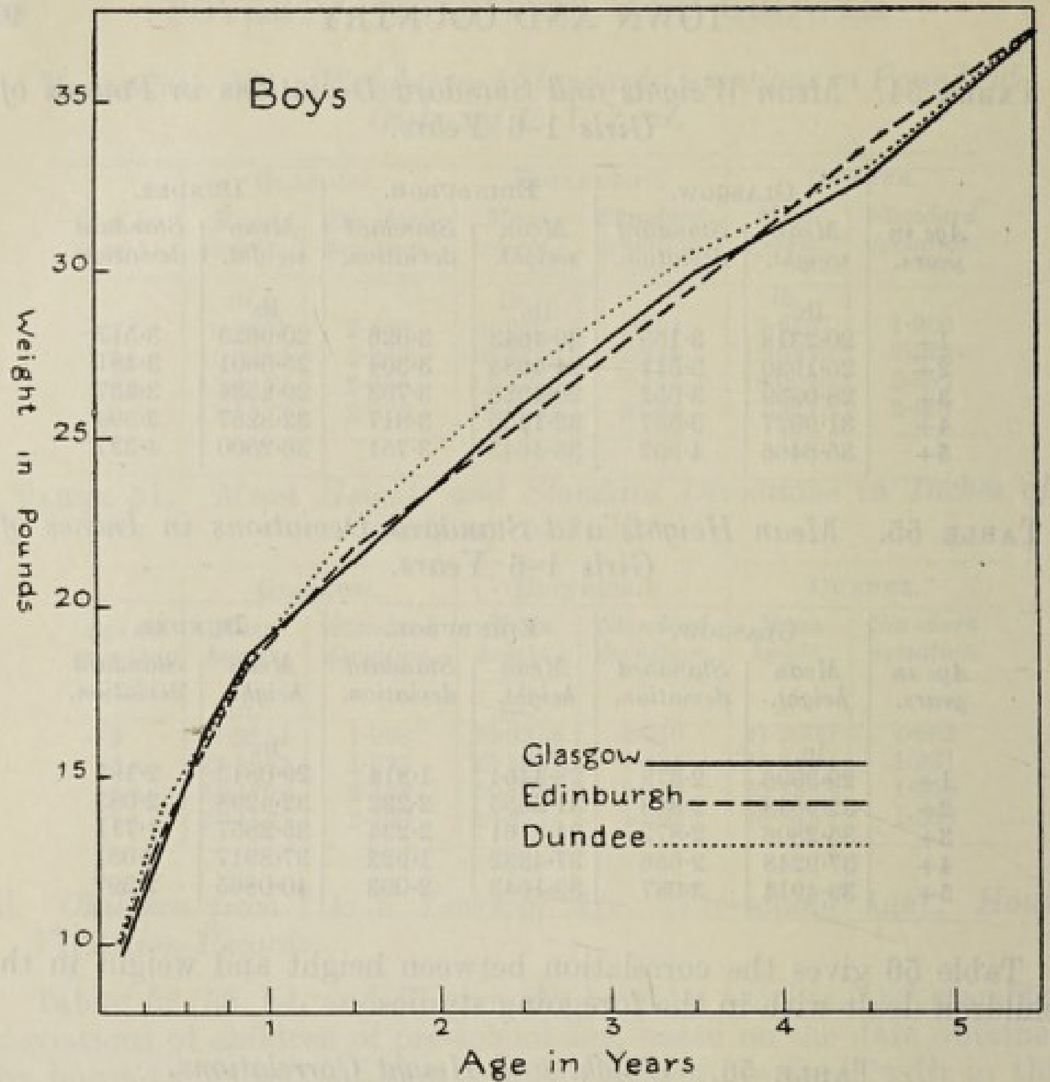


CHART XX. Mean weights of boys of pre-school age in Glasgow, Edinburgh, and Dundee.

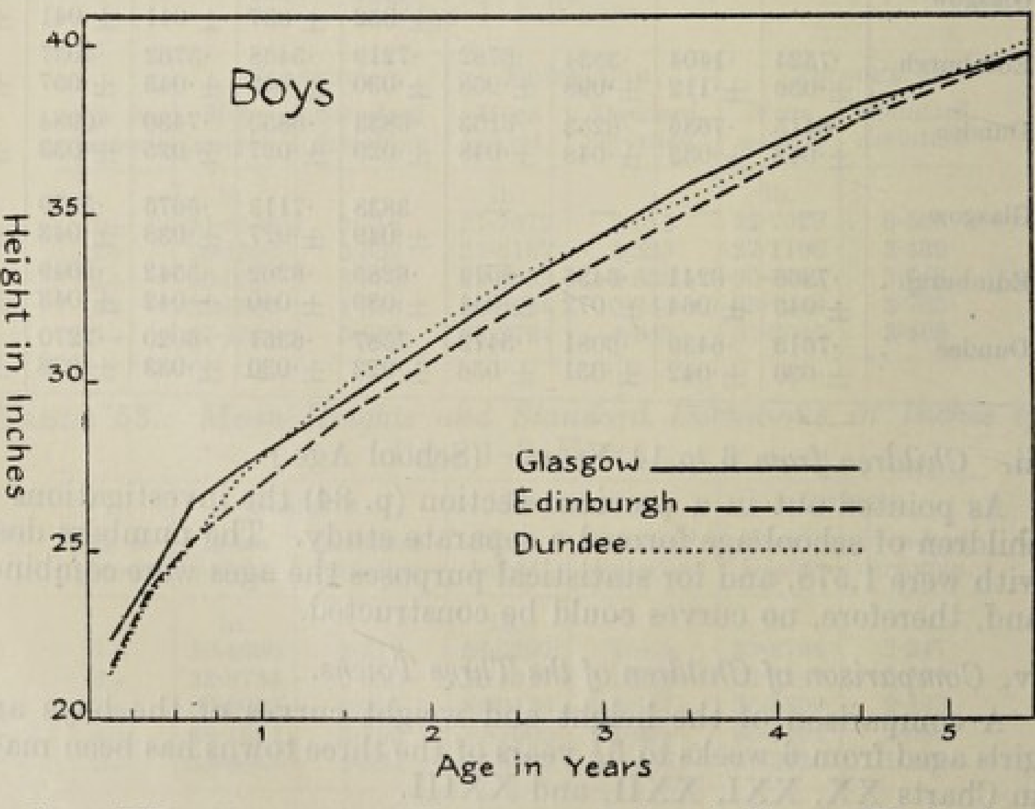


CHART XXI. Mean heights of boys of pre-school age in Glasgow, Edinburgh, and Dundee.

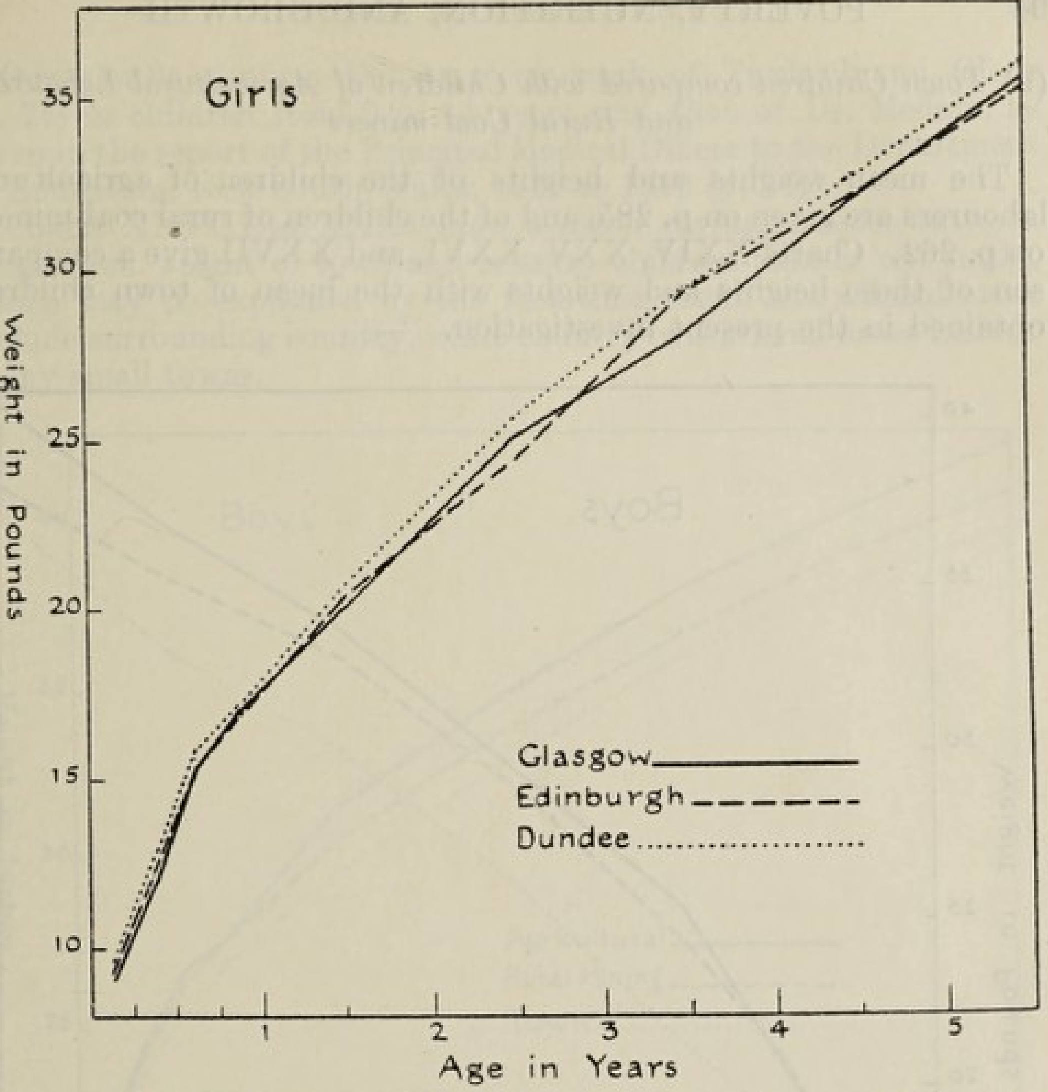


CHART XXII. Mean weights of girls of pre-school age in Glasgow, Edinburgh, and Dundee.

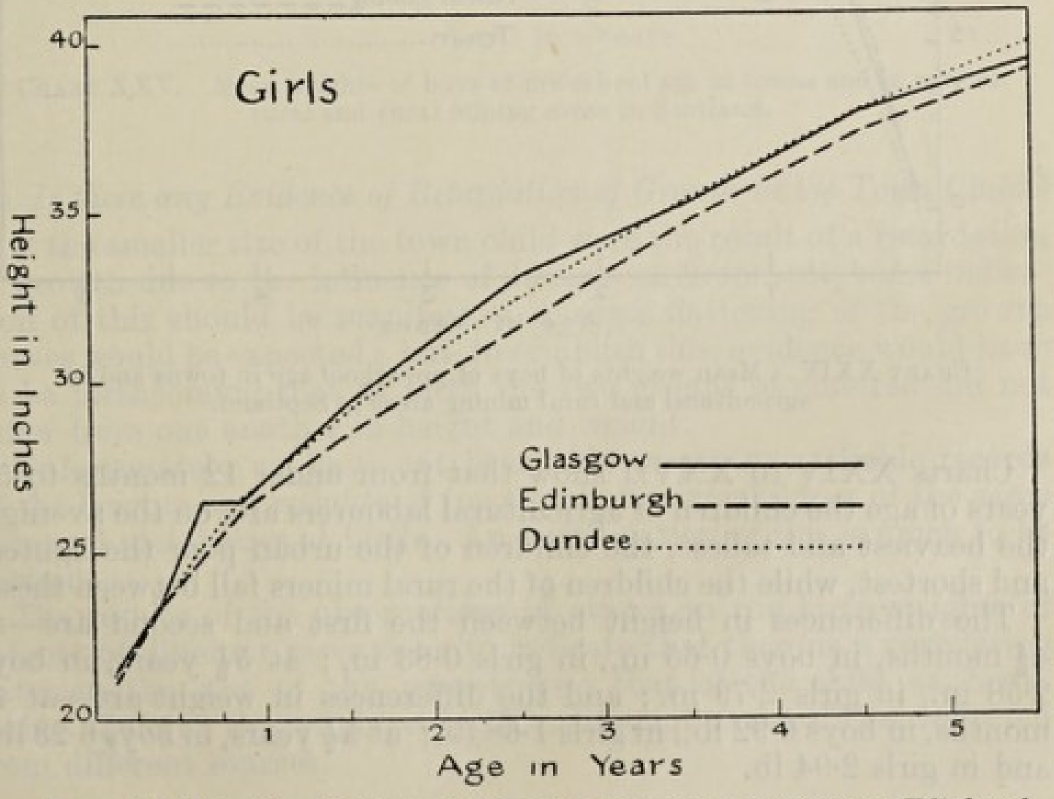


CHART XXIII. Mean heights of girls of pre-school age in Glasgow, Edinburgh, and Dundee.

(b) *Town Children compared with Children of Agricultural Labourers and Rural Coal-miners*

The mean weights and heights of the children of agricultural labourers are given on p. 285, and of the children of rural coal-miners on p. 262. Charts XXIV, XXV, XXVI, and XXVII give a comparison of these heights and weights with the mean of town children obtained in the present investigation.

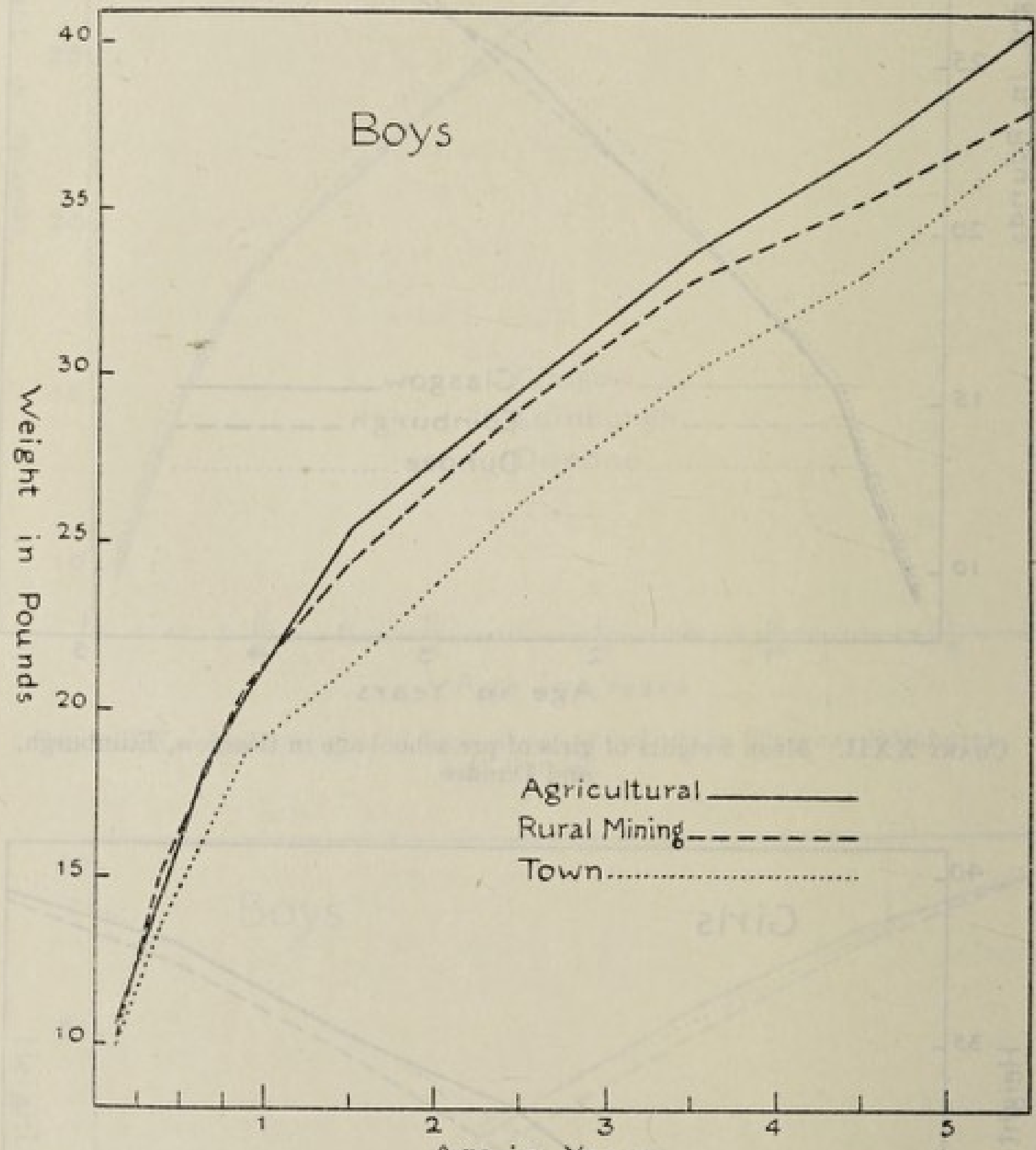


CHART XXIV. Mean weights of boys of pre-school age in towns and in agricultural and rural mining areas in Scotland.

Charts XXIV to XXVII show that from under 12 months to $5\frac{1}{2}$ years of age the children of agricultural labourers are, on the average, the heaviest and tallest, the children of the urban poor the lightest and shortest, while the children of the rural miners fall between these.

The differences in height between the first and second are—at $4\frac{1}{2}$ months, in boys 0·65 in., in girls 0·83 in.; at $5\frac{1}{2}$ years, in boys 2·58 in., in girls 2·79 in.: and the differences in weight are—at $4\frac{1}{2}$ months, in boys 0·92 lb., in girls 1·68 lb.; at $5\frac{1}{2}$ years, in boys 3·23 lb., and in girls 2·94 lb.

Our results confirm the previous work of Tuxford and Glegg (p. 74) in children from 3 to 14 years and that of Dr. Medam, as given in the report of the Principal Medical Officer to the Department of Education, New South Wales, 1918 to 1919 (p. 74).

Charts XXVIII to XXXI show a closer correspondence between height and weight of town and country children than in our study, which may be explained by the fact that urban educational areas include surrounding country, while country educational areas include many small towns.

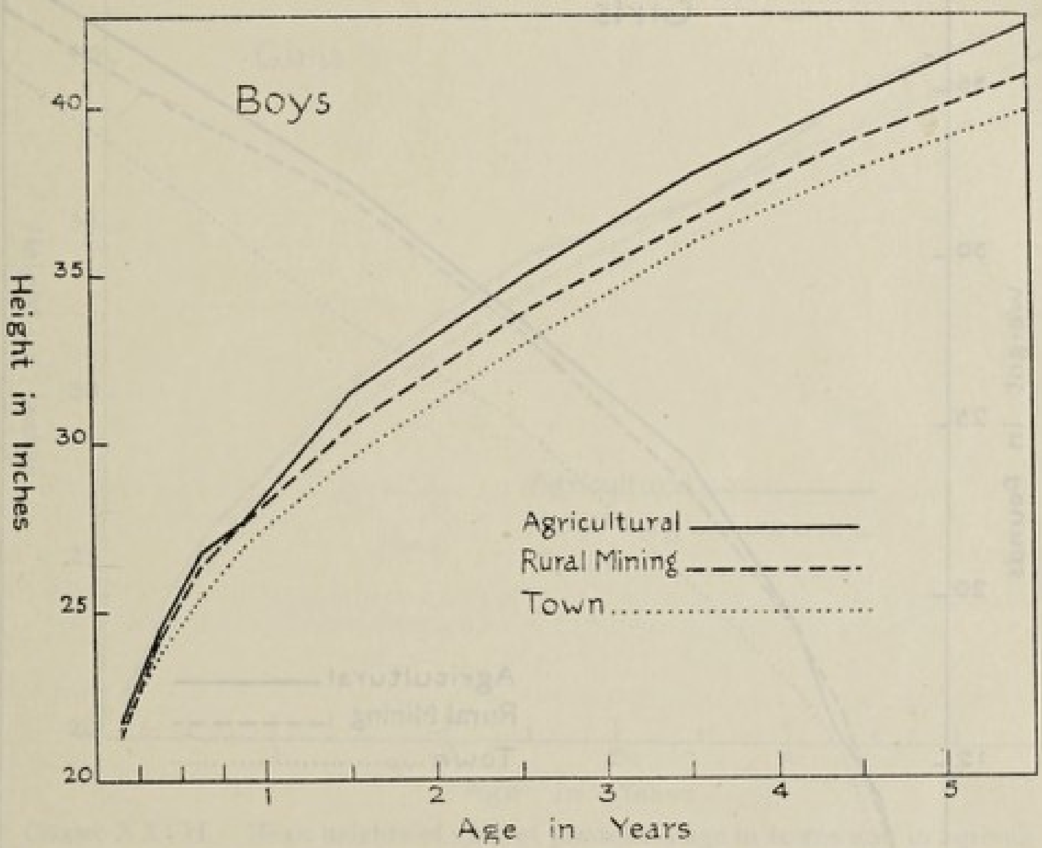


CHART XXV. Mean heights of boys of pre-school age in towns and in agricultural and rural mining areas in Scotland.

(c) *Is there any Evidence of Retardation of Growth in the Town Child?*

If the smaller size of the town child were the result of a retardation of growth due to the influence of adverse environment, some indication of this should be manifest, e. g. some flattening of the growth curves would be expected ; but, to establish this, evidence would have to be forthcoming that at birth the two groups of children did not differ from one another in height and weight.

Unfortunately we have not been able to procure reliable records of the heights and weights of town and country children of the same race and social class at birth. An investigation of this is much to be desired.

The results of the observations of others on the birth weights of infants of different races seem to indicate that there is a correlation between the size of the parents and that of the child at birth. Table 57 shows the weight at birth in different nationalities, collected from different sources.

Lane (1903), in attempting to correlate the size of the child with the diameter of the pelvic outlet of the mother, gives some figures of the birth weights of European infants on the one hand, and of Bengali infants on the other. Although the numbers are small they tend to show that the Indian child is lower in weight than the European and Eurasian.

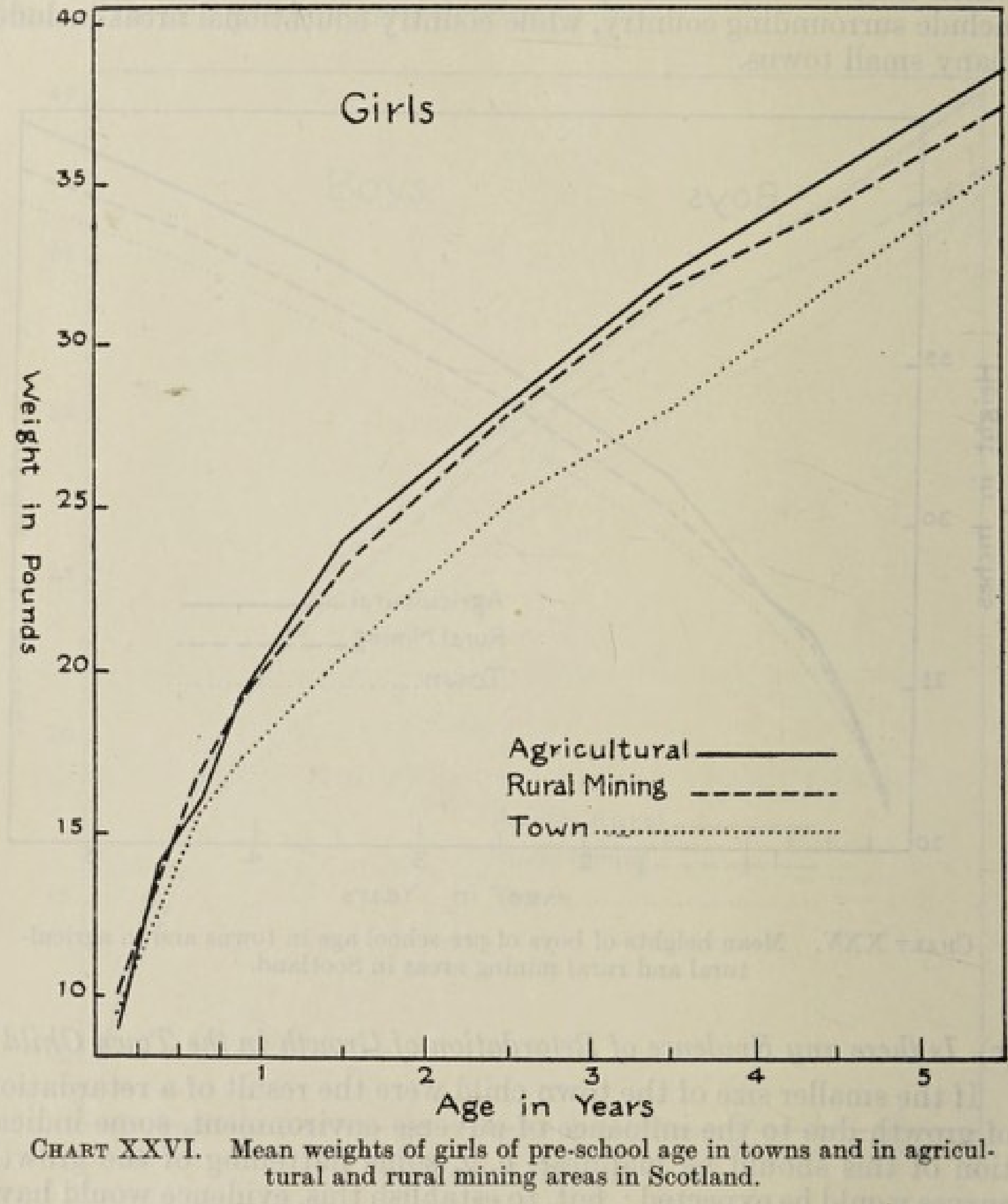


CHART XXVI. Mean weights of girls of pre-school age in towns and in agricultural and rural mining areas in Scotland.

TABLE 57. *Birth Weights of Infants of Different Nationalities. (Various Authorities.)*

Country.	*Authority.*	*Birth weight (in kilos).* *Boys.*	*Girls.*
England (Leeds)	Robertson	3·30	3·20
,, (London)	,,	3·31	3·21
America	Holt	3·40	3·26
South Australia	Robertson	3·59	3·41
Germany	Camerer	3·48	3·24
Belgium	Quetelet	3·10	3·00
France	Broudic	3·13	3·02
Russia	Gundobin	3·55	3·38
Japan	Misawa	3·00	2·90

Brenton (1921) gives the results of the weighing of 341 newly born infants of American-born parents and of 625 infants of foreign-born parents in Minnesota, showing the greater weight in the case of the former.

Apart from racial differences, Robertson (1915), quoted by Brenton, finds that the new-born children of British descent born in Australia weigh more than those born in Britain and that Anglo-American infants are intermediate in weight.

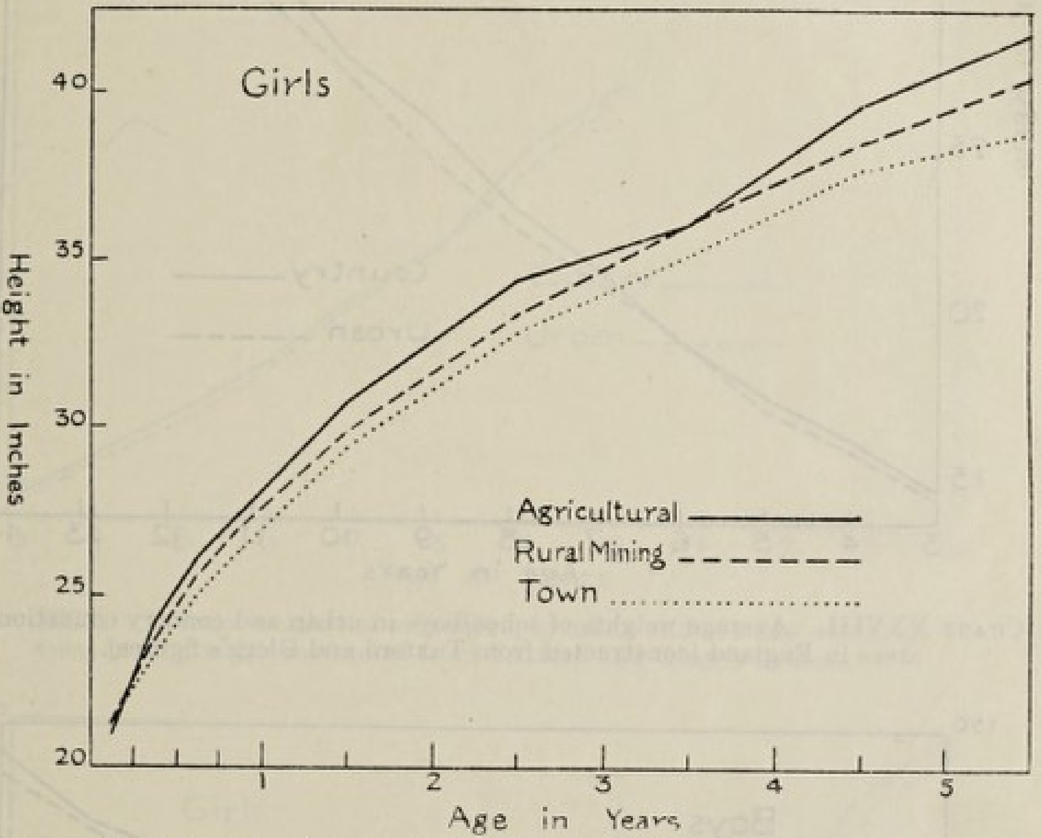


CHART XXVII. Mean heights of girls of pre-school age in towns and in agricultural and rural mining areas in Scotland.

Paul Heiberg (abstracted in *Anthropologie*, 1917, **24**, 89) gives results to show that the illegitimate infants born in Copenhagen Maternity Hospital are distinctly lighter than the children born in the country. The relatively greater poverty of the urban population dealt with cannot be ignored.

The curves given in Charts XXIV–XXVII of boys and girls from $1\frac{1}{2}$ months to $5\frac{1}{2}$ years suggest that there may be a lag in the average increase of weight of the town children between six and eighteen months of age, but that after this age growth proceeds at the same rate as in country children.

A calculation of the percentage difference in weight and height found in the town and country children in this investigation is given in Table 58.

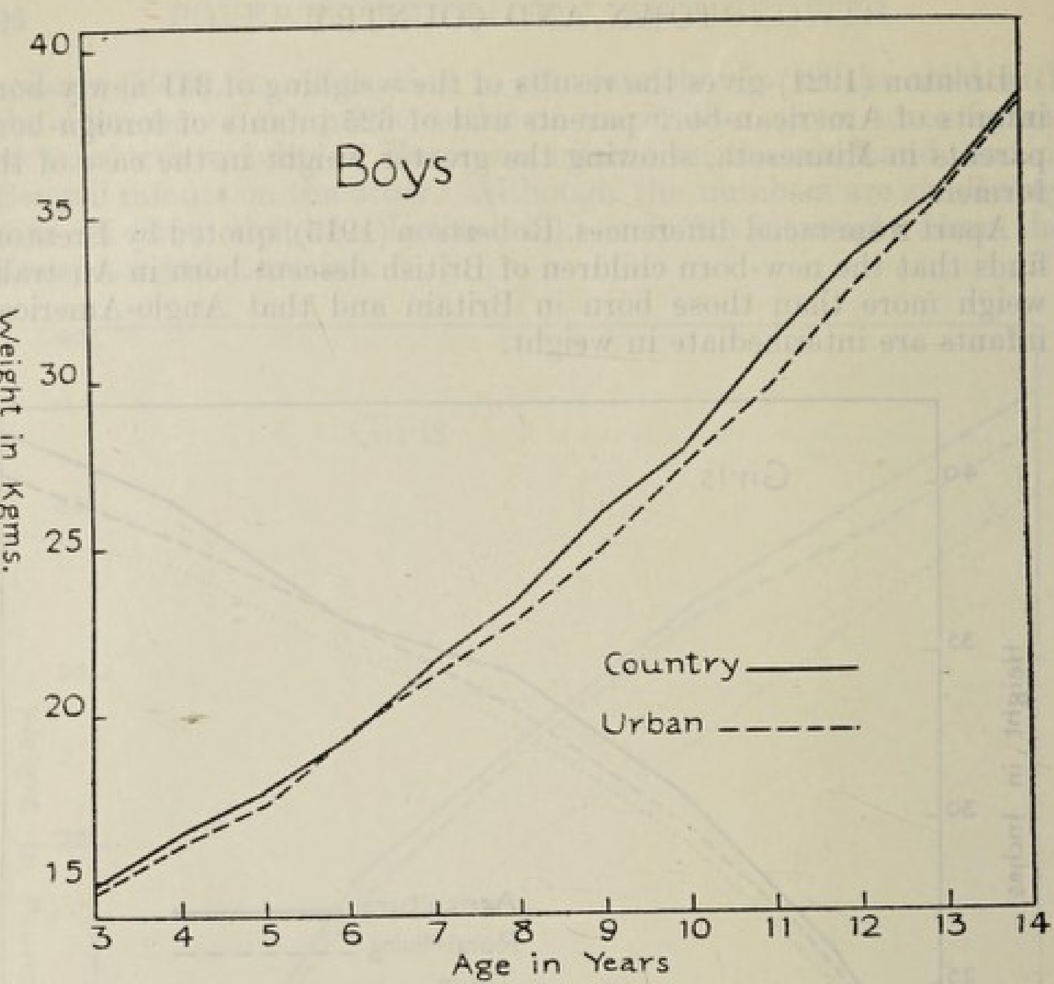


CHART XXVIII. Average weights of schoolboys in urban and country education areas in England (constructed from Tuxford and Glegg's figures).

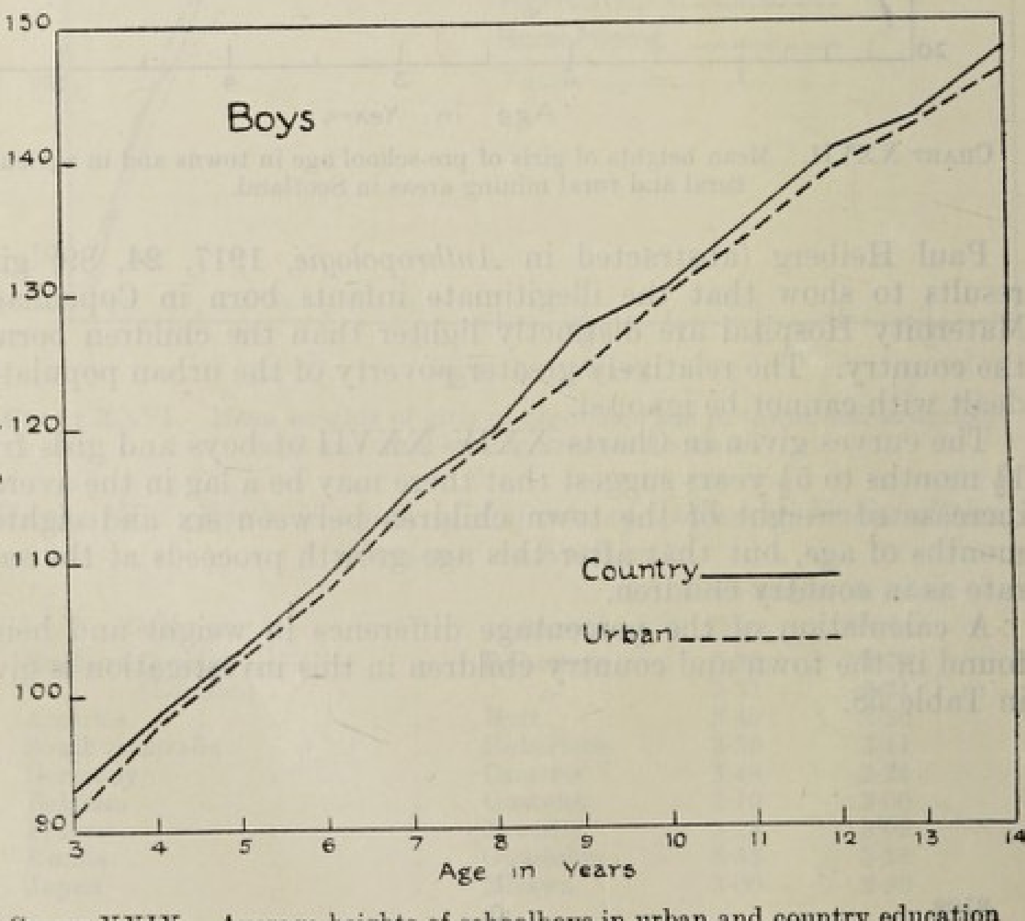


CHART XXIX. Average heights of schoolboys in urban and country education are as in England (constructed from Tuxford and Glegg's figures).

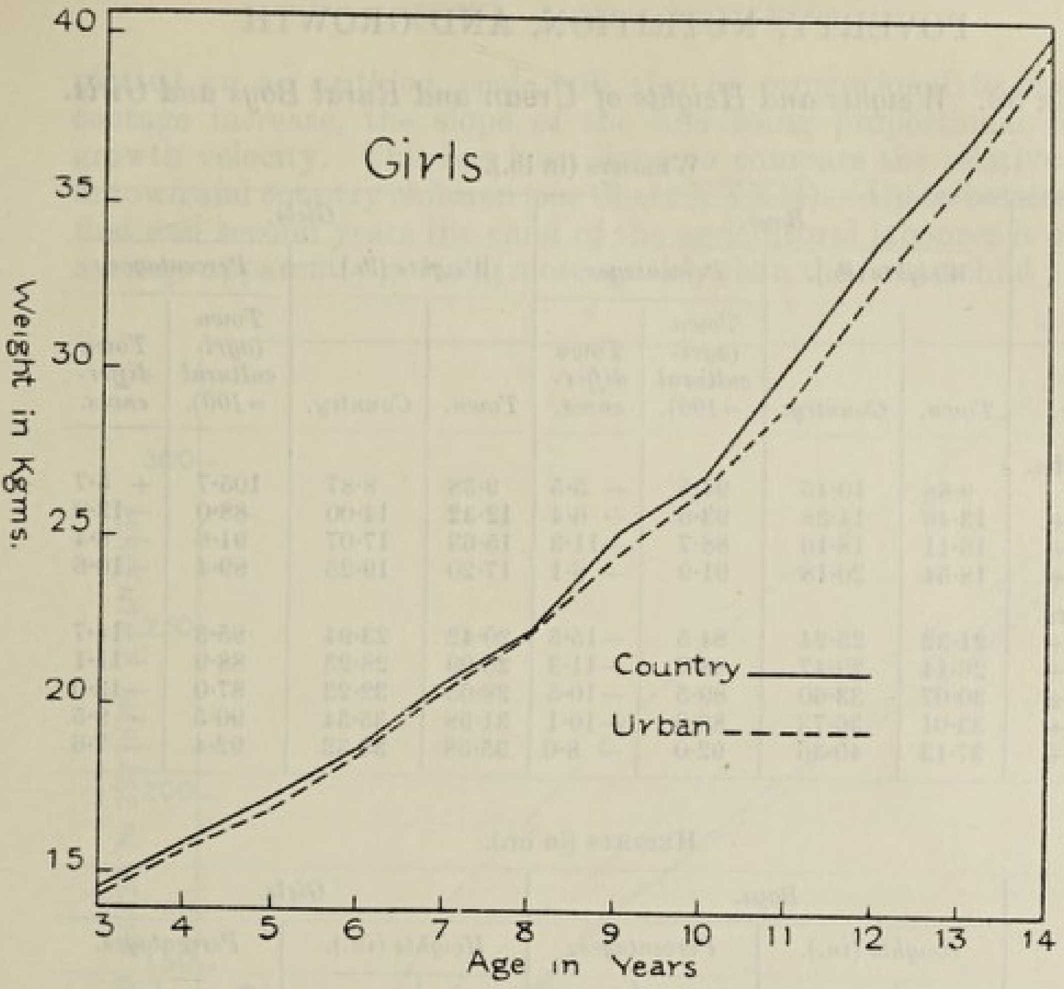


CHART XXX. Average weights of schoolgirls in urban and country education areas in England (constructed from Tuxford and Glegg's figures).

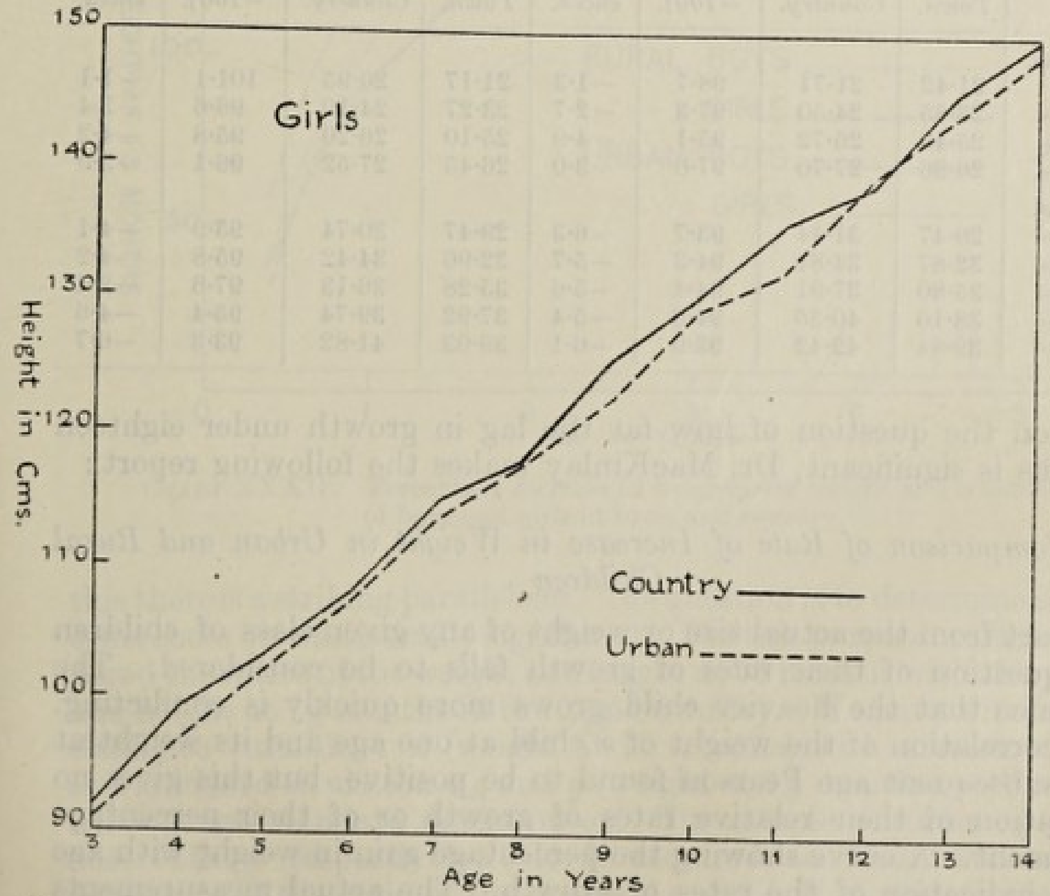


CHART XXXI. Average heights of schoolgirls in urban and country education areas in England (constructed from Tuxford and Glegg's figures).

TABLE 58. *Weights and Heights of Urban and Rural Boys and Girls.*

WEIGHTS (in lb.).

Age.	Boys. Weights (lb.). Town.	Boys. Weights (lb.). Country.	Boys. Percentages. Town (agricultural =100).	Boys. Percentages. Town differences.	Girls. Weights (lb.). Town.	Girls. Weights (lb.). Country.	Girls. Percentages. Town (agricultural =100).	Girls. Percentages. Town differences.
Months.								
−3	9·88	10·45	94·5	− 5·5	9·38	8·87	105·7	+ 5·7
3+	13·46	14·38	93·6	− 6·4	12·32	14·00	88·0	−12·0
6+	16·11	18·16	88·7	−11·3	15·63	17·07	91·6	− 8·4
9+	18·54	20·18	91·9	− 8·1	17·20	19·25	89·4	−10·6
Years.								
1+	21·32	25·24	84·5	−15·5	20·42	23·94	85·3	−14·7
2+	26·14	29·47	88·7	−11·3	25·09	28·23	88·9	−11·1
3+	30·07	33·60	89·5	−10·5	28·05	32·23	87·0	−13·0
4+	33·01	36·73	89·9	−10·1	31·98	35·34	90·5	− 9·5
5+	37·13	40·36	92·0	− 8·0	35·58	38·52	92·4	− 7·6

HEIGHTS (in in.).

Age.	Boys. Heights (in.). Town.	Boys. Heights (in.). Country.	Boys. Percentages. Town (agricultural =100).	Boys. Percentages. Town differences.	Girls. Heights (in.). Town.	Girls. Heights (in.). Country.	Girls. Percentages. Town (agricultural =100).	Girls. Percentages. Town differences.
Months.								
−3	21·42	21·71	98·7	−1·3	21·17	20·95	101·1	+1·1
3+	23·85	24·50	97·3	−2·7	23·27	24·10	96·6	−3·4
6+	25·40	26·72	95·1	−4·9	25·10	26·20	95·8	−4·2
9+	26·86	27·70	97·0	−3·0	26·45	27·52	96·1	−3·9
Years.								
1+	29·47	31·44	93·7	−6·3	29·47	30·74	95·9	−4·1
2+	32·87	34·84	94·3	−5·7	32·96	34·42	95·8	−4·2
3+	35·80	37·91	94·4	−5·6	35·28	36·13	97·6	−2·4
4+	38·16	40·35	94·6	−5·4	37·92	39·74	95·4	−4·6
5+	39·84	42·42	93·9	−6·1	39·03	41·82	93·3	−6·7

Upon the question of how far the lag in growth under eighteen months is significant, Dr. MacKinlay makes the following report:

(d) *Comparison of Rate of Increase in Weight in Urban and Rural Children*

Apart from the actual size or weight of any given class of children the question of their *rates* of growth falls to be considered. The evidence that the heavier child grows more quickly is conflicting. The correlation of the weight of a child at one age and its weight at any subsequent age Pearson found to be positive, but this gives no indication of their relative rates of growth or of their percentage increment. A curve showing the percentage gain in weight with age gives indication of the rates of growth. The actual measurements plotted on an arithlog. scale will also be proportional to the percentage increase, the slope of the line being proportional to the growth velocity. This has been done to compare the relative rates in town and country children (see Chart XXXII). Up to between the first and second years the child of the agricultural labourer is on the average apparently growing more quickly than the urban child ; after

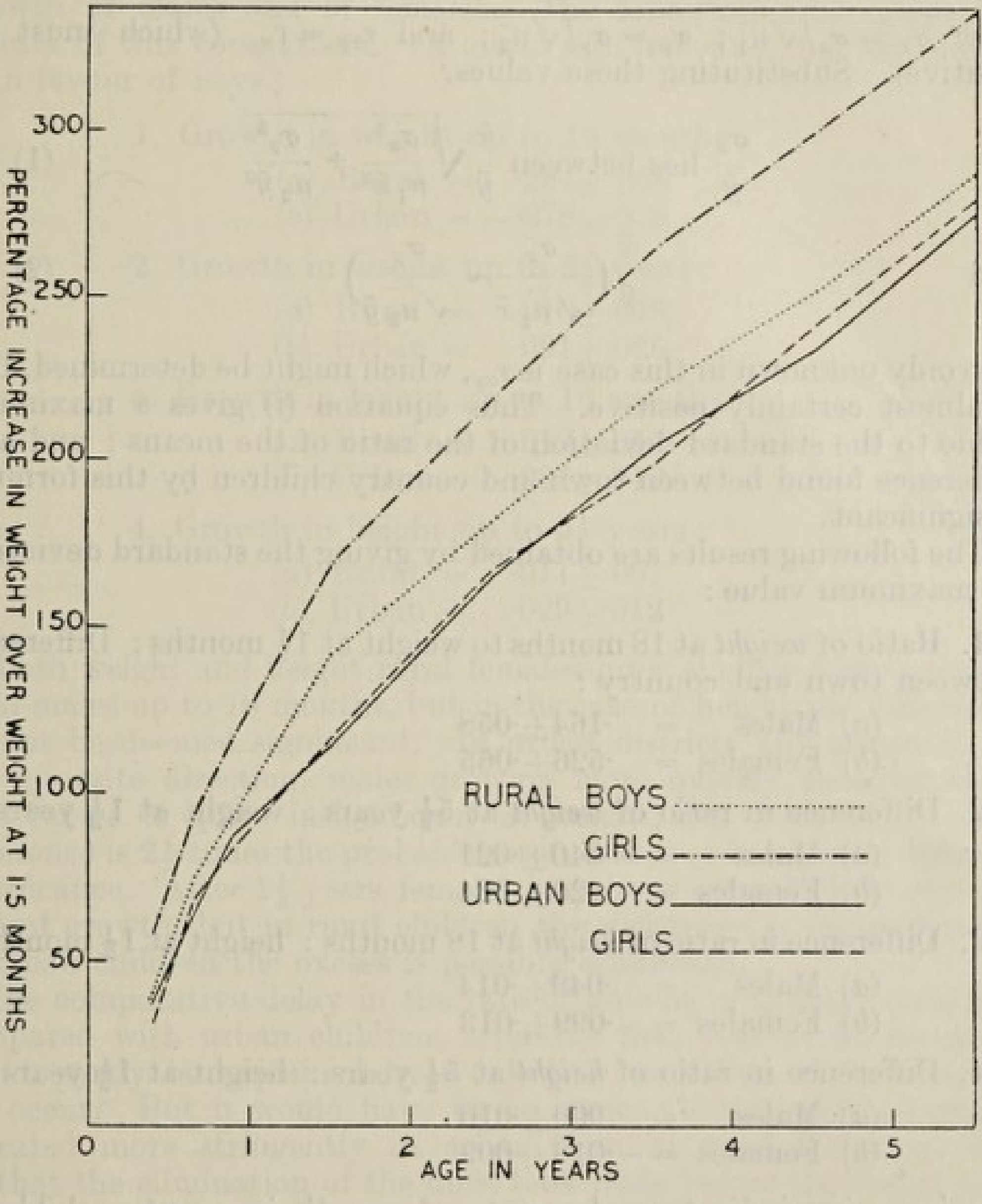


Chart XXXII. Percentage *increase* in weight over weight at 1·5 months of boys and girls in town and country.

this there is a striking parallelism. The question is to determine if these differences are statistically significant. For this purpose we have compared the ratios of the weight and height at 18 months with the weight and height at $1\frac{1}{2}$ months in town and country. We have thus in each class two variables : x (weight at 18 months) with a mean value $\bar{x}$ and standard deviation σ_x, and y (weight at $1\frac{1}{2}$ months) with a mean value $\bar{y}$ and standard deviation σ_y. The sample contains n_1 and n_2 observations respectively. It is required to find the standard deviations of the ratio of the means, i.e. $\bar{x}/\bar{y}$. If n_1 and n_2 are fairly large, and if σ_x and σ_y are not very large, the standard deviations of $\bar{x}$ and $\bar{y}$ will be small and their respective ratios to $\bar{x}$ and $\bar{y}$ will be so small that we can safely use statistical differentials to find the standard deviation of $\bar{x}/\bar{y}$, i.e. we can put

$$\frac{\sigma_{\bar{x}}}{\bar{y}} = \frac{\bar{x}}{\bar{y}}\sqrt{\frac{\sigma_{\bar{x}}^2}{\bar{x}^2} + \frac{\sigma_{\bar{y}}^2}{\bar{y}^2} - \frac{2\,\sigma_{\bar{x}}\sigma_{\bar{y}}r_{\bar{x}\bar{y}}}{\bar{x}\bar{y}}}$$

Now $\sigma_{\bar{x}} = \sigma_x/\sqrt{n_1}$; $\sigma_{\bar{y}} = \sigma_y/\sqrt{n_2}$; and $r_{\bar{x}\bar{y}} = r_{xy}$ (which must be positive). Substituting these values,

$$\frac{\sigma_{\bar{x}}}{\bar{y}} \text{ lies between } \frac{\bar{x}}{\bar{y}}\sqrt{\frac{\sigma_x^2}{n_1\bar{x}^2} + \frac{\sigma_y^2}{n_2\bar{y}^2}} \qquad (1)$$

and

$$\frac{\bar{x}}{\bar{y}}\left(\frac{\sigma_x}{\sqrt{n_1}\,\bar{x}} \sim \frac{\sigma_y}{\sqrt{n_2}\,\bar{y}}\right) \qquad (2)$$

The only unknown in this case is r_{xy}, which might be determined, but is almost certainly positive. Thus equation (i) gives a maximum value to the standard deviation of the ratio of the means ; and any difference found between town and country children by this formula is significant.

The following results are obtained by giving the standard deviation its maximum value :

1. Ratio of *weight* at 18 months to weight at $1\frac{1}{2}$ months : Difference between town and country :
   - (*a*) Males = ·164±·058
   - (*b*) Females = ·526±·065
2. Difference in ratio of *weight* at $5\frac{1}{2}$ years : weight at $1\frac{1}{2}$ years :
   - (*a*) Males = −·040±·021
   - (*b*) Females = −·120±·024
3. Difference in ratio of *height* at 18 months : height at $1\frac{1}{2}$ months :
   - (*a*) Males = ·049±·014
   - (*b*) Females = ·099±·013
4. Difference in ratio of *height* at $5\frac{1}{2}$ years : height at $1\frac{1}{2}$ years :
   - (*a*) Males = 000±·010
   - (*b*) Females = −·018±·009

A minus sign indicates a less rate of growth in country children. The country child, therefore, grows in weight and height more quickly than the urban child up to between the first and second years, the difference being much more marked in the case of girls. In the age period $1\frac{1}{2}$–$5\frac{1}{2}$ years the differences in the rates of growth so far as they may be deemed significant are in favour of the urban-bred child. Three of the four differences are negative in sign, the positive one being practically zero. With regard to growth in *weight*, in both males and females, any excess is in favour of the town child, but the significance of the difference in boys is doubtful, having regard to the size of the probable error. Urban girls have, however, a definite superiority, the difference being five times the probable error. With *height* any difference is in favour of the town female, but as the difference is just twice the probable error the significance of this excess is also doubtful. Boys show absolutely no difference with regard to growth in height at these ages.

Rate of growth in males and in females.

In a manner similar to the above we can compare the rate of growth of males and of females. The following table gives the results of this comparison. (A minus sign indicates that the excess is in favour of boys.)

1. Growth in weight up to 18 months:
   (*a*) Rural = $\cdot 284 \pm \cdot 068$
   (*b*) Urban = $-\cdot 078 \pm \cdot 055$
2. Growth in weight up to $5\frac{1}{2}$ years:
   (*a*) Rural = $\cdot 010 \pm \cdot 018$
   (*b*) Urban = $\cdot 091 \pm \cdot 026$
3. Growth in height up to 18 months:
   (*a*) Rural = $\cdot 019 \pm \cdot 014$
   (*b*) Urban = $-\cdot 031 \pm \cdot 013$
4. Growth in height up to $5\frac{1}{2}$ years:
   (*a*) Rural = $\cdot 011 \pm \cdot 007$
   (*b*) Urban = $\cdot 029 \pm \cdot 012$

In both weight and height rural females grow slightly more quickly than males up to 18 months, but in the case of height the difference cannot be deemed significant. In urban districts any excess is in the opposite direction, males growing more quickly than females. The excess is quite insignificant in weight, but with height the difference is $2\frac{1}{2}$ times the probable error, and may have some definite significance. After $1\frac{1}{2}$ years females may have some slightly greater rate of growth, but in rural children the difference is insignificant; in urban children the excess is possibly significant.

The comparative delay in the rate of growth in country children compared with urban children, after the first year or 18 months, might partly be explained by a selective mortality, if such really did occur. But it would have to be shown (1) that this selection operated more stringently in urban than in rural districts, and (2) that the elimination of the unfit took place before the end of the second year of life. Such occurrences would afford a simple explanation of the above findings, the unfit being gradually and more surely eliminated from the ranks of the town children until by the end of the second year we are left with the fittest of the town children to compare with the average of the rural population, in which more of the unfit are allowed to survive due to the relative absence of the factors influencing adversely the mortalities of infancy and childhood. The mortality rates in urban and rural districts show the great excess of infant mortality in the former; but this is in itself no evidence of selection. Epidemics, one of the chief causes of variations in mortality at this period of life, have not been shown to affect any special type of child; and it seems more probable that these strike indiscriminately at the fit and unfit during this susceptible period. Further, Dr. Snow, one of the strong adherents of that school of thought which considers the present efforts at conservation of child life an interference with natural selection, divided his districts into (*a*) certainly rural and (*b*) certainly urban, and found that there was evidence of a selective death-rate in the rural districts, but no evidence of such in urban districts. He, however, shows that the influences of selection are mainly operative in the first and second years of life.

Dr. Kerr in the Annual Report for 1905 to the Education Committee of the L.C.C. has shown that children born in years of high infantile mortality are found, when examined in subsequent years, to have poorer physique than those of an equal age born in years of low infant mortality. Yule (1909–10) concludes, in his investigation into the possibility of a selective mortality, that after the third year of life the weakening influence of the conditions which cause a high infant death-rate preponderate over any selective influence, which result, he says, is a perfectly possible one, provided that the mortality of infancy is selective only as regards the special dangers of infancy, and its influence scarcely extends beyond the second year of life, while the weakening effects of a sickly infancy is of greater duration. Snow's work also tends to show that selection does operate in the first two years of life ; but only in rural districts is his evidence very strong.

A selective death-rate, however, does not satisfy the mind as an explanation of the retarded growth in urban children. The death-rates of infancy and childhood are more dependent on environment (using the term in its broadest sense to include epidemic, meteorological variations, &c.). The explanation of the differences between the growth of these two groups of children may be that there is some unknown difference in the innate potentialities for growth, or it may be due to the greater reaction of the younger child to unfavourable external conditions. P. L. MacK.

A consideration of these facts indicates that while there is apparently some delay in rate of growth [1] *of the average town child between birth and eighteen months, after that date the growth proceeds as rapidly in the town as in the country child.*[2]

This conclusion is in accord with the observations of previous investigators on the rate of growth of children of different social classes (see p. 120 *et seq.*).

The following important question has to be faced : Is the low weight of the town child due to this retardation of growth below eighteen months, and if so, is this retardation due to environmental conditions, or is it an inherited character of a town population ?

As will be shown later we have been unable to correlate any particular environmental condition with the period of slower growth.

The efficiency of the mother, which is the variable most closely

[1] The possible association of the apparent delay in the increase of weight below the eighteenth month of life with the appearance of the next child and the decreased maternal care thus involved has not been considered in this investigation.

[2] The longer continuance of growth—as indicated by Davenport (1917)—would of course have to be considered as a possible factor in causing differences of stature in the adult of the two classes.

correlated with the size of the child, shows a definite correlation in the case of children under 1 year in Dundee. In Glasgow, on the other hand, this correlation is only observed after the age of 1 year.

The idea that the comparative slowness of increase in weight in the town infant is due to the defective supply of milk is attractive, but seems to be contradicted by the fact that the consumption of milk per man per day is even lower in the families of the rural miners, where the retardation is not manifest, than in the urban families (Charts XIV to XVII).

(e) *Possible Influence of Heredity*

The evidence that heredity plays a part in determining the lower weight of the town child has to be considered. The adult town dweller in Britain is on the average smaller than the country dweller (p. 18), and there is evidence of a correlation between the size of the child and that of the parent, as shown below.

On this subject a large amount of work has been recorded.

Francis Galton in various publications (1876–97) explained his theory of inheritance of physical traits, including that of stature. His law of inheritance is based upon the averages of a representative group of the adult population, and the result of his investigation indicates the broad *average* tendency in inheritance. He himself says, 'The neglect of individual prepotencies is justified in a law that avowedly relates to average results' (1897). Succeeding investigators have modified various factors in his statement of what is described by Pearson (1902–3 *b*) as 'Galton's great discovery of the general form of blending characters in a stable community', but the general principle laid down by him is generally accepted.

In stating his law of inheritance of stature Galton put forward two axioms of doubtful correctness, viz. (i) that from generation to generation the average height of the population is the same and has like variation, and (ii) that there is no regard of stature in marriage selection. He says 'the peculiarities of stature are that paternal and maternal contributions blend freely and that selection, whether under the aspect of marriage selection or of the survival of the fittest takes little account of it'. Later, Pearson(1902–3 *b*) from a reasonably wide range of inquiries deduced that the size of the race was not stable, the tendency being to increase in height. Davenport (1917) stated that 'very tall men tend to marry a greatly disproportionate number of very tall women (and few or no very short ones); similarly, tall men marry a disproportionate number of tall women; medium men tend to marry women of the various statures about in their proportion in the general population; short men tend to marry short women and very few tall ones. . . . In a word, persons of similar stature tend to marry each other and extremes are more particular in this respect than those of medium stature.'

In stating his law Galton uses the term 'mid-parent', by which he means the imaginary mean of two parents after the female measurement has been transmuted to the male equivalent (i.e. multiplied, in the case of stature, by 1·08), so that a mid-parent of 70 inches in height refers to a couple whose mean stature, under the above reservations, is 70 inches. It is the *mean* stature which is the main factor in the average inheritance, and it is not of importance whether it is derived from parents of approximately equal height or from one tall and one short parent. He states that in the inheritance of stature 'the influence pure and simple of the mid-parent may be taken as $\frac{1}{2}$, of the mid-grand-parent as $\frac{1}{4}$, of the mid-great-grand-parent as $\frac{1}{16}$, of an individual of the next generation as $\frac{1}{64}$, and so on. . . . It is some consolation to know that in the commoner questions of heredity the genealogy is fully known for two generations and that the average influence of the preceding ones is small.'

Still referring strictly to averages, Galton states that the height of the offspring deviates from the mean stature of the race $\frac{2}{3}$ of the height deviation of the parents. It would thus appear from this that the diminution of the deviation from the mean stature in succeeding generations would ultimately bring all the race to one uniform level, but, in opposition to such a result, he says that 'The units of the population group themselves as it were by chance into married couples whence the mid-parentages are derived and then by a regression of the values of the mid-parentages the true generants are derived. . . . Each generant is a centre whence the offspring diverge. The stability of the balance between the opposed tendencies is due to the regression being proportionate to the deviation; it acts like a spring against a weight.'

Pearson (1895) from his examination of Galton's material and also from a larger mass of data collected by himself (3,000 to 4,000 schedules of pairs of brothers or sisters) found, like Galton, that the contributions of the ancestry follow a geometrical series, although not that originally proposed by Galton. He considered that his mathematical formulae did not justify Galton's theory of a mid-parent. He (1902–3) could not accept Galton's statement that there was no selection in marriage, as regards stature, and says, 'We are forced to the conclusion that the bulk of the observed resemblances in physical characters between parents is due to a direct if unconscious selection of like by like and possibly in a contributory degree to a likeness in parents for the characters under consideration emphasizing their fertility.'

After considering the various results of his records, Pearson says (1902–3) 'there appears to be no substantial difference . . . between the inheritance of physique in man and its inheritance in other forms of life.' . . . 'The constants of parental heredity deduced from my Family Records, made on members of many English local races, are closely like results found for such selected breeds as racehorses and greyhounds.' (See Table 59.)

TABLE 59. *Parental Inheritance in Different Species.*
(Estimated after Completion of Growth.)

Species.	*Character.*	*Mean value.*	*No. of pairs used.*
Man	Stature	0·506	4,886
	Span	0·459	4,873
	Forearm	0·418	4,866
	Eye colour	0·495	4,000
Horse	Coat colour	0·522	4,350
Bassett hound	,, ,,	0·524	823
Greyhound	,, ,,	0·507	9,279

Pearson says, 'For most practical purposes we may assume that parental heredity for all species and for all characters is approximately ·5. . . . Selection for two generations should suffice to give offspring the same very nearly as the selected ancestry.'

Davenport (1917) also continued the work commenced by Galton. From a consideration of the measurements of 2,354 children whose parents were also measured he gave the following results: When both parents are tall, all the children are above the average in stature. When both parents are very short all children are short or very short. Both parents medium gives medium children. Of the mating of very short with very tall all the offspring are within an inch and a half of the average of the population. His modification of Galton's law is briefly, (i) That the very tall and the very short elements of the population tend to marry those with like statures, (ii) That the offspring resulting from the marriage of tall parents is on the average tall, but that the offspring of short parents, though approximating to the parents' height, tend on the average to regress towards the mean of the race in stature, i.e. tend on the average to be slightly taller than the parents. This supports Pearson's finding that the race is slightly increasing in stature. Davenport's hypothesis is that shortness is due to certain positive factors that inhibit growth, and that 'short' parents may, and frequently do, carry germ cells which lack the shortening factors, while in 'tall' parents the gametes are more nearly homogeneous, and all lack most of the shortening factors. In the case of giants, for instance, when both parents are tall all the children are tall.

The tendency to ascribe modifications of physical character to environmental influence rather than to heredity is criticized by Davenport (1917) in his consideration of Ripley's attempt to account for the short stature of the inhabitants of the interior cantons of Finisterre, as compared with the dwellers on the coast of that district, on the ground of the inferior food supply of the former. Davenport considers that the greater stature of the coastal dwellers is inherited.

In this connexion Davenport instances the tall inhabitants of Lexington (Kentucky) who have been popularly supposed to owe their great stature to the lime in the soil, but which he considers is in reality due to their Scottish ancestry. He points out that in Scotland Country (North Carolina), where there is no lime in the soil, the inhabitants who are equally of Scottish descent are equally tall, and says, 'This experience points strongly to the conclusion that internal constitutional factors are more important than the ordinary environmental differences.'

The persistence of racial characteristics has been interestingly shown in the report of the Medical Department of the U.S. Army in the World War (1921), where statistics relating to measurements of draft recruits in the U.S. Army showed racial differences as to height and build clearly marked in the inhabitants of the country, the Scot-American being tallest of the eight European races listed, with an average height of 67·93 in., while the Italian-American had an average height of 65·03 in. Racial variation is also shown in other measurements.

As already stated, the possibility of differences of inherited physique has to be kept constantly in view in such an investigation as the present one, where the various groups of children studied may not be strictly homogeneous racially.

J. A.

Miss Clark has taken advantage of the curious dual character of the population of Dundee in order to study the question of heredity in its relation to stature. In this city a considerable proportion of undersized men and women exist alongside those of more normal stature. She reports as follows:

Relationship of the Stature of Children to Stature of Parents in Dundee

In Dundee it was possible to obtain exact measurements of the height of quite a number of the parents, and advantage was taken of this to work out some special figures on the correlation in stature between parents and children.

Owing to there being so much unemployment in Dundee at the time of the investigation more fathers were at home than is usual and advantage of this was taken to have them measured. In a few cases, if the father were not at home at the time of the visit, measurements were taken from army cards (seen by the investigator).

The women usually work at home in heelless felt or jute slippers, so that in very few cases had any deduction to be made for heels. In the rare cases where measurements were made in boots a deduction of one inch was made. Measurements were taken to the nearest half-inch in parents and to the nearest quarter inch in children, the children being all measured without boots.

The heights of 177 fathers and 533 mothers were recorded, with the following frequency (Table 60).

This gives a mean stature for fathers of 64·819 in.±·178, with a standard deviation of 3·511 in.±·126 [1] and a range of from 57·5 in., to 72·5 in. This mean falls very far below Pearson's (1902–3 b) of 67·68 in., standard deviation 2·70, ranging from 58 in. to 76 in., but

[1] The standard deviation of stature of fathers is higher than that found by Pearson, but the explanation of this is not apparent.

TABLE 60. *Dundee. Parents' Stature. Frequency.*

Stature in inches	52·5 53·5	53·5 54·5	54·5 55·5	55·5 56·5	56·5 57·5	57·5 58·5	58·5 59·5	59·5 60·5	60·5 61·5	61·5 62·5	62·5 63·5	63·5 64·5	64·5 65·5	65·5 66·5	66·5 67·5	67·5 68·5	68·5 69·5	69·5 70·5	70·5 71·5	71·5 72·5	Total.
Observed frequency	—	—	—	—	—	3	4	14·5	12·5	20·5	18·5	13·5	16·5	20·5	6·5	10	10·5	19·5	4·5	2·5	177 fathers
Observed frequency	2	6	2	16	34	57	62·5	80	52	55	42·5	59·5	35	13·5	12	2·5	0·5	—	1	—	533 mothers

Pearson's figures were compiled from fathers of families in London, whereas the Dundee fathers are chiefly of the unskilled labouring class. Tocher (1906–7) records the heights of 141 adult male patients in the Dundee District Asylum, and his figures give a mean of 65·34 in., which approximates much more closely to the present Dundee figure.

For mothers the mean stature from the frequencies given is

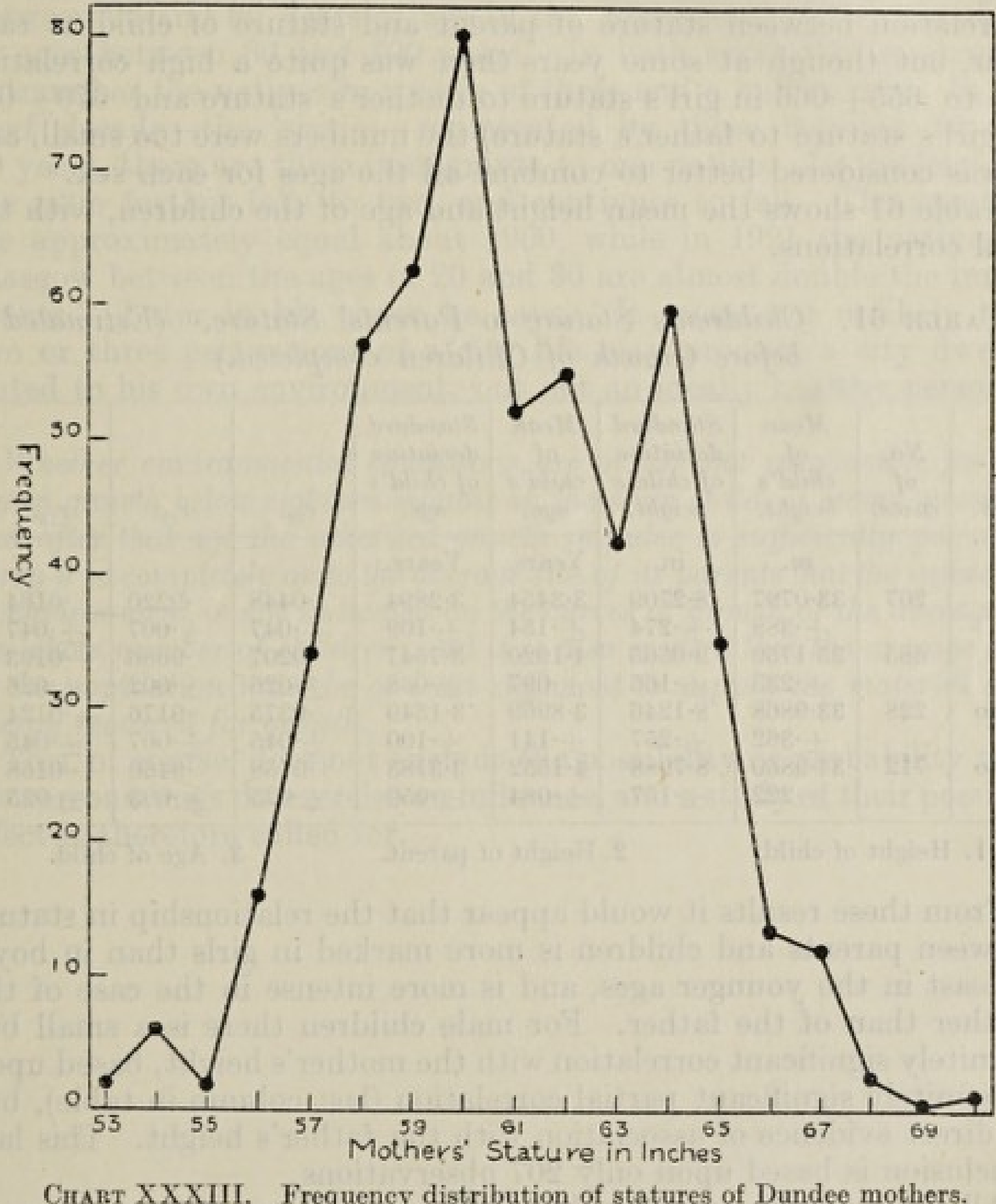


CHART XXXIII. Frequency distribution of statures of Dundee mothers. (Labouring class.)

60·939 in. ± ·086, standard deviation 2·931 in. ± ·061, with a range from 52·5 in. to 71·5 in. The mean, again, is far below that of Pearson's London mothers (Mean 62·48 in., standard deviation 2·39 in.), though the range is practically the same, but corresponds extraordinarily closely with Tocher's mean for 200 female patients of 60·925 in. Tocher (1906–7) states, 'Only pauper lunatics having been measured, the population of each asylum is a local sample of the district served by that asylum.' The Dundee District Asylum patients may therefore be taken as representative of the class from which our normal samples are drawn.

The frequency of the Dundee mothers' statures gives a rather interesting bi-modal curve with crests at 59·5–60·5 and at 62·5–64·5 in. (Chart XXXIII).

The theory that there are two distinct racial types in the working-class population of Dundee seems to receive some support from these figures.

The children measured ranged in age from two weeks to $13\frac{11}{12}$ years and were of both sexes. It was at first attempted to work out the correlation between stature of parent and stature of child at each year, but though at some years there was quite a high correlation (up to ·655±·066 in girl's stature to mother's stature and ·670±·081 in girl's stature to father's stature) the numbers were too small, and it was considered better to combine all the ages for each sex.

Table 61 shows the mean height and age of the children, with the final correlations.

TABLE 61. *Children's Stature to Parents' Stature. (Estimated before Growth of Children completed.)*

Correlation.	*No. of cases.*	*Mean of child's height.*	*Standard deviation of child's height.*	*Mean of child's age.*	*Standard deviation of child's age.*	r_{12}.	r_{13}.	r_{23}.	$r_{12\cdot3}$.
		in.	in.	Years.	Years.				
Son to father	207	33·0797 ±·388	8·2709 ±·274	3·3454 ±·154	3·2894 ±·109	·0448 ±·047	·9220 ±·007	·0164 ±·047	·0767 ±·047
Son to mother	685	35·1759 ±·233	9·0565 ±·165	4·1920 ±·097	3·7547 ±·068	·0207 ±·026	·9686 ±·002	−·0193 ±·026	·1585 ±·025
Daughter to father	228	33·9868 ±·362	8·1246 ±·257	3·8969 ±·141	3·1549 ±·100	·0375 ±·045	·9176 ±·007	−·0124 ±·045	·1230 ±·044
Daughter to mother	712	34·9860 ±·222	8·7988 ±·157	4·1552 ±·084	3·3183 ±·059	·0758 ±·025	·9460 ±·003	−·0168 ±·025	·2829 ±·023

1. Height of child. 2. Height of parent. 3. Age of child.

From these results it would appear that the relationship in stature between parents and children is more marked in girls than in boys, at least in the younger ages, and is more intense in the case of the mother than of the father. For male children there is a small but definitely significant correlation with the mother's height, based upon a definitely significant partial correlation (last column in table), but no direct evidence of association with the father's height. This last conclusion is based upon only 207 observations.

All these results are very definitely below those of Pearson upon *adults*, which average ·505 for the four cases, on over 1,000 observations in each case. The explanation may be offered that in earlier years factors other than heredity affect the growth of children of both sexes, and that the effect of heredity on stature cannot be gauged till after the maximum growth period has been passed. M. L. C.

The conclusion seems inevitable that inheritance of stature is at least one factor in determining the height and weight of the child. May it be that the smaller town race is really an adaptation to environment? It is possible that the small machine-tending male, and the small, not too prolific female, requiring little food and little exercise, are better suited to urban surroundings than the big brawny man and the large prolific woman whose energies are more appropriately employed in rural surroundings. Brownlee (1925 *a*) gives evidence that the population of Glasgow is becoming more and more town-bred. Referring to a table prepared by Dr. Dunlop, Registrar-General for Scotland, Brownlee says, ' The relative proportions of natives and immigrants can, however, be seen roughly, without any correction. The survivors of the persons who were between 20 and 30 years of age in the 'fifties and 'sixties are those at ages between 80 and 100 years. In both sexes the immigrants outnumber the natives in a ratio of three and a half to one. In the next decade—the 'sixties—represented by those between 70 and 80 years, there are three immigrants to one native. In the 'eighties the ratio further falls to two, and continues to fall. The numbers are approximately equal about 1900, while in 1921 the natives of Glasgow between the ages of 20 and 30 are almost double the immigrants.' Later in his paper he says, ' It seems not unlikely that two or three generations of a city life may produce a city dweller suited to his own environment, but not an ideally healthy person.'

Whether environmental conditions are or are not responsible for the lag in growth below eighteen months in the slum child, it seems manifest that after that age the inherited growth impulse is sufficiently potent to carry it so completely on to the average size of its parents that the influence of environment is not indicated on the curves of growth of the average of the whole number of children, and it is also evident that the average diet of the population must be at least sufficient to supply the material and energy required for growth.

This, of course, does not exclude the possibility or probability that the surroundings do exercise an influence, and a study of their possible effect is therefore called for.

PART III. A PRELIMINARY CONSIDERATION OF SOME OF THE FACTORS GENERALLY SUPPOSED TO INFLUENCE THE NUTRITION AND GROWTH OF CHILDREN

As indicated in the introduction, the nutrition and growth of the slum child is generally considered to be determined by, or at least affected by, the conditions under which it lives. These conditions may, for convenience, be divided into environmental and parental, although these are undoubtedly interdependent and react on one another. In the former are included poverty and overcrowding as indicated by the income available per member of the family, the air-space available per person, the size of the family, and the food supply. In the latter are included the condition of the parents and more especially of the mother.

Before proceeding to submit the evidence which has been collected, it may be well to indicate some of the difficulties of assessing its significance.

The investigation of the possible influence of environment is really the investigation of a form of stimulation by external conditions that may produce a change. Now, it is well known that any change in external conditions may modify living matter differently, according to the velocity of the change and according to its range. A change which occurs rapidly may lead to increased activity or death, while if it occurs more slowly it may lead to adaptation, so that the processes of life go on much as before, or merely modified to suit the altered conditions. Thus environmental changes which, if rapidly produced, might lead to catastrophic effects upon a population, if sufficiently slowly developed may merely lead to adjustment and adaptation.

The range of stimulus may be effective only within certain limits. This is illustrated by Weber's law of the relationship of sensation to stimulus. Within a certain range, the sensation varies with the stimulus ; below and above this range the proportionate correspondence does not occur. Brownlee (1925) has pointed out the danger of ignoring this in statistical investigations of the influence of environmental conditions. It may be that as regards such factors as food and income there is a point below which a further decrement produces no further decrease in the nutrition, as there certainly is a point above which an increment is not responded to by any increase in nutrition. The question then arises, Are we in our investigation of various environmental differences working in the region of effective stimuli ? This has in each case been considered by us.

In tracing cause and effect it is a truism to say that to establish a correlation between two variables is not to prove the directness of the relationship between them, for each of the variables may be correlated with others, and to prove the validity of direct correlation the influence of these others has to be excluded by the investigation of partial correlation. But when this is done the statistical method does no more than establish that the correlation exists, and the determination of which of either of the two variables is causal has yet to be considered and investigated, when possible, by the experimental method of eliminating each in turn. Unfortunately, in such social studies this is generally impossible.

PART IV. INCOME AND HOME CONDITIONS

CONTENTS

(1) INCOME

THAT the small size and weight of the slum child is the result of poverty has been very generally maintained. Much has been said and written about a living wage, but no one has succeeded in defining what this should be.

The work of previous investigators has amply proved that, generally speaking, the children of the well-to-do urban dwellers are, age for age, bigger and heavier than those of the very poor. But this is a comparison between two social classes which differ from one another, not only in the size of their income but in many other conditions of life. It does not touch the question which is at present under consideration—whether in the poorer classes there is any difference between the children of families with comparatively low and of those with comparatively high incomes, and whether there is any evidence that a moderate increase of income, such as is economically feasible, would ensure the better growth of the child.

The experience of workers among the poor has taught that an increase of income does not generally mean better housing and better feeding, although it may mean the expenditure of more money on food, nor does it always mean better care of the children.

(i) Previous Work

(a) Mortality Rates and Social Status.

Although the present investigation is not directly concerned with the question of child mortality, some evidence of the higher rate in the poorer urban classes may be referred to.

Stevenson (1923), in his study of the social distribution of mortality from different causes in England and Wales in 1910 to 1912, shows very definite differences between the mortality rate of the better, as contrasted with that of the poorer classes, the difference being in favour of the well-to-do.

Stevenson further shows a close relationship between social status and the rate of infant mortality. In the table which follows, Class I is of the highest social grade and the social status steadily decreases to Class V, which is the lowest.

Table 62. *Infantile Mortality Rates in different Social Classes* (Stevenson).

	Infantile mortality rate (1911).
Class I (highest social class)	76·4
Class II	106·4
Class III	112·7
Class IV	121·5
Class V (lowest social class)	152·5

Much evidence of a similar nature can be adduced, but it is proposed to give briefly only such further figures as relate to the three urban centres in which the present investigation was conducted. In Glasgow, Russell (1888–9) found that the mortality rate of persons living in one- and two-roomed houses was nearly three times as great as that of persons living in houses of five rooms and over. His figures are as follow:

Type of house.	*Mortality rate (Glasgow, 1885).*
1 and 2 rooms	27·74
3 and 4 rooms	19·45
5 rooms and over	11·23

He also pointed out the excessive mortality of young children among the poorer classes—the rate for nervous diseases and diseases of nutrition being per 100,000:

Type of house.	*Mortality rate: nervous and nutritional diseases.*
In 1 and 2 rooms	480
In 3 and 4 rooms	235
In 5 rooms and over	91

In Edinburgh the social position of the households was decided according to the rental of the houses and the death-rates calculated. It was found that the general death-rate was greatly increased after the rental fell below £15 per annum.

In Dundee, Carnelly, Haldane, and Anderson (1887) gave an analysis of the death-rates in that town, grouping the cases according to whether they lived in one-, two-, three-, or four-roomed houses. Their published results are of special interest as showing a very strongly marked relationship between the death-rate of children under five years and the type of house. The following figures have been extracted from their elaborate tables:

Table 63. *Mortality Rates in Houses of different Size* (Carnelly *et al.*).

	No. of cases.	*Type of house.* 4 *rooms.*	3 *rooms.*	2 *rooms.*	1 *room.*
Average number of persons per room	60	1·3	—	3·4	6·6
Space per person (cubic feet)	60	1833	—	249	212
General death-rate (per 1,000)	3,119	12·3	17·2	18·8	21·4
Death-rate under 5 years	1,347	3·3	5·8	9·8	12·3
Death-rate of all over 5 years	1,772	9·0	11·4	9·0	9·1
Mean age of all who died	3,119	40	30·6	21·3	20·9
Mean age of all who died under 5 years	1,347	1·4	1·2	1·1	0·9
Death-rate per 100,000 from diarrhoea, acute bronchitis, broncho-pneumonia, and meningitis (chiefly children)	—	19·6	27·6	39·7	59·8

The writers say: 'As we pass from 4-roomed and upwards to 3-, 2-, and 1-roomed houses . . . there is . . . increase in the death-rate, together with a marked lowering of the mean age at death.' They conclude that 'the rapid increase in the death-rate, as we pass from 4- to 1-roomed houses, is by far the most marked in children under 5; that the death-rate among these young children in 1-roomed houses is nearly four times as great as in 4-roomed houses, whereas the general death-rate is not quite twice as great; further, that although there is still a marked increase in the death-rate for all above five years of age in the smaller houses, yet this increase is comparatively small. . . . The mean age at death in the better-class houses is almost twice as great as in the 1-roomed houses. Persons living in 1-roomed houses have therefore the chance at birth of living only one-half as long as those in better-class houses, or they die nearly 20 years sooner, on the average, than those of the better class.'

(*b*) **Size of Child and Income.**

It may be taken as proved that with decrease of social status—a status fundamentally based on the financial circumstances of the family—there is increase in the struggle to survive, especially among the very young; and the effect of this increased struggle among the poorer of the population, shown so clearly in the mortality rates just quoted, might be expected to be shown in the condition of the children.

In the present investigation, the income per person is taken as the criterion of the financial environment of the child, and, so far as can be ascertained, little work has been done in which this very direct estimate of the family finances is used. We are able to cite only two previous investigations in which the actual income has been used as an index of financial position.

Child at Birth. As regards the child at birth and the relationship of its physical condition to the poverty or otherwise of the family, Bruce Murray (1924), using material obtained at St. Thomas's Hospital, London, arranged the new-born infants of primiparae of the hospital class into three groups:

(*a*) Those with incomes above the average.
(*b*) Those with incomes below the average.
(*c*) Those who were in extremely poor circumstances.

The years studied by the author were 1914, 1915, and 1918, and the average incomes for the three years are given as follow:

Class A (1914)	Income per person per week =	9/9
,, (1915)	,, ,, ,, ,, ,, =	13/3
,, (1918)	,, ,, ,, ,, ,, =	19/4
Class B (1914)	,, ,, ,, ,, ,, =	5/8½
,, (1915)	,, ,, ,, ,, ,, =	6/7
,, (1918)	,, ,, ,, ,, ,, =	11/2½

Class C had incomes so indefinite and irregular that it was not possible to estimate them, but they were definitely below the level of Class B incomes.

She compared the infants' heights and weights with those of infants of mothers in Private Homes who were in better circumstances than the three classes mentioned (see Table 64 below).

TABLE 64. *Average Birth Heights and Weights of Infants in Private Cases and in three Hospital Classes, grouped in Descending Value of Income* (Bruce Murray).

	Average weight (lb.).		*Average height (in.).*	
Class.	*Boys.*	*Girls.*	*Boys.*	*Girls.*
Private Homes	7·57±·074	7·24±·050	20·93±·111	20·55±·085
Class A	7·33±·044	7·07±·048	20·38±·040	20·02±·039
Class B	7·27±·046	6·97±·044	20·20±·034	19·89±·038
Class C	7·22±·107	6·96±·112	20·18±·081	19·90±·107

The author in discussing her findings says: 'It will be seen that they' (the Private-Home cases) 'show an average birth weight of 0·2 lb., or three ounces, heavier than Class A, or the best endowed hospital group. This difference when tested just seems to satisfy the criterion of significance. There is an increase of length of 0·52 inch, which is also significant.' The author, however, in spite of these significant differences, concludes: 'We are not . . . prepared on the present data from Private Homes to contradict the evidence of the hospital data which supports the idea that the normal average weight and height are fully maintained despite varying maternal circumstances.'

Child after Birth. In 1913 Pooler (1913) published the results of a study of the infants of working-class parents in Birmingham. The infants, under one year, were grouped according to the income of the household, and the average weight in each group is shown in Table 65.

TABLE 65. *Weights of Birmingham Infants* (Pooler).

Average income per head, less rent.	*Age.*									
	3 weeks.		13 weeks.		26 weeks.		39 weeks.		52 weeks.	
	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
1/7	8	1	10	9	12	1½	15	11½	17	1
2/11½	8	3	10	10	13	14	15	12½	17	8
4/11½	7	15½	11	1½	14	3	16	11	18	11

These results seem to indicate a direct relationship between the rate of family income and the weight of the infant at 13 weeks and over.

In the large mass of work available on the differences of the size of children of the poor as compared with the well-to-do part of the population, social status is generally accepted as the criterion of the financial condition of the families studied.

(*c*) Size of Child and Social Status.

Child at Birth. Goldfeld (1912) in 1912 gave data for the height and weight of new-born infants classified under 17 different headings according to the occupation of the father. He found that the children of teachers were largest and those of day labourers smallest.

Child after Birth. The work done on the relation of social class and the development and growth of children after birth is very largely concerned with the school child. Only a few observers give data for children during the early years of life, and these generally deal with the years three and onwards. This is the more to be regretted, in view of the marked increase of the death-rate with decrease of social status among children under five years of age, already referred to.

Almost without exception, previous workers have found that with improvement of social conditions there is superiority both in height and in weight. If, however, we except Karn and Pearson's (1922) recent work on the data provided by a baby clinic in a large manufacturing town, none of the observers has gone beyond the compilation of data showing the broad general differences in height and weight between children of the different social grades. They have made no systematic attempt, so far as we can discover, to analyse the various factors within the changing social grades affecting the development of the children.

In 1829 Villermé (1829), quoted by Burk (1898), stated that stature is greater and the growth sooner completed, all other things being equal, in proportion as the country is richer and the comforts of the inhabitants more general.

In 1833 Stanway (1833) gave data regarding the heights and weights of boys and girls aged 13–14 years of the factory and non-factory working classes. In the following table, extracted from the Report of the British Anthropometric Committee, 1880, p. 147, his figures are compared with those of other investigators among children of similar classes.

TABLE 66. *Heights and Weights of Boys and Girls aged* 13–14. (*British Anthropometric Committee, after Stanway.*)

Date of observation.		*Heights.*		*Weights.*	
		Boys. in.	*Girls.* in.	*Boys.* lb.	*Girls.* lb.
1833	Factory children (Stanway)	54·48	55·64	72·11	72·25
1833	Non-factory children (Stanway)	54·98	55·07	75·36	72·72
1871–3	Factory children (Ferguson)	—	—	68·72	70·25
1873	Non-factory children (Roberts)	55·21	56·08	76·48	77·58

The heights and weights of the boys at Marlborough Public School (British Anthropometric Committee's Report) show an average height 4·22 in. greater and an average weight 20·19 lb. heavier than that of these factory boys.

In 1863 Boudin (1863), quoted by Burk (1898), without giving figures however, states that stature is to a great extent 'independent of comfort and misery and is, on the contrary, closely connected with race'.

In 1875–6 Pagliani (1876) compared the weights of girls in a private school near Turin, Italy, with those of charity girls in the city. At 15 years the charity girls were 37·1 kilos in weight and the private-school girls 45·6 kilos in weight. The height also of the private-school girls was greater than that of the charity girls.

In 1878 Kotelmann (1879), quoted by MacDonald (1897–8), measured students in Hamburg and found that those of the *Gymnasien* exceeded those of the lower schools in height and in weight.

In 1878 Roberts (1878) gave data grouped into eight different classes:

(i) Professional classes and merchants.
(ii) Clerks and shopkeepers.
(iii) Labouring class—selected.
(iv) ,, ,, —outdoor, country.
(v) ,, ,, —outdoor, sea-faring.
(vi) ,, ,, —underground.
(vii) Industrial class—indoor, towns, artisans.
(viii) ,, ,, —indoor, towns, factory workers, sedentary trades.

His data include heights of males and females from 5 years to 50 years. The heights of the various classes decrease steadily from class (i) to class (viii), the mean of 2 in. of difference being observed between the most favoured class and the industrial classes.

In 1875 and 1879 Bowditch (1875, 1879), in examining the relative importance of the mode of life and of race in determining the size of growing children, arranged his data on height and weight of American school children according to the occupation of the parents into Professional, Mercantile, Skilled Labour, and Unskilled Labour groups, giving heights and weights for all ages from 5 to 18. He found that almost always the children of the non-labouring classes were both taller and heavier than those of the labouring classes, though less markedly so than in English records. After considering the effect of racial differences among the children examined, he remarks: 'It will probably be safe to conclude that the importance of the mode of life as a factor in determining the size of growing children in this community is at least equal to, and possibly even greater than, that of race.'

From 1880 to 1883 the Anthropometric Committee of the British Association (1880, 1881, 1883) published in the reports of the British Association the results of a wide survey of the stature and weight of the inhabitants of the British Isles. Along with much valuable data they give a table showing the relative statures of boys of the age of 11–12 years grouped according to the type of school attended and the grade of occupation followed by the father, and also whether they had been reared in town or country. This table shows a steady decrease of the mean height of the boys with that of their social position, ranging from a mean of 55 in. in the case of the country boys at public schools to a mean of 50 in. in the case of boys in industrial schools. The data as to the stature of adults grouped into five social classes show a difference of 3½ in. between the mean of the most favoured class and that of the poorest town class.

In 1882 Hertel (1882) published figures comparing the growth of boys and girls in the *Gymnasien* and in the *Real-* and *Bürgerschulen*, at the ages of 11, 12, 13, and 14 years. His results show the superiority in both height and weight of the more favoured classes.

In 1885 Key (1885), in dealing with data from 15,000 boys and 3,000 girls, compares children attending the preparatory and middle schools with those of the *Volksschulen*, the former representing the more favoured classes, the latter the poorer classes. The difference in favour of the better class children, indicated by a plus sign, is given in the following table. (A minus sign indicates a difference in favour of the poorer class.)

TABLE 67. *Showing difference in Height and Weight in Better Class and Poor Class Children* (Key).

				Height (cm.).					
Age	7	8	9	10	11	12	13	14	15
Boys	+4	+4	+6	+4	+2	+3	+2	+5	+4
Girls	−1	+2	+2	+2	+3	+3	+2	+2	+3
				Weight (kilos).					
Age	7	8	9	10	11	12	13	14	15
Boys	+0·3	+0·4	+3·0	+1·6	−1·4	+1·5	+1·6	+5·3	—
Girls	−0·6	+1·8	+1·4	+1·4	+1·4	+2·0	+1·9	+3·5	+2·9

In 1888 Landsberger (1888) found the children of the well-to-do taller than poor children. He gives the following figures from the heights of children whom he measured yearly:

TABLE 68. *Heights of Well-to-do and of Poor Children* (Landsberger).

Year of study.	*No. of cases.*	*Well-to-do children. Heights (cm.).*	*No. of cases.*	*Poor children. Heights (cm.).*
1880	22	108·9	58	106·1
1881	20	114·5	53	111·4
1882	12	119·6	47	116·7

In 1892 Geisler (1892), quoted by Burk (1898), grouped data regarding 1,386 boys and 1,420 girls according to the school attended—at one school the children paid 18 marks, and at the other they paid 9 marks. He summarizes his findings as follows: 'The differences in height for boys of similar ages vary in favour of the richer class from 0·7 to 4·0 centimetres, and in weight between 1·3 and 4·7 pounds (German); with girls from 1·7 to 4·1 centimetres in height, and in weight between 1·6 and 4·6 pounds (German).'

In 1888 Erismann (1888), using data collected by Michailoff (1887), compared the physical development of children in the city school of Moscow, in village schools, and in factories. He found the height of the boys in the Moscow schools was superior to that of the factory boys by the following amounts (in centimetres).

TABLE 69. *Amount in cm. by which Heights of School Boys exceeded those of Factory Boys* (Erismann).

Age .	9	10	11	12	13	14	15	16	17 years
Boys .	0·4	4·6	5·7	5·7	7·7	9	9·7	8·7	5·4 cm.

He found, however, that the factory girls were generally taller than the school girls till the age of 14 years.

In 1888 Stephenson (1888) published a report based on the results of Bowditch and the British Anthropometric Committee, in which he gave the heights and weights of males from 10 to 30 years, grouped into labouring and non-labouring classes. The non-labouring classes were 2·5 in. taller and 1 lb. heavier than the labouring classes at 10 years of age, and 2·5 in. taller and 14 lb. heavier at 30 years of age.

In 1897–8 Macdonald (1897–8) found that, in America, children of parents of the non-labouring class were superior in height, sitting height, and weight to those of children whose parents were of the labouring class. The following table gives his results as to the older and younger children which he studied:

TABLE 70. *Heights and Weights of Children of Non-labouring and Labouring Classes* (Macdonald).

Class.	*Age.*	*Height.* in.	*Sitting height.* in.	*Weight.* lb.
Non-labouring .	5 y. 8 m. to 6 y. 6 m.	45·01	25·06	46·50
Labouring . .	,, ,,	44·12	24·40	44·30
Non-labouring .	16 y. 7 m. to 17 y. 6 m.	67·21	34·74	128·38
Labouring . .	,, ,,	65·87	33·83	119·33

In 1899 Hrdlicka (1899), quoted by Montessori (1913), compares the stature of poor children in orphan asylums and children in the Boston public schools. His general results are given in the tables which follow:

TABLE 71. *Heights of Boys and Girls in Schools and Orphan Asylums* (Hrdlicka).

	Stature of boys (cm.).			*Stature of girls (cm.).*	
Age.	*Asylum orphans.*	*Boston public schools.*	*Age.*	*Asylum orphans.*	*Boston public schools.*
5	97·1	106·0	5	—	105·2
6	108·8	112·0	6	—	110·9
7	117·2	117·6	7	110·1	116·7
8	116·3	122·3	8	115·8	122·1
9	123·4	127·2	9	120·4	126·0
10	126·1	132·6	10	128·9	131·5
11	131·5	137·2	11	129·0	136·6
12	136·7	141·7	12	—	145·2
13	142·4	147·7	13	—	149·2
14	145·2	155·1	14	139·8	153·2
15	151·8	159·9	15	—	155·9
16	—	166·5	16	—	156·7

In 1901 Schmidt Monnard (1901) compared the height and weight of boys and girls, aged six years, in different classes. His results are as follow:

TABLE 72. *Heights and Weights of Boys and Girls of two Social Classes* (Schmidt Monnard).

	Boys (aged 6).		*Girls (aged 6).*	
	Height. cm.	*Weight.* kilos.	*Height.* cm.	*Weight.* kilos.
Children of labourers . .	105·4	17·38	105·4	17·31
Children of clerks and artisans	110·0	18·4	110·8	18·5

In 1902 Pfitzner (1902) stated that he found stature to increase with improvement in social class. He gives the following figures grouped in three classes—Class A = poorer class, Class B = middle class, Class C = better class:

TABLE 73. *Heights in three Social Classes (Pfitzner).*

	Class A.	*Class B.*	*Class C.*
Height (males) (in cm.) . .	166·1	166·2	168·2
Height (females) (in cm.) .	155·4	155·5	157·5

In 1904 Rietz (1904) compared the heights and weights of boys and girls attending the *Gymnasien* and *höhere Mädchenschulen* and *Gemeindeschulen* in Berlin, and found that the children of the well-to-do were taller and heavier than those of the poor. He also compares the results of investigators of the effects of social conditions in other countries. His collected material is interesting. An examination of it, however, seems to indicate that variations may be due to racial rather than environmental conditions. For instance, the *well-to-do* Italian girl of eight years of age is 120·2 cm. in height and 22·8 kilos in weight, while the *poor class* Boston girl, presumably in poor circumstances, of the same age is rather heavier and taller than the Italian, showing as she does a height of 120·6 cm. and a weight of 23·5 kilos.

In 1903 Niceforo (1903) gave figures showing a greater stature among children of the rich as compared with that of the poor. His results are as follow:

TABLE 74. *Heights of Children* (Niceforo).

	Stature (cm.).	
Age.	*Rich.*	*Poor.*
7	120	116
8	126	122
9	129	123
10	134	128
11	135	134
12	140	138
13	144	140
14	150	146

In 1908 Camerer (1908) grouped his data regarding heights of children according to whether the children attended (*a*) Public Schools or (*b*) Private Schools. He found that the children attending private schools, i. e. children having better-class parents, were at six years 4 cm. and at 14 years 13 cm. taller than the children attending public schools.

In 1908–9 Macgregor (1908–9) published the results of a comparison of the heights and weights of Glasgow children in the wards of the Belvidere Fever Hospital, Glasgow, grouping them into (*a*) Scarlet Fever Cases, (*b*) Measles Cases, and (*c*) Whooping-cough Cases. As about 90 per cent. of the scarlet fever cases in the city were treated at the hospital, it is reasonable to suppose that the children in the scarlet fever wards are fairly typical of the children of the city as a whole. Of the children in the measles and whooping-cough wards, 95·5 per cent. and 93·4 per cent., respectively, came from homes of one and two apartments. The measles group had a larger proportion of two-roomed homes than had the whooping-cough group. The three groups may, with good reason, be taken to represent different classes of the community. An examination of the heights of both boys and girls shows a relationship with the social conditions. Both boys and girls in the scarlet fever group are, on the whole, taller than the children in the measles and whooping-cough groups. The latter two groups approximate, but the advantage is with the measles group.

Table 75. *Statures of Boys and Girls* (Macgregor).

		Scarlet fever cases.		*Measles cases.*		*Whooping-cough cases.*	
Age.	*Sex.*	*No. exam-ined.*	*Height.* in.	*No. exam-ined.*	*Height.* in.	*No. exam-ined.*	*Height.* in.
2–3	M	17	34·0	42	30·2	37	30·7
	F	15	33·6	39	29·9	37	30·1
3–4	M	34	35·5	48	33·3	29	31·9
	F	34	35·2	46	32·5	43	31·9
4–5	M	36	37·7	46	36·8	37	36·3
	F	46	36·7	31	35·5	28	34·5
5–6	M	30	38·5	45	38·8	23	37·4
	F	36	40·0	32	38·2	26	39·0
6–7	M	42	41·1	40	41·1	24	38·8
	F	47	42·2	25	40·3	22	41·2
7–8	M	28	42·8	22	43·5	—	—
	F	31	45·2	15	42·2	—	—
8–9	M	20	45·9	—	—	—	—
	F	39	46·4	—	—	—	—
9–10	M	15	47·4	—	—	—	—
	F	21	48·4	—	—	—	—

In 1911 Weissenberg (1911) contrasted the development of the poorer, middle, and wealthy class child. His results are summarized in the following table:

Table 76. *Height and Weight of Children of three Social Grades* (Weissenberg).

	Height in cm.				*Weight in kilos.*		
Age.	*Poor class.*	*Middle class.*	*Wealthy class.*	*Age.*	*Poor class.*	*Middle class.*	*Wealthy class.*
10	124·2	124·7	125·6	10	25·95	25·69	25·25
11	125·9	128·0	131·5	11	26·99	27·29	27·28
12	130·8	134·5	137·8	12	29·03	30·75	31·97
13	133·3	137·7	140·4	13	32·23	33·34	34·74

In 1913 Young (1913) found the children of the rich in America to be taller and heavier and to have greater lung capacity than those of the poor.

Freeman (1914) compared the children seen by him in private practice in America with children in an institution run upon good lines and with children attending school. He found that the private-practice children were tallest and heaviest, the institution children next, and the school children shortest and lightest. He and Macdonald and Hrdlicka give results indicating that the difference in weight and in height between the classes increases with age. The results of Macgregor, Niceforo, and Elderton, on the other hand, tend to show a similar rate of growth.

In 1914 Elderton (1914) divided the children attending elementary schools in Glasgow into four groups:

A. Those attending schools in poorest districts.
B. Those attending schools in poor districts.
C. Those attending schools in better-class districts.
D. Those attending schools in districts of still better class.

She gives a series of elaborate tables of the heights and weights of boys and girls in each of the four groups. They show in nearly every instance an increase from A to D in both height and weight.

The following table shows the difference in average height and in average weight between Class A and Class D in the youngest and oldest age-groups of these Glasgow children:

TABLE 77. *Heights and Weights of Glasgow Children* (Elderton).

Sex.	Age (years).	Weight (lb.). Class A.	Weight (lb.). Class D.	Height (in.). Class A.	Height (in.). Class D.
Boys	5·5 to 6·5	40·9	43·3	41·3	43·0
,,	13·5 to 14·5	75·6	83·2	55·2	57·7
Girls	5·5 to 6·5	39·9	41·8	41·0	42·7
,,	13·5 to 14·5	76·8	89·0	55·8	58·7

In 1914 Dikanski (1914) published the results of a study of 1,843 girls of six years and seven years of age in Munich. These girls he divided into three classes: (*a*) Well-to-do, (*b*) Middle Class, and (*c*) Working Class. He found that the well-to-do group were taller and heavier than the working-class group by the amounts shown in the following table:

TABLE 78. *Range of Average Variation in Height and Weight of Girls of Two Social Classes* (Dikanski).

	6-year-old girls.	7-year-old girls.
Height	3·7 cm. = 3·42 % taller	3·3 cm. = 2·93 % taller
Weight	1·3 kilos = 7·18 % heavier	1·1 kilos = 5·67 % heavier

The average height and weight for the two ages—six and seven years—and for the three social classes are as follow:

TABLE 79. *Weight and Height of Girls of Three Social Classes* (Dikanski).

Class.	Weight (kilos). 6-year girls.	Weight (kilos). 7-year girls.	Height (cm.). 6-year girls.	Height (cm.). 7-year girls.
a	19·42	20·52	111·8	115·7
b	18·7	19·3	110·1	113·2
c	18·15	19·39	108·1	112·5

Baldwin (1921), referring to this study, says: 'From the averages alone one would conclude that better social environment is correlated with better physical growth. Since the variations about the mean are greater with rising social class, this conclusion becomes less significant.'

In 1916 Brailsford Robertson (1916) examined 50 American children of eight years of age in each sex and in three social groups. His results are as follow:

TABLE 80. *Height and Weight of Eight-year-old Children* (Brailsford Robertson).

	Type of school attended.	Weight. (lb.).	Variability (per cent.).	Height (in.).	Variability (per cent.).
Boys	Residential district	59·6	14·2	50·8	4·2
,,	Average district	55·4	13·5	50·3	4·8
,,	Factory district	53·3	10·3	48·3	5·1
Girls	Residential district	58·0	12·1	50·8	4·1
,,	Average district	53·5	13·4	49·8	4·1
,,	Factory district	51·7	11·7	48·5	4·5

He states that among children of eight years of age it is found that, as the unfavourable character of the environment increases with lack of medical care, there is a parallel decrease of weight and height, and that this is accompanied by a decrease in the variability of weight and an increase in the variability of height.

Pfaundler in 1916 (1916) grouped his data of German children into (*a*) *Höherer Stand*, (*b*) *Mittlerer Stand*, and (*c*) *Arbeiter-Stand*, and gave graphs showing that the well-to-do are better developed than the poorer groups—the middle-class children taking an intermediate place.

In 1917 Schlesinger (1917) published data on boys' heights and weights. He shows in tables and graphs that the children of poor families are under-developed in weight and in height as compared with families more favourably situated.

In 1921 Baldwin (1921) found that the heights and weights of children of the well-to-do were relatively very high. In the same year Benedict and Talbot (1921) pointed out the superiority in both height and weight of private-school children, as compared with the average school child, and said, ' They (i. e. the private-school children) are taller for the same age and heavier for the same age. When, however, we compare the height to weight irrespective of age we find that our laboratory (poorer class) children of both sexes are slightly heavier for the same height than are our private-school children. . . . The striking superiority in height to age and weight to age of our private-school children is in part at the sacrifice of what is commonly considered the most advantageous relationship between height and weight.'

In 1922 Oettinger (1922) found, in Breslau and Charlottenburg, that the boys attending the *höhere* schools were taller and heavier than those attending the *Volks-* and *Fortbildungsschulen*.

In Leipzig during the years 1918–22 a large series of studies, comprising 604,000 observations, and published in *Grösse und Gewicht der Schulkinder* (1924), show that the children attending the *Volksschulen* are shorter and lighter than those attending the *höhere Schulen*. Another series of observations carried out in Berlin from 1921 to 1923, and given along with the foregoing data, gives a similar result.

In 1923 Schiotz (1923) found that boys and girls attending *Volksschulen* in Christiania were shorter and lighter than those attending the *höhere Schulen*.

In the same year Schmidt (1923) in Bonn and Gaspar (1923) in Stuttgart obtained similar results to those of Schiotz in Christiania.

It may be that, to some extent at least, the variation in height and weight of different children when grouped according to social class is due to racial rather than environmental factors. It has been pointed out that in countries where there is a long-established and exclusive upper class its special characteristics tend to persist. Beddoe (1870) states when referring to the racial characteristics of class in the British Isles : ' In the thirteenth century the great landowners and the upper class generally were still mainly Norman . . . the mainly Scandinavian aristocracy of Normandy were still, we have reason to believe, blond and long-headed, and the remains of the Anglo-Danish one with which they certainly mixed to a certain extent were a purer breed of the same type which is still the prevailing one among the upper classes of England.' Ripley (1900) says, ' The aristocracy (of Great Britain) everywhere tends toward the blond and tall type, as we should expect.' Bryce (1921) says, ' Some of the best blood in Scotland is, of course, Norman in origin, as many of the most honoured national names proclaim.'

(ii) Present Investigation

(*a*) Determination of Income.

The income was not always easy to determine. Miss Tully, who has had a specially wide experience of these investigations, reports : In the collection of information regarding income of family, the total income coming into the house was ascertained in practically all cases. This included the husband's or wife's wages, the earnings of any of the older members of the family who were working, and, in addition, any income derived from keeping lodgers and other sources.

In most of the families the husband's or wife's earnings (Dundee) constituted the sole income of the household. There were, on the whole, very few families in which any substantial sum was being contributed by the children, the tendency being for the older children to marry whenever their wage would permit. Consequently, any money obtained from sons or daughters working amounted merely to a few shillings, their work being unskilled or their wages low because they were apprenticed.

In most of the families dealt with, the mother obtained practically the full wage from her husband and handed back a certain sum for his use. The same thing happens in the case of the elder children. On the other hand, there were families in which the husband only gave his wife a proportion of his wages, the woman frequently knowing how much he earned. In such cases it did not always follow that the money kept by the husband was spent on his own pleasures and pursuits. Not unfrequently this money provided clothes, light, and any other extra necessities.

There were, of course, families in which the mother received very little money from her husband and had no idea of how much he actually earned. Owing very largely to the state of trade, such conditions were rarer at the time of our investigation than would have been the case if work and wages had been plentiful. The unemployment dole left little scope for keeping back money, and the man who had been accustomed to keep back the larger proportion of his wages for his own use was compelled by unemployment and short time to hand over practically the whole of his earnings or dole in order to provide the barest existence.

Consequently, in practically all cases the total income of the family was used to get the income per person. The cases in which only the amount given to the mother was stated were comparatively few, and the money represented the total income for maintaining the home just as much as in those families where the whole income was handed over for household purposes.

(*b*) Income per Person or Income per Man.

The income recorded was the total earnings of the family, and, since this is significant only in relationship to the size of the family, it seemed expedient to express it as per person per week.

The question of calculating the income as per man, as was done in the case of the dietary studies, was considered, as this, at first sight, for the following reasons, might seem the proper method. As we have already seen, the greater proportion of the income (some 50–70 per cent. or more) is spent on food, and it is also true that the cost of clothing a child is not equal to that of a grown adult; in fact, from a list of clothing costs for children of different ages and for adult males and females, it would seem that this is proportionately less expensive for the child than is food (see Appendix V). There is, however, the question of rent, coal, and gas, the cost of the care of the child, as, for example, when the mother is out at work, which might counterbalance the relatively lesser cost of food and clothing, as well as the final difficulty of knowing the exact ratio which the cost of the general upkeep of children of varying ages bears to that of the adult male. Nevertheless, in view of the dubiety in our minds on the question, we decided, as suggested by Dr. Greenwood, to submit the matter to a test by calculating in

Table 81. *A Comparison of the Correlations found by using Income per Man and Income per Person (Income per Person in brackets).*

	Weight—Income.	*Height—Income.*	*Air-space—Income.*	*Size of family—Income.*	*Maternal health—Income.*	*Maternal efficiency—Income.*
Glasgow girls	·0178 ± ·060	− ·1440 ± ·058	·2668 ± ·055	− ·4738 ± ·046	·0630 ± ·059	·0544 ± ·059
1 year .	(·0057 ± ·058)	(− ·1051 ± ·057)	(·2182 ± ·055)	(− ·4858 ± ·044)	(·0868 ± ·057)	(·0787 ± ·057)
Glasgow boys	·0866 ± ·068	− ·0784 ± ·068	− ·3510 ± ·060	·2833 ± ·063	·0485 ± ·068	− ·0528 ± ·068
1 year .	(·1300 ± ·064)	(− ·0625 ± ·065)	(·3146 ± ·059)	(− ·3866 ± ·055)	(·0055 ± ·065)	(− ·0160 ± ·065)
Glasgow girls	·1976 ± ·061	− ·0308 ± ·063	·1270 ± ·062	− ·3073 ± ·057	·0990 ± ·063	− ·2135 ± ·061
5 years .	(·1818 ± ·061)	(− ·1286 ± ·062)	(·1426 ± ·061)	(− ·3798 ± ·054)	(·0408 ± ·063)	(− ·2332 ± ·059)
Glasgow boys	·1957 ± ·063	·1403 ± ·064	·4098 ± ·054	− ·4568 ± ·052	·1485 ± ·064	·1943 ± ·063
5 years .	(·2570 ± ·060)	(·1814 ± ·062)	(·4645 ± ·050)	(− ·4534 ± ·051)	(·2539 ± ·060)	(·2262 ± ·061)
Dundee girls	− ·0867 ± ·066	·0521 ± ·066	·2384 ± ·063	− ·3120 ± ·060	·0025 ± ·066	·2432 ± ·063
5 years .	(− ·1375 ± ·065)	(− ·0053 ± ·066)	(·4498 ± ·053)	(− ·2667 ± ·061)	(− ·0123 ± ·066)	(·1927 ± ·064)
Dundee boys	·0596 ± ·065	·1944 ± ·063	·1973 ± ·063	− ·1235 ± ·065	·0310 ± ·065	·1343 ± ·064
5 years .	(− ·0379 ± ·064)	(·1755 ± ·062)	(·2162 ± ·061)	(− ·0092 ± ·065)	(− ·0073 ± ·065)	(·1384 ± ·063

Table 82. *Correlations. Income to Size of Family.*

	Age . .	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow . .	− ·5844	− ·5349	− ·5064	− ·3040	− ·3866	− ·5138	− ·3265	− ·3707	− ·4534
		± ·043	± ·050	± ·056	± ·076	± ·055	± ·040	± ·057	± ·055	± ·051
	Edinburgh .	− ·4074	− ·5994	− ·4405	− ·3470	− ·4975	− ·4978	− ·4470	− ·4188	− ·3360
		± ·108	± ·073	± ·091	± ·095	± ·047	± ·046	± ·051	± ·053	± ·073
	Dundee . .	− ·2422	− ·4608	− ·5022	− ·3741	− ·3313	− ·1943	− ·2817	− ·2638	− ·0092
		± ·067	± ·062	± ·059	± ·067	± ·046	± ·049	± ·051	± ·060	± ·065
Girls	Glasgow . .	− ·4747	− ·4925	− ·4480	− ·4729	− ·4858	− ·3149	− ·3817	− ·3657	− ·3798
		± ·053	± ·057	± ·060	± ·077	± ·044	± ·050	± ·048	± ·058	± ·054
	Edinburgh .	− ·5084	− ·4684	− ·4902	− ·5010	− ·4754	− ·5730	− ·3504	− ·5139	− ·3053
		± ·087	± ·082	± ·094	± ·087	± ·049	± ·045	± ·054	± ·049	± ·073
	Dundee . .	− ·5406	− ·4094	− ·2031	− ·2104	− ·3888	− ·2969	− ·1963	− ·1855	− ·2667
		± ·050	± ·059	± ·078	± ·077	± ·045	± ·046	± ·050	± ·058	± ·061

a series of selected cases the data according (1) to man value, using Lusk's scale, as has been done in the case of the dietary studies, and according (2) to person or individual. From Table 81 it is seen that in all the cases tested *no difference is obtained between the two methods of apportionment—per person or per man—and that we are justified in the use of the more readily calculated figure of income per person as an index of the economic condition of the family.*

(*c*) **Range of Income.**

The mean incomes per person per week in the three towns were :

Glasgow	9·32*s.*
Edinburgh	8·24*s.*
Dundee	7·58*s.*

To determine whether the dispersal of income was sufficient to allow of its effects to be manifested, the range and frequency distribution were determined, and these are shown in the following table :

TABLE 83. *Range of Income per Person per Week in Families Studied in Glasgow, Edinburgh, and Dundee.*

Income per person per week.	*Glasgow.* *No. of families.*	*Edinburgh.* *No. of families.*	*Dundee.* *No. of families.*
1/- to 5/- . .	78·5	74·5	185·5
5/- to 10/- . .	421·0	359·5	470·5
10/- to 15/- . .	186·0	144·5	163·0
15/- to 20/- . .	77·5	28·0	33·0
20/- to 25/- . .	16·5	1·5	10·5
25/- to 30/- . .	7·5	—	2·5
30/- to 35/- . .	2·0	—	—
Totals . .	789·0	608·0	865·0

Limits of range of income per person per week.

	Glasgow.	*Edinburgh.*	*Dundee.*
Highest	33/4	21/2	26/9
Lowest	1/1	3/3	1/-

While in over 50 per cent. of the families the income was between 5*s.* and 10*s.* per person, the range of variation is sufficiently wide to allow the possible effects of such differences of income as are practically possible of attainment in this class to be manifested.

The relationship of the average income and of the range of income to the proportion of skilled and unskilled workers in the different towns is dealt with on pp. 17 and 18.

In working out the correlations of income with other variables, it was decided to take the difference of 5*s.* between the groups, in order that with this grouping sufficient numbers for statistical treatment would be obtained.

Since the investigations were carried out during a period from 1919 to 1923 in which a slump in the trade of the country occurred and during which unemployment became more and more common,

TABLE 84. *Correlations. Weight to Income.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	·1246 ±·064	·0826 ±·069	−·0127 ±·076	·1086 ±·083	·1300 ±·064	·1958 ±·052	·0392 ±·064	·1011 ±·063	·2570 ±·060
	Edinburgh	·1439 ±·127	·1516 ±·111	·2565 ±·105	·1956 ±·104	·1881 ±·060	·1344 ±·060	·1826 ±·062	·0691 ±·068	·1686 ±·079
	Dundee	·0936 ±·070	·4214 ±·064	·1682 ±·077	·1537 ±·076	·0883 ±·051	·1406 ±·050	·0289 ±·055	·2321 ±·061	−·0379 ±·064
Girls	Glasgow	·0372 ±·068	·2329 ±·071	−·1388 ±·073	·2101 ±·092	·0057 ±·058	−·1437 ±·054	−·0486 ±·055	−·0281 ±·066	·1818 ±·061
	Edinburgh	−·1887 ±·113	·0468 ±·105	·3549 ±·108	·0978 ±·115	·2293 ±·060	·1775 ±·064	·0878 ±·061	·0470 ±·067	·0292 ±·081
	Dundee	−·0729 ±·070	·0803 ±·071	·1222 ±·080	·1778 ±·078	·0763 ±·053	·0103 ±·051	·0292 ±·052	·0477 ±·060	−·1375 ±·065

TABLE 85. *Correlations. Height to Income.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	—	—	—	—	−·0625 ±·065	−·0265 ±·054	−·0383 ±·064	·0689 ±·064	·1814 ±·062
	Edinburgh	·1768 ±·126	·0841 ±·113	·0738 ±·112	·2218 ±·103	·1979 ±·060	·1977 ±·059	·3024 ±·058	·0446 ±·069	·3842 ±·070
	Dundee	·1704 ±·069	·4124 ±·065	·0445 ±·078	·1550 ±·076	·1330 ±·051	·1146 ±·050	·1596 ±·054	·2945 ±·058	·1755 ±·062
Girls	Glasgow	—	—	—	—	−·1051 ±·057	−·2955 ±·050	−·2055 ±·053	−·0253 ±·066	−·1286 ±·062
	Edinburgh	−·1851 ±·113	·0093 ±·105	·0086 ±·123	·0778 ±·115	·1923 ±·061	·2745 ±·061	·1142 ±·061	·1678 ±·065	·0226 ±·081
	Dundee	·0325 ±·070	·1364 ±·070	·1348 ±·080	·0437 ±·080	·1115 ±·053	·2032 ±·048	·0714 ±·052	−·0349 ±·060	−·0053 ±·066

the incomes given cannot be considered as representing the amounts permanently accruing to the family. Sometimes when the visit was made the father was in work, sometimes he was on the dole. But there is little doubt that the averages represent the financial position fairly accurately.

(*d*) Income and Height and Weight of Child.

(i) *Pre-school Children.*

As already indicated, it was anticipated that evidence would be obtained that the available income, determining as it does, or should do, the character of the house and of the diet, would be highly correlated with the condition of the children as represented by height and weight. Tables 84 and 85 on page 129, of children of pre-school age, show, however, that such a correlation is not revealed.

These correlations of both weight and height to income are of low order and with few exceptions insignificant. There is no change with age and no apparent difference in the sexes. These results show that within the range of income dealt with the variations of height and weight in children under five years do not appear to be definitely related to the economic condition of the family.

(ii) *Children aged* 6–14 *years.*

As already stated, the children of six years of age and over were grouped together irrespective of age, the necessary correction for age being made by the method of partial correlation. The partial correlations between height and weight of these children and the family income for constant age are given in Table 86, below.

TABLE 86. *Correlations. Height and Weight to Family Income for Children of* 6–14 *years* (*Corrected for Age*).

		Glasgow.	*Edinburgh.*	*Dundee.*
Boys .	Weight/Income .	−·2753 ± ·031	−·0390 ± ·051	·2386 ± ·046
„ .	Height/Income .	−·2074 ± ·032	·1900 ± ·049	·2919 ± 045
Girls .	Weight/Income .	−·0019 ± ·033	·2245 ± ·046	·1198 ± ·048
„ .	Height/Income .	·0875 ± ·033	·1783 ± ·047	·2020 ± ·046

The correlations of income with weight and height are discordant. Glasgow boys give a significant negative correlation ; Dundee boys a significant positive correlation ; while Edinburgh boys show no relationship. Edinburgh girls give a significant positive correlation ; Dundee and Glasgow girls show no significant relationship.

Between weight and height and income no definite relationship can be said to exist on these findings. In the families of agricultural labourers and of rural coal-miners there is the same absence of correlation between the weight and height of the child and the income per person (see pp. 264 and 288).

(*e*) Income and Size of Family.

In these poor families the income per person depends largely upon the size of the family. Table 82 on p. 127 shows this. The correlations, it will be noted, between income per person and size of family are fairly high and significantly negative, indicating that, as the size of the family increases, the income per person decreases.

(2) THE HOME (AIR-SPACE PER PERSON)

The absence of a significant correlation between income and height and weight of the children raises the question of how far the income has any relationship to the character of the house occupied. It is a well-known fact that, as the size of the family increases, it is rare that a move is made to a bigger house. Even when the elder children are past school age and begin to earn, so that the family income becomes larger, it is customary for the family to continue in the same dwelling.

It is apparent that the only possible measure of the house in relationship to its occupants is the air-space per person. But a larger air-space does not necessarily mean better ventilation, for this is dependent upon the facilities available for the circulation of fresh air and the extent to which these are utilized, nor does it necessarily indicate a larger house: it generally means a smaller family, with less overcrowding.

The examination of the relationship of varying air-space per head, and the growth and nutrition of the child as carried out in the present investigation, has not, so far as can be traced, been investigated in the same detail by other workers, who have, in general, contented themselves with the study of the broad general effects of faulty environment, as indicated by the number of rooms in the home or the number of persons per room rather than an exact estimation of the air-space per person. This, as already indicated, is interrelated with income, and any correlation which may exist between mortality rates or nutrition of the child and air-space may possibly be due to the part played by differences of income and class.

(i) Previous Work

Previous work bearing on the relationship between the size of the house and mortality rates among children in Glasgow, Edinburgh, and Dundee has already been given in the section Income. The results, already cited (p. 117), of Carnelly, Haldane, and Anderson on data from Dundee are of special interest as indicating the relatively greater struggle for existence of children under five years of age among the poorer and less well-housed portion of the population. The marked differences in the death-rates shown among these very young children is a sound argument, if such an argument were needed, for the decision to concentrate the work of the present investigation on children of pre-school age.

Last year (1925), in a report published under the auspices of the Glasgow Public Health Department, Jones gave a series of tables showing that expectation of life is greater in houses of larger size. He said, ' The expected years of life for one-apartment males at age 10 is exceeded by 2·6, 5·56, and 6·13 years respectively, in the two-, three-, and four-apartment groups. Among females at the same age the differences are 3·05 and 7·86 years for the two and three apartments, while the difference compared with four apartments is as much as 11·95 years.'

The nearest approach to the present method of analysis of the home conditions is to be found in Macgregor's paper (1908–9) on the physique of Glasgow children, where the children are grouped according to the number of rooms in the home—one-room, two-room, and three-room—and the average heights calculated for boys and girls. The results of this analysis are given in the following table:

TABLE 87. *Heights of Children (Glasgow) graded according to the size of the House. Rachitic Children are tabulated separately* (Macgregor).

		One room.		Two rooms.		Three rooms.		Rickets.	
Age.	Sex.	No. of cases.	Height (in.).	No. of cases.	Height (in.).	No. of cases.	Height (in.).	No. of cases.	Height (in.).
2–3	M	48	31·6	42	31·7	—	—	48	30·2
	F	37	28·8	47	32·1	—	—	33	30·2
3–4	M	41	33·2	58	33·7	11	35·2	48	31·8
	F	43	32·1	67	33·0	13	35·3	47	31·9
4–5	M	46	36·7	61	37·0	10	37·9	49	36·0
	F	30	33·9	66	37·1	9	37·8	37	34·2
5–6	M	33	37·8	53	38·6	12	40·2	28	36·0
	F	27	38·5	54	39·0	13	40·7	20	37·7
6–7	M	30	41·1	58	40·3	17	41·9	17	37·7
	F	19	40·5	64	41·1	13	43·3	16	38·5
7–8	M	17	42·0	32	42·3	—	—	8	38·0
	F	15	42·3	42	43·4	—	—	14	42·2
8–9	M	—	—	20	44·7	8	46·5	—	—
	F	—	—	28	46·2	17	46·8	—	—
9–10	M	—	—	14	46·2	—	—	—	—
	F	—	—	15	46·2	—	—	—	—

In the Report of the Education Committee of the London County Council for 1905 (1905) there is a short note on the relationship of overcrowding to physique, in which the following table is given:

TABLE 88. *Relation of Children's Physique to Number of Rooms in Home.*

	No. of cases.	Average divergence from normal age physique of the school. Weight (kilos).	Height (cm.).
Living in 1-roomed tenements . .	15	−1·3	−2·6
,, 2 ,, ,, . .	70	0·0	−1·0
,, 3 ,, ,, . .	35	0·0	+1·0
,, 4 ,, ,, . .	84	+1·3	+2·0

A table is also given showing the relationship of the physique of school children to the number of occupants per room.

TABLE 89. *Relation of Children's Physique to Number of Inmates per Room.*

No. per room.	No. of cases.	Average divergence from normal age physique of the school. Weight (kilos).	Height (cm.).
1–2	41	+0·5	+1·5
2–3	66	0·0	0·0
3–4	39	0·0	−0·3
4–5	16	0·0	−0·7
More than 5	10	−3·5	−7·6

Here it is seen that there is a slight correlation only until we reach the serious overcrowding of more than five to a room, when the divergence of the physique of the child occupants from the average becomes very marked.

Findlay and Ferguson (1918) showed a definite relationship between the cubic air-space per person and the incidence of rickets in Glasgow homes. They found that the air-space per person was 32 per cent. less in families with cases of marked rickets than in families with non-rachitic children.

Karn and Pearson, in 1922 (1922), found that there was a significant but very small correlation between the health of yearling babies and crowding. They found that crowding depends very largely on the number of living children, with which it is very highly correlated, and they suggest that the correlation between the health of the baby and the crowding may be accounted for by the fact that babies in later pregnancies are less strong, since in these the family is larger and hence there is more overcrowding. J. A.

Such evidence as is available points to some relationship between the air-space per person and the development of the child, but it has to be kept in mind that air-space is itself closely correlated with other factors—poverty, size of family—and that its relationship with the development of the child may be an indirect one.

(ii) Present Investigation

(a) Range of Air-space per Person.

The following table shows the range of air-space per person met with in the present study:

TABLE 90. *Range of Air-space per Person in Houses in Glasgow, Edinburgh, and Dundee.*

Air-space per person in cub. ft.	*Glasgow.* *No. of families.*	*Edinburgh.* *No. of families.*	*Dundee.* *No. of families.*
100 to 200	39·5	18	30
200 ,, 300	182·5	134·5	212·5
300 ,, 400	218	175	251·5
400 ,, 500	161·5	140	157
500 ,, 600	89	70	97
600 ,, 700	49	37	58·5
700 ,, 800	22·5	16·5	33·5
800 ,, 900	11	12·5	13
900 ,, 1,000	5	2·5	5
1,000 ,, 1,100	4	1	3
1,100 ,, 1,200	1	1	3
1,200 ,, 1,300	3·5	—	—
1,300 ,, 1,400	2·5	—	—
1,400 ,, 1,500		—	—
1,500 ,, 1,600	—	—	—
1,600 ,, 1,700	—	—	1
Totals . . .	789·0	608·0	865·0

Percentage of families with between 200 to 500 c. ft.

Glasgow	71
Edinburgh	73
Dundee	71

(b) Air-space per Person and Height and Weight of Child.

The correlations of air-space with height and weight of infants and children of pre-school age are given below (Tables 91 and 92).

The correlations of height and weight with air-space under one year are in the main insignificant. Over one year the correlations are chiefly positive and are just significant. In the case of weight, in Edinburgh the correlations in both boys and girls seem to be of a slightly lower order than in the other two cities.

TABLE 91. *Correlations. Height to Air-space.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	—	—	—	—	·0129 ±·065	·1907 ±·052	·1487 ±·062	·2173 ±·061	·1971 ±·062
Boys	Edinburgh	·2273 ±·123	·1464 ±·111	·1401 ±·110	·0730 ±·107	·1705 ±·061	·1935 ±·059	·2329 ±·061	·0434 ±·068	·3563 ±·071
Boys	Dundee	−·1782 ±·069	·3297 ±·070	·0000 ±·079	−·0144 ±·078	·1042 ±·051	·2718 ±·047	·1883 ±·053	·4207 ±·053	·1247 ±·063
Girls	Glasgow	—	—	—	—	−·1169 ±·057	·1705 ±·054	·1090 ±·055	·0900 ±·055	·1564 ±·061
Girls	Edinburgh	−·0683 ±·117	−·0037 ±·105	·0131 ±·123	−·0346 ±·116	·1051 ±·063	·2771 ±·061	·0657 ±·061	·2163 ±·064	·1693 ±·078
Girls	Dundee	−·0205 ±·070	·1160 ±·070	−·0424 ±·081	·2460 ±·075	·1153 ±·053	·2613 ±·047	·3079 ±·047	·3116 ±·054	·3756 ±·057

TABLE 92. *Correlations. Weight to Air-space.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	·0776 ±·064	−·1455 ±·068	·3194 ±·068	·2895 ±·077	·2720 ±·060	·2346 ±·051	·1798 ±·062	·2518 ±·060	·2973 ±·059
Boys	Edinburgh	·3134 ±·117	·0581 ±·114	·3037 ±·102	−·1854 ±·104	·2600 ±·058	−·0009 ±·062	·1904 ±·062	·0326 ±·068	·0536 ±·082
Boys	Dundee	−·0165 ±·071	·1941 ±·075	·2147 ±·075	·0184 ±·078	·0597 ±·052	·2670 ±·047	·1529 ±·054	·1746 ±·062	·0275 ±·064
Girls	Glasgow	−·0752 ±·067	−·0469 ±·075	−·1187 ±·073	·1562 ±·094	·0966 ±·057	·2363 ±·052	·1771 ±·054	·0031 ±·066	·2583 ±·058
Girls	Edinburgh	−·0755 ±·117	·0424 ±·105	·1466 ±·120	−·0402 ±·116	·1515 ±·062	·1429 ±·065	−·0411 ±·061	−·0185 ±·067	−·1503 ±·079
Girls	Dundee	−·0053 ±·070	·2117 ±·068	−·0202 ±·081	·3204 ±·072	·1189 ±·053	·0354 ±·050	·1087 ±·051	·0990 ±·059	·2447 ±·062

From these results it would appear that the effects of overcrowding are not apparent till after the first year of life, after which the weight and height of children in the more overcrowded homes are, on the whole, lower. *But the size of the correlations does not justify the suggestion that in these homes overcrowding is a dominant factor in influencing the nutrition and growth of the child.*

The correlations of air-space with height and weight of school children aged 6–14 are shown in Table 93.

Table 93. *Correlations. Weight and Height to Air-space for Children of 6–14 Years (Corrected for Age).*

	Glasgow.	*Edinburgh.*	*Dundee.*
Boys —Weight/Air-space .	·1568 ± ·033	·1681 ± ·050	·1484 ± ·048
„ —Height/Air-space .	·2352 ± ·032	·2755 ± ·047	·2335 ± ·046
Girls —Weight/Air-space .	·1737 ± ·032	·0511 ± ·048	·1277 ± ·048
„ —Height/Air-space .	·2065 ± ·032	·2118 ± ·046	·2035 ± ·046

The correlations of weight and air-space for these school children in all three cities give a small but significant positive result. In girls all correlations are positive, but only in Glasgow is the result significant. Height in the school children also gives a uniform series of positive correlations of a slightly higher order than those of weight. Like the children of pre-school age, these school children show a slight association between their condition and the state of overcrowding in their homes. In this period of life height seems to be more closely associated with overcrowding than does weight.

(*c*) Air-space per Person and Income per Person.

Just as income per person is related to the size of the family so it is necessarily correlated with the air-space per person.

These correlations are shown in Tables 94 and 95.

Table 94. *Correlations. Income to Air-space for Children of 6–14 Years (Corrected for Age).*

	Glasgow.	*Edinburgh.*	*Dundee.*
Boys . Income/Air-space .	·3274 ± ·030	·4452 ± ·041	·3898 ± ·041
Girls . Income/Air-space .	·2428 ± ·031	·1560 ± ·047	·3081 ± ·044

As was to be expected, the correlations are all significantly high, showing that air-space per person is closely related to the income per person, since both depend so directly upon the size of the family.

(*d*) Air-space per Person and Size of Family.

The air-space available per person in the class of the community studied depends to a great extent on the size of the family, and this is shown in Table 96.

As was to be expected, the correlations are significantly negative and show how closely the air-space per person is determined by the number of living children. With increase of size of family there is a steady decrease in the air-space available for each individual.

TABLE 95. *Correlations. Income to Air-space (Pre-school Children).*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	·3344 ±·057	·3281 ±·062	·3478 ±·068	·5341 ±·060	·3146 ±·059	·2553 ±·051	·2979 ±·058	·0896 ±·064	·4645 ±·050
	Edinburgh	·4716 ±·101	·1432 ±·112	·1346 ±·110	·1903 ±·104	·3516 ±·055	·2820 ±·057	·3771 ±·055	·4004 ±·057	·5249 ±·059
	Dundee	·3475 ±·062	·4201 ±·064	·2638 ±·073	·3866 ±·066	·3030 ±·047	·3318 ±·045	·3866 ±·047	·3898 ±·054	·2162 ±·061
Girls	Glasgow	·4779 ±·053	·2484 ±·071	·3435 ±·065	·3271 ±·086	·2182 ±·055	·2714 ±·051	·1875 ±·054	·0299 ±·066	·1426 ±·061
	Edinburgh	·3837 ±·100	·1578 ±·103	·3949 ±·104	·1879 ±·112	·3069 ±·058	·4552 ±·053	·3502 ±·054	·3647 ±·058	·4579 ±·064
	Dundee	·4236 ±·058	·4188 ±·059	·2564 ±·076	·3957 ±·067	·4184 ±·044	·3740 ±·043	·3730 ±·045	·0796 ±·059	·4498 ±·053

TABLE 96. *Correlations. Air-space to Size of Family.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	−·3475 ±·057	−·4197 ±·058	−·5732 ±·056	−·3785 ±·072	−·4618 ±·051	−·3024 ±·049	−·4051 ±·053	−·4052 ±·054	−·4708 ±·050
	Edinburgh	−·3582 ±·113	−·1553 ±·111	−·4771 ±·087	−·3244 ±·097	−·3796 ±·054	−·1978 ±·059	−·4758 ±·050	−·3646 ±·059	−·3862 ±·070
	Dundee	−·2955 ±·066	−·5117 ±·062	−·3383 ±·069	−·3970 ±·066	−·3447 ±·046	−·3645 ±·044	−·2791 ±·051	−·3253 ±·057	−·3079 ±·058
Girls	Glasgow	−·3759 ±·058	−·3835 ±·064	−·5365 ±·065	−·4173 ±·080	−·2607 ±·054	−·3510 ±·048	−·3364 ±·049	−·1882 ±·064	−·4341 ±·051
	Edinburgh	−·4489 ±·094	−·2951 ±·096	−·5639 ±·084	−·3004 ±·105	−·4204 ±·052	−·4375 ±·054	−·3177 ±·055	−·2988 ±·061	−·4216 ±·066
	Dundee	−·4873 ±·054	−·3134 ±·064	−·3116 ±·073	−·3118 ±·069	−·4385 ±·043	−·3898 ±·043	−·3628 ±·045	−·4019 ±·050	−·4595 ±·052

(e) Size of Family and Height and Weight of Child.

As pointed out, size of family, like air-space per person, is an index of the condition of overcrowding and might be expected to show correlation with the weight and height of the children in the same way as does air-space. The correlations of size of family and weight and height of children of pre-school age in the three cities are shown in Tables 97 and 98.

These correlations are chiefly negative but of a very low order, being of less significance than the correlations already shown between weight and height and air-space. In children under a year there is no evidence of significant association with either weight or height and size of family. In children over one year, the results of height and size of family are, on the whole, higher than those of weight, which, although chiefly negative in sign, are mostly insignificant. *The results serve to support the conclusions already drawn with regard to the small effect which relative degrees of overcrowding, within the range studied, have upon the growth and nutrition of the child.*

This inquiry affords no information as to the average size of the household in the district studied. The investigation is concerned with the condition of the children, and for this reason households with at least one child were dealt with ; but the number of children was not allowed to determine the selection of families, and the size of the family may be taken as representative of households in which children are present.

(3) INCOME AND DIET

When the income rises above the poverty line, above the line below which the necessities of life alone can be procured, it is frequently found that the diet becomes more liberal, while the amount of energy purchased per penny decreases because more expensive foods are purchased. The dietary studies of the unemployed and of the artisan class in Glasgow exemplify this (pp. 155 and 165). The present study is concerned with families below the poverty line, and the question to be considered is, whether there is evidence of a positive correlation between the variations of the incomes and the energy value of the diets procured.

As only a limited number of complete dietary studies could be made, as explained on p. 149, it is not possible to work out a correlation between the income and the energy value of the diets of all these families. But the series of dietary studies upon typical families of the class studied gives some data bearing upon the question of how far the variations of income are related to the energy value of the diet. This is shown in a dietary study upon 12 families published by Miss Tully and Miss Urie (1922). The families are divided into two groups, those with incomes over 8*s*. per man per week, and those with incomes under 8*s*. per man per week. They give the following result (see Table 99):

TABLE 97. *Correlations. Weight to Size of Family.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	−·0651 ±·064	−·1890 ±·068	−·2187 ±·072	−·1882 ±·081	−·0855 ±·065	−·1347 ±·053	−·0098 ±·064	−·2537 ±·060	−·1181 ±·063
	Edinburgh	−·3163 ±·117	·0251 ±·114	−·4096 ±·094	·0146 ±·108	−·0704 ±·062	−·1526 ±·060	−·1320 ±·063	−·1559 ±·066	−·1579 ±·080
	Dundee	·0695 ±·070	−·0796 ±·078	−·0794 ±·078	·0018 ±·078	−·0861 ±·051	−·1632 ±·050	·0890 ±·055	−·1114 ±·063	−·0991 ±·064
Girls	Glasgow	−·0719 ±·067	−·1001 ±·075	·1832 ±·072	−·0096 ±·096	−·0770 ±·057	·0152 ±·055	−·1171 ±·055	−·0533 ±·066	−·2604 ±·058
	Edinburgh	·1050 ±·116	·0509 ±·105	−·1392 ±·121	−·1609 ±·113	−·2562 ±·060	−·1870 ±·064	·0027 ±·061	·0911 ±·067	−·1449 ±·079
	Dundee	·0617 ±·070	−·1858 ±·069	−·0579 ±·081	−·0062 ±·080	−·0889 ±·053	−·0708 ±·050	−·0055 ±·052	−·1665 ±·058	−·2813 ±·061

TABLE 98. *Correlations. Height to Size of Family.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	—	—	—	—	·0858 ±·063	−·0069 ±·054	−·0705 ±·057	−·2219 ±·061	−·2688 ±·060
	Edinburgh	−·1632 ±·126	−·0173 ±·114	−·1975 ±·108	−·0035 ±·108	−·1252 ±·062	−·2079 ±·059	−·2120 ±·061	·0053 ±·068	−·2937 ±·075
	Dundee	·0400 ±·071	−·0083 ±·078	−·0737 ±·078	·0136 ±·078	−·0723 ±·051	−·0807 ±·051	−·0146 ±·055	−·3514 ±·056	·0028 ±·065
Girls	Glasgow	—	—	—	—	−·0339 ±·058	·0407 ±·055	−·0192 ±·056	·0391 ±·066	−·1772 ±·061
	Edinburgh	·1821 ±·113	·0085 ±·105	−·0436 ±·123	−·0839 ±·115	−·1397 ±·062	−·3188 ±·056	−·2954 ±·056	−·2335 ±·063	−·2139 ±·077
	Dundee	−·0342 ±·070	−·1055 ±·070	−·1543 ±·079	−·1413 ±·078	−·1127 ±·053	−·1703 ±·049	−·0664 ±·052	−·2707 ±·055	−·3408 ±·058

TABLE 99. *Glasgow Dietary Expenditure* (Tully and Urie).

Families with over 8s. per man per week.

Date.	*Calories.*	*Average income.* *Per man per week.*	*Spent on food per man.*	*Energy value purchased per penny.*
Apr. 21	2,466	12/-	9/1¾	173·8
June 22	2,605	8/9¾	6/1	237·3

Families with under 8s. per man per week.

Date.	*Calories.*	*Average income.* *Per man per week.*	*Spent on food per man.*	*Energy value purchased per penny.*
Apr. 21	2,505	6/10½	6/1¼	219·8
June 22	2,182	4/11¾	3/10¼	302·3

A dietary study upon families during a period of employment in Glasgow, made by Miss MacNae in 1924 (p. 162), shows that if they are divided into those above the mean income of 10·3*s.* per man per week and those below the mean, the following average results are given :

Above mean income . . 2,355 calories per man per day
Below mean income . . 2,824 calories per man per day

A study made by Miss Clark in Dundee in 1923 (p. 165), when destitution was very extreme, shows that if incomes are divided into those above and those below the mean income, the energy value of the diets in the former are 2,197 calories (five families), and in the latter 2,064 calories (seven families). These results so formulated do not show a close relationship between the calorie value of the diet and the income.

Dr. MacKinlay has used the figures given in the various dietary studies by Miss Tully (1921), Miss Tully and Miss Urie (1922), Miss MacNae (see p. 162), and the *Report on Miners' Dietaries* (1924) to attempt to correlate the income with the energy value of the diet. The families investigated numbered 47.

Tully and Urie . . .	12 families
Tully	11 ,,
MacNae	9 ,,
Miners	15 ,,

The following variables are used :

(1) Income per man.
(2) Income per man spent on food.
(3) Calories per man.
(4) Calories per penny.

The results are collected in Table 100.

From these figures it appears that, in the class of people under investigation, an increase in income results in an increase in the calorie content of the diet. The crude correlation of income per man to calories per man is,

$$r_{13} = \cdot 5474 \pm \cdot 069.$$

TABLE 100. *Variables used in this Study.*

	(1) *Total income per man.* Shillings.	(2) *Income spent on food per man.* Shillings.	(3) *Calories per man.* Calories.	(4) *Calories purchased per penny.* Calories.
Means	10·4447	7·0749	2657·0851	227·7234
Standard deviations	4·5389	2·6855	621·4229	52·3270
Coefficients of variation	43·46	37·96	23·39	22·98

Correlations.		*Partial correlations.*			
r_{12}	·7579±·042	$r_{12\cdot34}$	·2464±·092	$r_{12\cdot3}$	·6278
				$r_{12\cdot4}$	·5844
r_{13}	·5474±·069	$r_{13\cdot42}$	·1538±·096	$r_{13\cdot2}$	·0545
				$r_{13\cdot4}$	·5617
r_{14}	−·5982±·063	$r_{14\cdot23}$	−·1645±·096	$r_{14\cdot2}$	−·0803
				$r_{14\cdot3}$	−·6102
r_{23}	·6883±·052	$r_{23\cdot14}$	·7742±·039	$r_{23\cdot1}$	·5007
				$r_{23\cdot4}$	·8480
r_{24}	−·7431±·044	$r_{24\cdot13}$	−·7934±·036	$r_{24\cdot1}$	−·5542
				$r_{24\cdot3}$	−·8724
r_{34}	−·1742±·095	$r_{34\cdot12}$	·7023±·050	$r_{34\cdot1}$	·2285
				$r_{34\cdot2}$	·6946

It is evident, however, that the total available income per man is not the sole determining factor. The correlation of that part of income spent on food per man to calories per man is (as might be expected) slightly higher. It is, in fact,

$$r_{23} = \cdot 6883 \pm \cdot 052.$$

The correlation of income per man to income spent on food is still higher, thus :

$$r_{12} = \cdot 7579 \pm \cdot 042.$$

If we connect these two variables—income spent on food per man (x_1) and income per man (x_2)—by a simple regression equation we find that

$$x_1 = 2\cdot 3913 + \cdot 4484 x_2 \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The standard error in predicting from this equation, however, is large—2·14*s*. In other words, a rise of 1*s*. in the income per man corresponds, on the average, to a rise of ·4484*s*. in the amount spent on food per man. A simple equation of this kind might give an index of the state of affairs in this social class as accurate as any more complicated formula, since the variability in both factors is very great. But it must be remembered that here the social obligations are at a minimum. As we ascend the social scale, the calls made on income from factors other than food increase, so that we should expect that the ratio of income spent on food to total income would become smaller—as in fact it does. This can be shown in two ways. A comparison of the percentage of income spent on food by the Glasgow labouring classes with that of the miners' families (Table 101) brings out this inverse relation.

Table 101. *Percentage of Income spent on Food.*

	Per cent.
Glasgow, Tully, 1921	86
,, Tully and Urie, 1922	77
Miners, Durham	64
,, Northumberland	53
,, Lancashire	53
,, Stirling	52
,, Derbyshire	47
All miners	52

Again, if we use the above regression equation (1) of income spent on food and total income per man, the extrapolate for the comparatively well-off miners should be too high, and indeed the table given below shows that in every case the prediction is higher than the actual values.

Table 102. *Income spent on Food by Miners' Families. Observed and Predicted Values.*

	Observed. Shillings.	*Predicted.* Shillings.
Derbyshire	7·8940	9·9588
Northumberland	6·1319	7·5339
Durham	5·8533	6·5815
Lancashire	6·6609	8·0180
Stirlingshire	7·0694	8·4473
All miners	6·7214	8·1837

Food, then, is a prime factor in absorbing the income of the labouring classes. To provide a physiologically adequate diet, rent and other obligations go by the board. The results of the dietary studies in Dundee, which were made after a prolonged lock-out, might seem to refute this conclusion, for although the diet yielded only 2,100 calories per man per day, not more than 45 per cent. of the income was spent on food. But, as is shown on p. 168, these families, unlike those in Glasgow, were paying their rents and, in many cases, were discharging debts.

Proceeding now to the relative importance of the various factors influencing the intake of food, we find that income per man becomes an almost negligible quantity when the amount spent on food is kept constant: $r_{13 \cdot 2} = \cdot 0545 \pm \cdot 098$. The correlation of calories per man to income spent on food, with income per man constant, is $r_{23 \cdot 1} = \cdot 5007 \pm \cdot 074$. Thus, if an attempt is made to estimate the diet from a knowledge of other variables, income per man apart from the amount spent on food would appear to be of little importance from the point of view of prediction.

The other factor concerned in the energy value of the diet is, of course, the efficiency of the spending of the money. It is common knowledge that the poorer families derive most of their energy from the cheaper carbohydrates. Table 103 indicates that the percentage of energy derived from carbohydrates shows an inverse, and that from fats a direct relationship to income, while the proportion of protein to total calories is practically uninfluenced by variations in income, roughly 11 per cent. of the total calories being obtained from protein.

TABLE 103. *Percentage (Average) of Energy from Proteins and from Fats in the various Dietary Studies (see Diet Section).*

Dietary study.	*Percentage of energy from* *Proteins.*	*Fats.*
Glasgow, 1921, above 8*s*.	12·12	29·27
„ „ under 8*s*.	10·49	27·21
„ 1922, above 8*s*.	12·34	31·31
„ „ under 8*s*.	11·76	26·13
„ MacNae, 1924	11·05	27·84
Dundee, 1923, above 9·3*s*.	11·78	25·23
„ „ under 9·3*s*.	11·16	24·78
Rural	11·51	23·56
Miners, Derby	10·09	32·19
„ Durham	9·81	28·71

In the case of the poorer incomes, however, a larger percentage of these is of vegetable nature, which is cheaper but proportionately less valuable for the animal economy. This relative disproportion between vegetable and animal origin of the food-stuffs is even more true of the fats, and hence the lesser total calorie value of the diets of the poorer families is only a partial evidence of their inferiority.

The correlation of energy value purchased per penny and income per man is $r_{14} = -{\cdot}5982 \pm {\cdot}063$, and of calories per penny with income spent on food is $r_{24} = -{\cdot}7431 \pm {\cdot}044$.

The lower the income spent on, or available for, food the more careful must be the husbanding of the resources, or the more must the palatability of the food be sacrificed for energy value.

The correlation of income per man to calories per penny becomes insignificant when the income spent on food is kept constant—$r_{14\cdot2} = -{\cdot}0803 \pm {\cdot}098$—while income spent on food to calories per penny for constant total income per man becomes

$$r_{24\cdot1} = -{\cdot}5542 \pm {\cdot}068.$$

The final partial correlations show that *the income spent on food and the energy value purchased per penny are of much more importance with relation to the calorie value of the diet than is income per man.*

An attempt was made to arrive at the expenditure required to supply a family diet equivalent to 3,000 calories per man per day. If we predict the calorie content of the diet (x_1) from the income spent on food (x_2) and the calories purchased per penny (x_3) by means of a multiple regression equation, we find that

$$x_1 = 288{\cdot}7450\, x_2 + 8{\cdot}9428\, x_3 - 1422{\cdot}2310 \quad . \quad . \quad . \quad (2)$$

The standard error in predicting from this equation is 9·74 per cent. The original variability in calories per man as measured by the ratio of the standard deviation to the mean value is 23·39 per cent., and for constant income spent on food and calories per penny the initial variability is reduced to 12·21 per cent.

The introduction of the other variable (income per man = x_4) gives the following regression equation :

$$x_1 = 268{\cdot}7583\, x_2 + 9{\cdot}0573\, x_3 + 16{\cdot}8992\, x_4 - 1483{\cdot}4192 \quad . \quad (3)$$

The standard error in predicting from (3) being 9·62 per cent., the variability in calories is further reduced to 12·06 per cent. This clearly shows that the income per man is of little value in predicting the diet energy value of the diet, so long as we take account of the income spent on food. Using equations (2) and (3), and substituting for x_2, x_3, and x_4 the means of the miners' families, the following predictions for the mean calories per man agree well with the actual values :

TABLE 104. *Average Calories per Man in Miners' Families.*

	Observed values.	*Predicted from equation (2).*	*Predicted from equation (3).*
Durham	2,830	2,949	2,939
Derbyshire	3,336	3,213	3,122
Northumberland	3,178	3,206	3,161
Lancashire	2,873	2,888	2,847
Stirlingshire	2,914	3,055	3,002
All miners	3,035	3,052	3,006

Taking the average energy value purchased per penny at 250 calories, an income of 7·3*s*. per man per week would be required for food alone to supply a dietary yielding 3,000 calories. For a family consisting of father, mother, and three children, equivalent to 3·76 men, 27·45*s*. would be required weekly. If 2,600 calories—about the average for Glasgow families—is to be purchased, this will entail an expenditure of 6·32*s*. weekly per man, or 23·76*s*. weekly per family.

The conclusions thus are : (1) *that there is a small correlation between the total income and the calories of the diet, but this is due to the fact that in the slum families so high a proportion of the income is spent on food ;* (2) *between income spent on food and calories purchased there is the expected correlation ;* (3) *the energy value of the diet is dependent upon the money spent on food and the energy purchased per penny, i. e. upon the marketing, rather than upon the total income.* P. L. MACK.

PART V. DIET

CONTENTS

(1) FAMILY DIETS

(i) Preliminary Considerations

It has not infrequently been asserted that the small size of the slum child is due to insufficient nourishment in consequence of the poverty of the parents. But the question of whether this is so is by no means an easy one to answer.

(a) Influence of Food upon Nutrition and Growth.

That nutrition and growth are influenced by the supply of food has been clearly demonstrated by experiments upon animals, by experience in feeding cattle, and by observations on the human subject. The work of Jackson and Stewart (1919) and of Osborne and Mendel (1914 *a*, 1915) on rats; of Wheeler (1913) on mice; of Boas (1912), Schloss (1911), Aron (1911–14), Oppenheimer (1901), and Goldstein (1922) on children may be cited to prove that when the normal rate of growth has been retarded by underfeeding it may be restored by an adequate supply of food.

Though *nutrition*, as indicated by weight, is specially susceptible to the influence of feeding, it is only so up to a certain point, for in every case there is an optimum food supply and a further increase is prejudicial rather than beneficial, since every animal at any given age has a maximum power of storing material. This depends partly upon the power of digestion and absorption from the alimentary canal, and partly upon the metabolic activity of the tissues. The amount of food consumed is not the direct measure of the amount of food available in the body, for it must be digested and absorbed before it can be used, and the power of digestion and absorption depends not merely upon the factors already indicated, but also upon the character and the mode of preparation of the food. One of the objects of cooking is to make food more easily digested.

Growth, as indicated by stature for age, is less readily modified by the supply of food. The inherited growth impulse is prepotent and increase in size may go on with no increase in weight. This has been shown by Waters (1908) in immature cattle. Aron (1911) found that in dogs the bones and brain continue to grow at the expense of the other tissues, and Variot (1908), Freund (1909), and Goldstein (1922) that in children in under-nutrition the reduction in the rate of growth in length is less than that in weight. Putnam (1922), referring to Waters's results, states that if the energy is insufficient, there may be continued skeletal growth without gain in weight, and that 'children, unless frightfully under-nourished . . . will have a reasonable normal skeletal growth with increasing age'. Variot (1908) draws attention to a seasonal variation in increase of weight and height, and says that during the autumn and beginning of winter the child increases in weight but not in height, while at the beginning of summer it grows in height but does not increase in weight.

Naturally, however, since food material is required for growth, a sufficient limitation of the food supply must lead to retardation. Not merely will a limitation of the total food supply have this effect, but the limitation of the supply of any material essential for growth may act in the same way. This is strikingly shown in the case of lime salts, a diminished supply of which markedly checks growth. (See Jackson, 1925.) The same phenomenon is also observed when the supply of any of the essential amino-acid constituents of the proteins of the body is curtailed (Willcock and Hopkins, 1906; Osborne and Mendel, 1914 *b*). The necessity for the presence of minute traces of other unknown food constituents, such as that or those associated with milk fat, has also to be recognized. These accessory factors, however, appear to be required in only very minute quantities, and any increase in the amount above the adequate minimum does not result in an increased effect, and in this way they resemble iodine.

(*b*) The Relationship of Nutrition and Growth to Food Supply.

In attempting to correlate the food supply with the requirements of the child, it is necessary to consider what these requirements are. The determination is based upon a knowledge of the energy expenditure of the individual. This is the sum of the energy necessary for the maintenance of life, i. e. the basal requirements plus that used during absorption of food, for growth, for muscular activity and for heat production, along with the energy lost in the excreta.

The usually accepted standard of basal metabolism at different ages is based upon a long series of observations by Benedict and Talbot (1921). But, since these observations were made upon children who had been fed generously before and up to the few hours of fasting which preceded the determination of the metabolic rate, it is questionable how far the results are strictly applicable to children who are accustomed to a less abundant diet. Helmreich (1924), for instance, working in Pirquet's clinique, has shown that the amount of food which the child has been consuming has a very direct effect upon the basal metabolism after the usual period of abstinence from food before the test is made.

The work of Benedict (1922) on underfed adults is of importance in this connexion. Twelve young men were kept for four months on a diet containing a little more than half their usual supply of energy. They were accustomed to a diet yielding from 3,200 to 3,600 net calories per day, and it was found that, after the body weight had fallen 12 per cent., a diet yielding 1,950 calories was sufficient to maintain the weight and to enable them to carry on their college work, both intellectual and physical, without impairment. One squad of twelve subsisted for three weeks on 1,400 net calories without evincing any special disturbance. It would therefore seem probable that by chronic under-nutrition the level of the metabolism can be lowered and that the organism can maintain itself in metabolic equilibrium with a relatively low calorie intake. This no doubt occurred among the non-combatants of the Central Powers during the great war, and possibly, though to a less degree, it still occurs in the slum population of our great cities. It is the energy in the food over that required for basal metabolism which is available for growth and for muscular activity, and Benedict has shown that, for muscular work at least, this surplus is just as available in the under-nourished as in the well-nourished. Whether this also applies to growth we do not know.

The striking results of the low energy intake actually required recorded by Chittenden (1905) deserve reconsideration in the light of Benedict's work.

The difficulties of understanding the relationship of nutrition and growth to food supply are very great. The problem to be solved is—how far growth and nutrition are determined by the diet on the one hand, and, on the other hand—how far the amount of food consumed is determined by the nutritional requirements of the child. A copious diet may help to build up a large child, but the size and activity of the child may, in their turn, determine the amount of food consumed.

The conditions of life are very different for town and for country dwellers. In towns the work done by the wage-earner is generally less, and the energy evolved by the children is limited by their less active life and by their less exposure to adverse weather conditions—cold and wet. Graham Lusk's (1915) observations on the dog show that want of muscular exercise is accompanied by a lowering of the basal metabolism. He found that after confinement in a cage for some months the basal metabolism had fallen no less than 16 per cent. without any loss in the body weight. 'Recovery from the condition was achieved through exercise.'

Further, in the town child the digestive capacity is probably reduced by the less sanitary conditions under which it lives and by the absence of the stimulus of fresh air and exercise. It is indeed problematic if the town child could deal with and use the amount of food consumed by the child resident in the country, even if it were available. The energy requirements of the children of an urban population are on an average lower than those of rural children, and the question arises—Do the country children eat greater amounts because they are bigger and more active, or are they bigger and more active because they eat more ?

A consideration of the relative weights of adults and of children in town and country suggests the possibility that the dwellers in the former require a smaller supply of food than those who live in the latter. Beddoe (1870) gives the difference in weight between adult men in rural Scotland and in Edinburgh and Glasgow as averaging 5 kilos (rural = 68 kilos : town = 63 kilos). This is a difference of nearly 8 per cent., and if the dietary requirements of the town man amounted to 2,700 calories per day, those of the country man would be 2,916 calories, irrespective of the influence of exposure to cold and of greater muscular activity.

Between the average weight of town and country children from 1 to 5 years we have found a difference of between 3 and 4 pounds, or nearly 11 per cent. On the basis of the figures for basal metabolism at different weights given by Benedict and Talbot (1921) that of the country child should be over 6 per cent. more than that of the town child. Taking into consideration the difference for other members of the families, if a family diet of 2,700 calories per man per day is sufficient to meet the requirements of the town dwellers, the greater weight of the country children would demand the equivalent of 2,900 calories without regard to the influence of exposure and greater muscular activity. If a difference of even 12 per cent. were discovered between the diets of the two types of families it would be difficult to decide whether the differences in the weight of the children were the result or the cause of the different consumption of food.

In the light of our present knowledge it would seem that the usually accepted estimates of the dietary requirements of families, especially of the urban poor, require revision. As already stated, the town dweller is generally one upon whom no great demands for the expenditure of energy are made, and who is accustomed either from necessity or choice to a restricted diet. The requirements of growth might therefore be met fully by a surplus food supply smaller than that required by a big country child with its greater activity and exposed to all weathers as well as being accustomed to a liberal diet. It would also seem possible that the dietary requirements of the families of agricultural labourers have been overestimated in the past. The studies recorded by A. Hill (1925) of the diets of Essex labourers (98 families), although not strictly quantitative and probably failing to include all the food used, give an average of only 2,872 calories per man per day, and the *résumé* of some previous work upon rural diets given in the report bears this out. In a study of the diets of asylum inmates in England there was also shown a lower energy intake than that generally considered necessary. The average of six asylums gave :

Males	2,644 calories
Females	2,350 ,,

(*c*) **Difficulties of Investigation and Methods employed.**

Not only are the difficulties of correlating nutrition and food supply very great, but the difficulty of procuring reliable information as to the family dietaries is enormous. Estimations of the food consumed based upon the money expended lead to erroneous conclusions. If the studies are to be of any value, accurate quantitative results must be obtained, and this implies the weighing of all the food consumed, a procedure which requires the constant attention of a trained investigator and the active co-operation of the mother. Even when the mother is intelligent and interested it is difficult to secure absolute accuracy, but when she is of the thriftless, indifferent class reliable results can only be obtained by endless trouble and attention on the part of the visitor. This is especially the case in towns, where the children may get pieces of bread or sweets outside, which, although generally noted, cannot be weighed, and, in some instances, are undoubtedly omitted. Hence, the studies must only be taken as representing on an average less rather than more of the actual amount of food consumed. The deficit, however, is probably not great, but it must be taken into account.

The method of conducting such studies is described in detail by one of us (D. N. P.) in the Introduction to a *Study of the Diet of the Labouring Classes in the City of Glasgow*, by Dorothy E. Lindsay (1913).

Weighing all the food purchased, examining and assessing the food value of all the refuse, and keeping accurate records of the meals taken by each member of the family, are so irksome to the mother and to the visitors alike, that it is rarely possible to get a study extending to more than a week. But the adoption of this period has the advantage that wages are generally paid weekly and that, when food is bought in advance, it is purchased for the week.

At the outset the question arises, How far does a study of this duration give a fair representation of the dietary habits of a family? Undoubtedly where the income fluctuates widely the food consumed may also vary. Dire poverty may necessitate its limitation, or temporary affluence may favour its expansion. It is, however, curious to observe how small these variations are in reality. During a week of poverty the food consumed is often little if at all decreased ; borrowing from neighbours carries the family over these bad times and expenditure on rent, fire, clothes, &c., is allowed to lapse, in order that food may be purchased. A prosperous week may follow on a period of poverty, but this unfortunately often means the payment of outstanding debts, without affording the means for increased expenditure on food. Even a more permanent increase of income is not always associated with increased purchase of food. Dietary habits, once formed, do not seem to be readily modified, and in poverty the choice of food is sadly limited.

The best evidence that these weekly studies do give a fair representation of the dietary of the poorer working classes is afforded by the repeated studies of the same families, carried out at intervals. These are not easy to secure, but we have been fortunate in obtaining the following :

Margaret Ferguson (1916–21) made four studies upon five families between 1915 and December 1918 : in 1915–16, in February 1917, in November 1917, and in December 1918. The energy intake is given in Table 105.

Table 105. *Calories per Man per Day in five Families.* (*Four Studies each.*) (Ferguson)

	Family.					
Date of study.	*1.*	*2.*	*3.*	*4.*	*5.*	*Average.*
May 1915 to May 1916 .	2,836	4,174	3,003	3,318	3,568	3,380
Feb. 1917 . .	2,530	3,112	2,714	3,476	3,690	3,104
Nov. 1917 . .	2,289	4,079	3,159	3,650	3,202	3,276
Dec. 1918 . .	2,713	2,892	3,003	3,332	3,691	3,126
Averages .	2,592	3,564	2,969	3,444	3,538	3,221

The average calorie intake of all these five families shows only a small variation, even during the critical period of the war—from 3,104 to 3,380 (Atwater's standard) or from 2,661 to 2,897 (Lusk's standard), and the dietary habits of each family tended to remain more or less constant. Thus, families 1 and 3 had throughout a lower calorie intake than families 4 and 5, while family 2 tended, unless prevented by poverty, to indulge in more generous diets.

Tully and Urie (1922) have recorded two studies of two families closely succeeding one another.

Table 106. *Dietary Studies of two Families* (Tully and Urie).

Date.	*Calories per man per day.*	*Income per man per week.*	*Per cent. of income spent on food.*
April 1921 . .	2,999	11/11½	72 2
May 1921 . .	2,810	3/3¾	228·7
June 1922 . .	1,808	4/4½	60·3
Nov. 1922 . .	2,072	6/1¼	57·3

In the first of these studies, in spite of the reduction of the income to less than a third, the dietary habit was maintained, the food being secured by borrowing and credit. In this family, after a year of continued poverty a third study showed that the calorie intake fell to 2,370 on an income of 4*s.* 7½*d.* per man per week and that nearly all the income, 97 per cent., was spent on food.

In the case of one family three separate studies were made at intervals over a period of four years, the income varying from 5*s.* 11*d.* to 7*s.* 4*d.* per man per week.

The results of the three studies are given in Table 107.

Table 107. *Three Dietary Studies of one Family.*

Date.	Calories per man per day.	Income per man per week.	Per cent. of income spent on food.
April 1921 (Tully)	2,766	7/4	94·3
June 1922 (Tully and Urie) . .	2,088	5/11	71·6
Sept. 1924 (MacNae)	2,344	7/2¾	63·7

This family will be dealt with again in considering the relationship of diet to height and weight (p. 179).

Studies extending over a week would thus seem to afford reliable results.

In a study of 98 families of agricultural workers by A. Hill (1925) an attempt was made to estimate roughly the energy value of the diet without actually measuring the amount consumed. Records of the diet of 6 families over different weekly periods are given, showing a close correspondence between the different periods in the case of each.

Another difficulty which has to be faced is that the diet at any particular period of the family history does not necessarily represent the conditions at an earlier period. Thus, it is well known that, when a couple marry, their income may be adequate till the birth of, say, three or four children, when circumstances become strained. After the elder children have passed school age and begun to earn, circumstances again become easier. A dietary study made in the second period might not represent the conditions under which the elder children had passed the early years of life.

(*d*) Previous Work.

It is unnecessary here to deal with the older work upon the energy requirements of the individual and upon family dietaries since these are considered in all the larger text-books of Physiology.

The numerous studies of family diets made by Atwater and his followers in America and by various workers under the direction of one of us (D.N.P.) in this country unfortunately are not of use for the purposes of the present investigation, since the condition of growth and nutrition of the children was not studied. These investigations were made with the object of determining how far the diets conformed with a theoretical standard of the requirements of the class studied.

A long series of family dietary studies carried out in Edinburgh and Glasgow from 1900 to 1923 seem to show that the energy value of the diet of the poorer labouring classes averages about 2,700 C. per man per day (Lusk's standard), but that during periods of trade depression and unemployment it may fall to about 2,200 C.

Only in the later of these inquiries was the physical condition of the children studied, and the data from these have been incorporated in the present investigation (p. 155 *et seq.*).

A qualitative study by Hughes and Roberts (1922) of the diet of 6,015 children between the ages of 2 and 7 years in Gary, Indiana.

TABLE 108. *Energy Value of Diets of Urban Families.*

No.	*Year.*	*Number of labouring-class families.*	*Calories, man equivalent.*	*Lusk's standard.*
1	1900	13*	2,792†	
2	1912	40	2,720†	over 5/-‡ 2,850; under 5/- 2,430
				Five families re-studied.
3	1915–16	40	2,900	2,897
4	Feb. 1917	10	2,660	2,661
5	Nov. 1917	5	2,808	2,803
6	Dec. 1918	5	2,670	2,670
		Unemployed and short time.		
7	Apr. 1921	11	2,500	over 8/- 2,470; under 8/- 2,505
8	June 1922	12	2,390	over 8/- 2,600; under 8/- 2,180
		Artisan class.		
9	May 1923	17	3,070	

* This study was made in Edinburgh, the rest in Glasgow: two families without a man are excluded from the original series of 15.

† In the earlier series of studies Atwater's coefficient of man value was used, but in the later ones that of Lusk was adopted. It has been found that in the average family, e. g. man, wife, and three children, the Lusk coefficient is about 14 per cent. under the Atwater standard, and, for comparison, this reduction has been made.

‡ 5/- per man per week, i. e. total income divided by man value of family.

U.S.A., throws some light upon the relationship of feeding to nutrition, but this study was merely qualitative not quantitative, the visitor simply ascertaining the material used in the children's meals on the day preceding the visit. The diets were classified into five groups—A, B, C, D, and E—according to their adequacy and suitability for children of these years. A and B diets were those apparently capable of covering the child's actual requirements, A being both adequate and suitable, and B adequate but with one or more flaws in respect to suitability. In A the children had at least 1½ pints and in B at least 1 pint of milk. C diet was questionable in its adequacy, but the child had at least one cup of milk. D diet lacked one or more of the essentials of nutrition and E was an almost entirely deficient diet, with usually no milk or less than half a pint per day. As regards the use of milk, the authors find that it is related to income, but that 'More than half of all the children (57·2 per cent.) had no milk at all to drink on the day for which the diet was reported'. Further, they find that 'in spite of the more extensive use of milk in the "group with the highest income" there still remains 38·5 per cent. of this group who were drinking no milk, and only 31·5 per cent. of them were receiving a pint or more daily'. Of the children in a more favoured residential district '44·7 per cent. had no milk to drink and only 30·1 per cent. had so much as the pint minimum'.

They found that only 8·9 per cent. of all the children had an adequate diet (qualitatively) and 29·2 per cent. a questionable diet, whereas 60·5 per cent. had an inadequate diet. They further found that, as regards the relationship to income, the A and B diets steadily increased in proportion as the highest income level was approached, while the proportion of inadequate diets fell. 'But the actual proportion of adequate and inadequate diets in the highest income group shows clearly that poverty is not the sole cause of faulty feeding. . . . The conclusion to which these data lead—that the need of education regarding the food needs of growing children is not restricted to the low-income groups—is borne out by other sections of the report.' The curious fact is noted and shown that even in children in families with the larger incomes there is still a considerable percentage of grades D and E (inadequate) diets.

The physical condition of the children is considered in relation to the diets. The authors say, 'If, as is frequently stated, weight is an accurate index of nutrition, a close relation might be expected to appear between the weight for height groups and the grade of diet. However, the distribution of the children in these weight groups . . . seems to bear little relation to their classification according to diet.'

TABLE 109. *Relation of Weight to Height by Grade of Diet* (Hughes and Roberts).

Relation of weight to height.	*Grade of diet.* A and B.	C.	D and E.
	(Percentage distribution of cases.)		
Average and above	40·7	42·9	43·5
Below average	57·8	59·3	56·5

They conclude—' . . . little correlation was found between weight for height and grade of diet.'

The results of most of the more important work upon the diets of Agricultural labourers in this country are summarized in Hill's paper (1925 *b*) on page 111 *et seq.*, and these have been tabulated in Table 110.

TABLE 110. *Calories consumed per Man per Day by Agricultural Labourers, according to Various Investigators* (from Hill).

Investigator and date.	*Calories consumed per man per day* (Lusk).
Dr. Edward Smith in 1863	2,800 to 3,100
S. Rowntree and M. Kendall in 1913	2,702
Board of Trade in 1903 (Cd. 1761)	3,037
Agricultural Wages Board in 1919 (Cmd. 76)	2,805

On page 103 *et seq.* of a previous report (1925 *a*) the results of the investigations on the diets of Essex labourers are given, showing that the average energy value is roughly 2,900 calories per man per day. After dealing with the weight and height of the children of these families the author concludes—' . . . the evidence as to the nutrition and growth of the Essex agricultural labourer's children does not support the view that a low diet is adversely affecting them. But there are other factors, e. g. the large proportion of vitamins present in their diet (in the fresh vegetables) and in the sunlight and open air to which they are continually exposed—the influence of which it is impossible to measure.'

In his more recent paper (1925 *b*) Hill states : ' In spite of the diet being low there is little evidence of malnutrition among the rural children of Essex, and their physique is better, age for age, than that of urban children, living on a diet equivalent or superior in energy value. Other factors, especially the " racial " factor and the " fresh air and sunlight " factor, however, must exert such an influence that the efficacy of the diets cannot be satisfactorily measured by a comparison of heights and weights.'

A fairly extensive study of the diet of Coal-miners' families is given in the Report on the Nutrition of Miners and their Families (1924). In this Report it is stated, ' In Derbyshire, where the weekly income per " man " of the miners' families examined is 16*s*. and the calorie intake 3,336, at ages 4–13 the heights for boys at all schools was above that of miners' sons (44 in number) except at the two extreme ends of the curve. In weight the miners' sons were slightly below except at the ages 8–11. In the case of the miners' daughters (50 in number) the general trend was the same as in Derbyshire school-girls in general, though there was a good deal of fluctuation in the individual age groups owing to the small numbers. In weight they were slightly below the general average except at the ages 7, 8, and 9. .

' In Durham, where the weekly income per " man " of the miners' families examined is only 9*s*. and the calorie intake 2,830, the miners' sons (53 in number) are below the general school standard in height, except at age 6 (in which group there are only two observations) ; and in weight they are well below the general average, most nearly approaching at the two extreme ends of the curve. In height the miners' daughters (57 in number) more nearly approach the general standard for the country than do the boys, but only at ages 6 and 11 do they exceed it. In weight they at no point exceed the standard, approaching it only at ages 6, 8, and 11.'

Hill gives graphs of the weights and heights of the children, and the conclusion is drawn that ' the children in our sample of Durham miners' families are, judged by the standard of all school children in the county, under weight '. The report goes on to say : ' It is not easy to determine how far this low weight is the result of an inadequate diet and how far other factors are concerned, but an attempt to correlate weight with calorie intake does not afford evidence of direct relationship. It would seem as if some other factor were operative. It is manifest that the nutrition of a child may be modified by want of sleep, by impaired digestion, and by other conditions.'

Hammond and Sheng (1925) record an interesting study of the development and diet of children in Northern China in a school for orphans and waifs.

The growth curves of these children, as indicated by charts of height for age and weight for age, run parallel with the curves for American children, given by Baldwin, but they are at a lower level—the children are throughout smaller. Sample diets of the Chinese children of 8 years of age gave 900 calories, of which 13 to 14 per cent. were yielded by fats, 74 to 75 by carbohydrates, and 11 to 12 by proteins. Sample diets for children of 12 years of age gave 1,000 calories, and those of children of 16 years of age gave 1,700 calories. A comparison of these diets with American diets is given, and it shows that these diets have about one-half the energy value of the diets of American children. ' No milk, butter, eggs, and practically no fruit were used. In spite of this the children lived a happy useful life, working hard and playing actively,' and, as already indicated, they showed a normal growth curve.

(ii) Present Investigation

It was, of course, impossible to carry out dietary studies on all the families investigated, but we have been successful in obtaining reliable information on the diets of typical samples of the various types of families included in our larger investigation: (1) certain slum families in Glasgow and Dundee, (2) families belonging to the artisan class in Glasgow, (3) families of the agricultural labouring class, and (4) families of coal-miners in Stirlingshire. These last were carried out in the course of the investigation into the dietaries of miners' families (loc. cit.) and have been used by us.

In all the investigations the method devised by Atwater and fully described by D. Noël Paton in the introduction to Miss Lindsay's report (1913) was used.

(*a*) **Glasgow Families.**

A. *Labouring-class Families: Fathers Out of Work or on Short Time.*

I. *Abstract of paper published in* 'Lancet', 1921, ii. 57, by Annabel M. T. Tully.

During April 1921, a study was made of the dietaries of 11 typical labouring-class families in Glasgow, with the view of ascertaining the effect of the present trade depression upon their food consumption. A general strike of coal-miners was in progress, and the fathers were either out of work or on short time.

This is a continuance of the series of dietary studies carried out by Miss Ferguson upon the same class during the war, all of which form supplements to the more exhaustive study made in 1911–12 by Miss Lindsay. The method of study and the source of the food analyses were those used by Miss Lindsay and Miss Ferguson. In each case the food was weighed and the waste collected for the period of a week. The studies included 12 men, 11 women, 34 children under 10 years of age, and 11 children over 10, i. e. 68 persons in all.

To make the results of the various families comparable and to render a comparison with the previous observations possible, the food is expressed as that consumed per unit of population—i. e. per man per day, taking the requirements of women and children at the usual proportion of those of a man (Lusk's standard).

In Table 111 the families are grouped according to income, above or under 8*s*. per man per week.

The energy values differ little in the two groups, but in the poorer families a larger proportion of energy is got from carbohydrates.

These tables show—what has been emphasized in previous studies of the social conditions of the very poor—that food, the supply of energy, is the first charge upon income.

TABLE 111. 1921 *Glasgow Dietaries* (Tully).

A. FAMILIES HAVING OVER 8s. PER MAN PER WEEK.

No.	Man value for diet.	Income weekly. Total.	Income weekly. Per man.	Expenditure weekly on food. Per man.	Expenditure weekly on food. % of income.	Calories per penny.	Diet per man per day. Proteins.	Diet per man per day. Fat.	Diet per man per day. Carbo-hydrates.	Calories.
		£ s. d.	s. d.	s. d.			gm.	gm.	gm.	
I	3·12	1 15 0	11 11¼	13 7¾	114·3	125·0	72·0	83·4	418·5	2,789
II	2·33	1 17 3	15 10½	6 5¼	42·3*	176·9	55·1	61·6	310·5	2,070
III	2·73	1 5 6	9 1¾	5 5¾	58·8*	176·3	43·4	47·9	252·9	1,660
IV	6·02	3 12 0	11 11½	8 5½	72·2	232·3	99·8	94·4	417·6	2,999
V	6·36	3 11 0	11 2	11 9½	105·8	158·6	94·4	100·7	363·2	2,813
Average	4·11	2 8 1¾	12 0	9 1¾	78·7	173·8	72·9	77·6	352·5	2,466

B. FAMILIES HAVING 8s. OR UNDER PER MAN PER WEEK.

No.	Man value for diet.	Income weekly. Total.	Income weekly. Per man.	Expenditure weekly on food. Per man.	Expenditure weekly on food. % of income.	Calories per penny.	Diet per man per day. Proteins.	Diet per man per day. Fat.	Diet per man per day. Carbo-hydrates.	Calories.
		£ s. d.	s. d.	s. d.			gm.	gm.	gm.	
VI	5·30	2 5 0	8 0	8 8¼	111·1	211·1	86·8	94·8	530·7	3,414
VII	3·50	1 10 0	6 10½	7 4	110·0	185·6	75·1	92·4	456·7	3,039
VIII	5·45	2 0 0	7 4	6 9¼	94·3	232·9	76·6	60·6	460·9	2,766
IX	4·35	1 5 0	5 8¾	5 6	98·6	248·8	64·9	73·1	359·1	2,426
X	2·93	1 3 6	7 10	4 1	53·2*	218·7	30·9	57·6	231·1	1,610
XI	2·33	0 13 0	5 6¾	4 3½	80·8	221·8	50·0	61·2	244·1	1,775
Average	3·98	1 9 5	6 10½	6 1¼	91·3	219·8	64·1	73·3	380·4	2,505

* The small percentage of the income spent on food was due to the fact that a considerable amount was being paid in liquidating outstanding debts; the proportion of available income spent on food was much higher.

Most of the families are living in very poor overcrowded quarters. The conditions may be briefly stated as follows :

Group A.

Average number of rooms	1·4
Average number of inmates per family	5·8
Average number of inmates per room	4·14
Average air-space per person	337 cub. ft.
Average rent per week	6*s.*

Group B.

Average number of rooms	1·5
Average number of inmates per family	6·5
Average number of inmates per room	4·33
Average air-space per person	309 cub. ft.
Average rent per week	6*s.* 6½*d.*

The social condition of these families is described in the original paper.

Condition of the Children.

The weights and heights of the children in these families is indicated by ● on the appended charts. (See Charts XXXIV, XXXV, XXXVI, and XXXVII.) These charts show the heights and weights of the children in the three dietary studies carried out in Glasgow grouped around the mean height and weight of Glasgow children as found in the present investigation. It will be seen that the weights and heights of the majority of the children in the first two studies (i. e. poor labouring-class children) fall below the mean, while the weights and heights of the children in the third study (i. e. artisan-class children, see p. 165) are for the most part above the mean line.

II. *Abstract of paper published in the* ' Glasgow Medical Journal ', *December* 1922,

by Annabel M. T. Tully and Elizabeth M. Urie.

Since the last study was made trade depression has become increasingly pronounced and unemployment has extended on all sides. Accordingly, it was thought that it might be of interest to investigate the effect of this prolonged period of unemployment, and a study was therefore made of twelve typical families in June and the beginning of July 1922. These families were not chosen as being specially necessitous, but were selected as representative of the type constantly met with in connexion with Child Welfare work in the poorer districts of the city. The study included 18 men, 14 women, 37 children over 5 years, and 25 under 5 years—in all, 94 individuals. Eight of the fathers had been unemployed for a considerable time, and of the remaining four two were dockers with a constantly varying income, and two were working on short time. Fortunately, it was possible to include in the present study three of the families (Nos. II, III, IV) from those which were investigated in April 1921—No. II on two separate occasions.

With the exception of families Nos. II and III (docker families), and VII and XI (on short time), all had been unemployed for several months. At first they had received from the Labour Bureau an un-

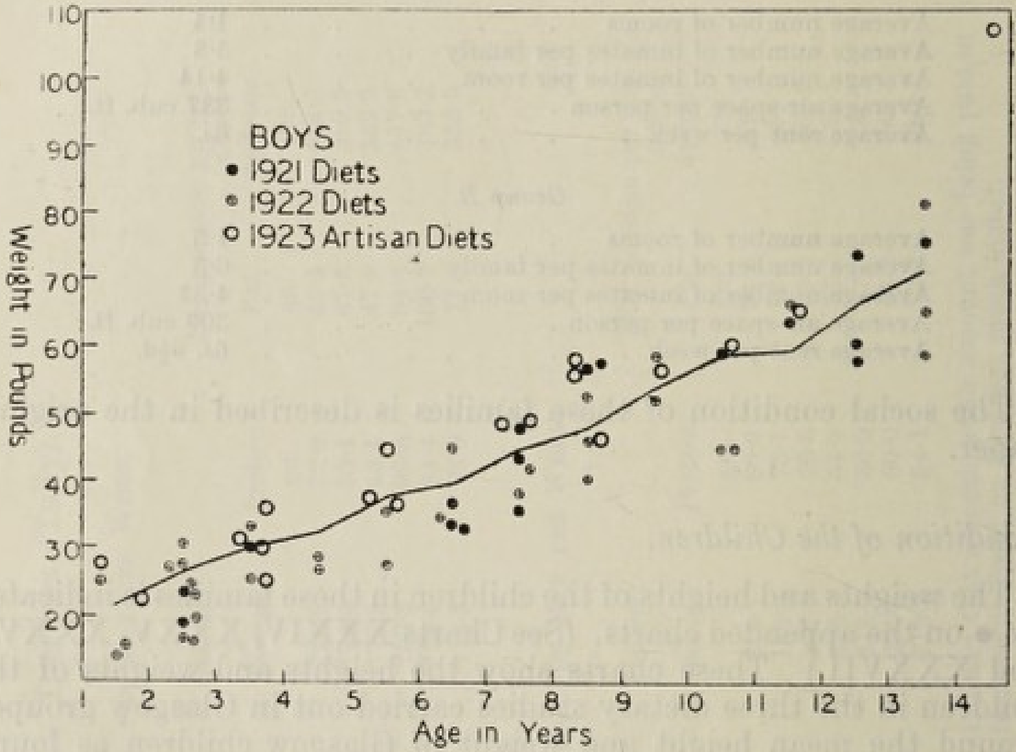


CHART XXXIV. Weights of boys in three Glasgow dietary studies plotted on mean weight curve of Glasgow boys.

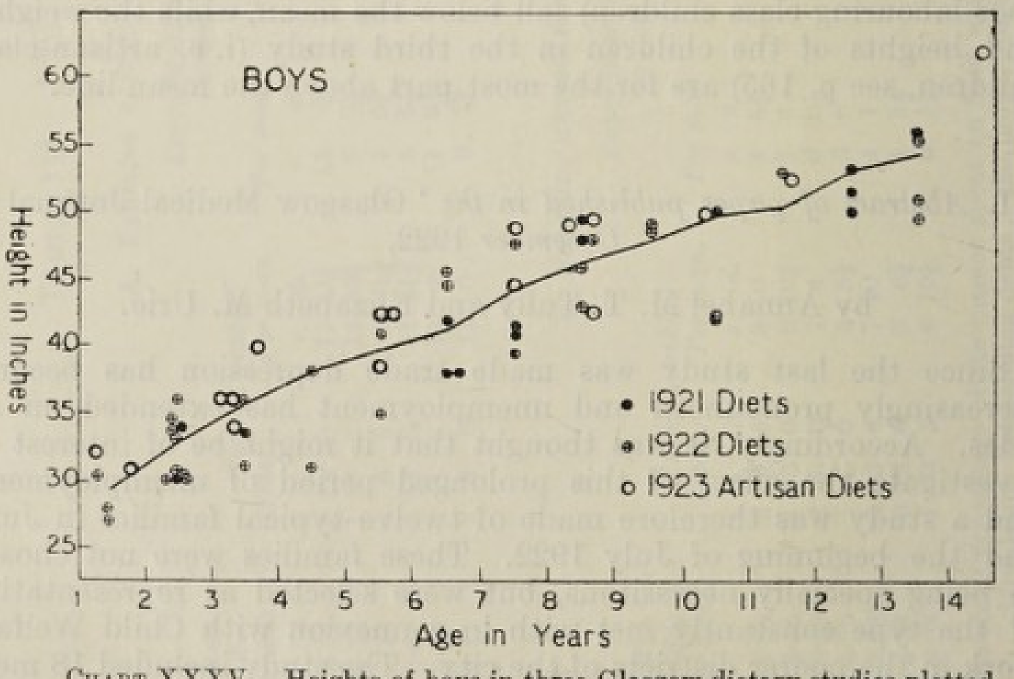


CHART XXXV. Heights of boys in three Glasgow dietary studies plotted on mean height curve of Glasgow boys.

employment weekly allowance—a sum varying according to the size of the family—which was augmented by a fortnightly dole from the Parish. The result of this, in some cases, was an ability to meet expenses for the first week by using up the fortnightly Parish allowance, and in the second week, when money was received from the

Bureau only, by contracting debts. A change was made in the administration of the Unemployment Insurance at the beginning of April 1922. By that time most of the men had exhausted their un-

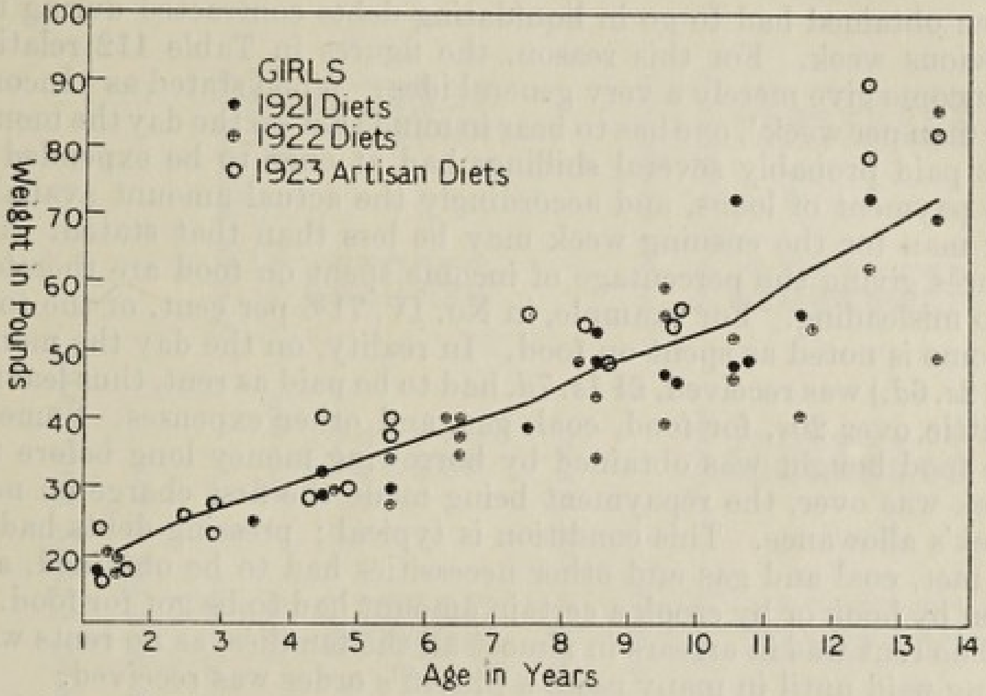


CHART XXXVI. Weights of girls in three Glasgow dietary studies plotted on mean weight curve of Glasgow girls.

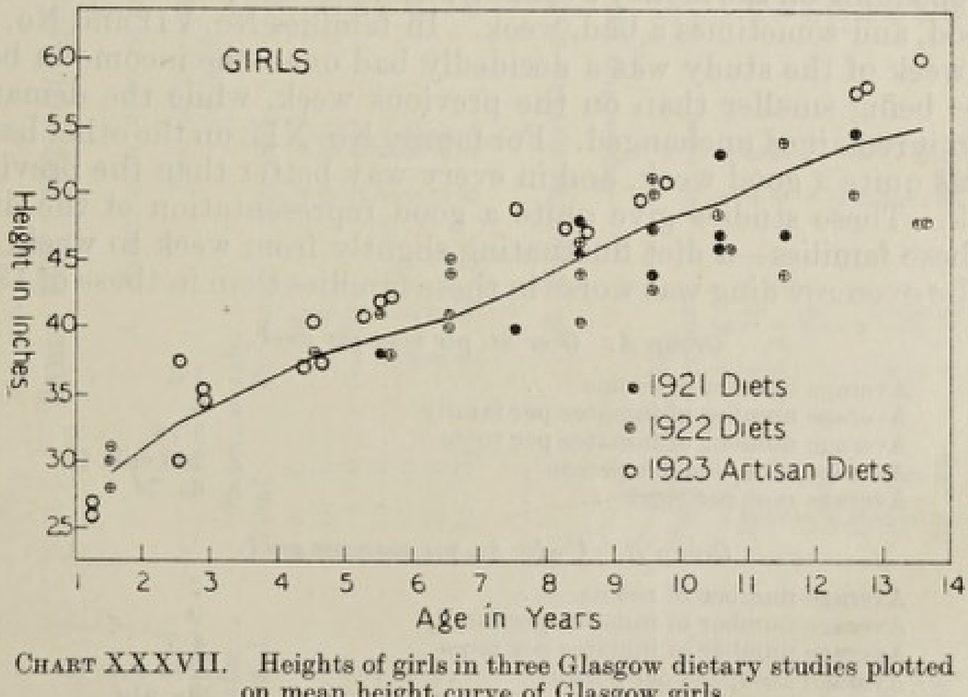


CHART XXXVII. Heights of girls in three Glasgow dietary studies plotted on mean height curve of Glasgow girls.

employment payments, with the result that they were only eligible for the five weeks' system. This meant that for five weeks they obtained their money in the usual way from the usual sources. Then for the next five weeks no money was received from the Unemployment Exchange, the Parish paying the full amount. Between the last Bureau payment and the first Parish augmented payment there was, in many cases, a gap of ten days when the people had no income at all. Food was obtained by borrowing money from neighbours, and in some cases credit was given by shopkeepers. Thus, the people were in a continuous state of debt, and a large percentage of their income when obtained had to go in liquidating debts contracted during the previous week. For this reason, the figures in Table 112 relating to income give merely a very general idea. When stated as 'Income per man per week', one has to bear in mind that on the day the money was paid probably several shillings had at once to be expended in the payment of loans, and accordingly the actual amount available per man for the ensuing week may be less than that stated. The figures giving the percentage of income spent on food are therefore also misleading. For example, in No. IV, 71·6 per cent. of the total income is noted as spent on food. In reality, on the day the money (£2 2*s*. 6*d*.) was received, £1 1*s*. 7*d*. had to be paid as rent, thus leaving a little over 20*s*. for food, coal, gas, and other expenses. Some of the food bought was obtained by borrowing money long before the week was over, the repayment being made the first charge on next week's allowance. This condition is typical; pressing debts had to be met, coal and gas and other necessities had to be obtained, and then by hook or by crook a certain amount had to be got for food.

The rent was in arrears in almost all the families, as no rents were being paid until in many cases a Sheriff's order was received.

In Table 112 the families are grouped according to income, above and under 8*s*. per man per week.

Depending on the money available, these diets represent sometimes a good, and sometimes a bad, week. In families No. VII and No. XI the week of the study was a decidedly bad one—the income in both cases being smaller than on the previous week, while the demands upon it remained unchanged. For family No. XII, on the other hand, it was quite a good week, and in every way better than the previous week. These studies give quite a good representation of the diets of these families—a diet fluctuating slightly from week to week.

The overcrowding was worse in these families than in those of 1921.

Group A. Over 8s. per man per week.

Average number of rooms	1·6
Average number of inmates per family	6
Average number of inmates per room	3·75
Average air-space per person	298 cub. ft.
Average rent per week	6*s*. 7*d*.

Group B. Under 8s. per man per week.

Average number of rooms	2
Average number of inmates per family	9
Average number of inmates per room	4·5
Average air-space per person	276 cub. ft.
Average rent per week	6*s*. 9¼*d*.

Condition of children.

The weights and heights of the children in these families are indicated by $\oplus$ on Charts XXXIV, XXXV, XXXVI, and XXXVII, on pp. 158, 159.

The social conditions of these families are described in detail in the original paper, and briefly above.

TABLE 112. 1922 *Glasgow Dietaries* (Tully and Urie).

A. FAMILIES HAVING OVER 8*s.* PER MAN PER WEEK.

No.	Man value for diet.	Income weekly. Total.	Income weekly. Per man.	Expenditure weekly on food. Per man.	Expenditure weekly on food. % of income.	Calories per penny.	Diet per man per day. Proteins.	Diet per man per day. Fats.	Diet per man per day. Carbo-hydrates.	Diet per man per day. Calories.
		£ s. d.	s. d.	s. d.			gm.	gm.	gm.	
I	2·56	1 10 0	8 6	5 3½	62·2	219·1	74·3	99·8	367·6	2,740
III	6·53	3 4 0	9 10	5 6¼	56·4	234·9	67·3	81·8	289·8	2,225
VI	3·43	1 10 0	8 9	8 6	97·2	223·6	98·4	93·5	484·5	3,259
VIII	3·93	1 15 0	8 11	4 8½	52·9	282·0	68·4	70·6	326·6	2,276
IX	3·94	1 12 6	8 1	6 4¼	78·7	226·9	83·5	92·8	321·5	2,523
Average	4·08	1 18 3½	8 9¾	6 1	69·5	237·3	78·4	87·7	358·0	2,605

B. FAMILIES HAVING UNDER 8*s.* PER MAN PER WEEK.

No.	Man value for diet.	Income weekly. Total.	Income weekly. Per man.	Expenditure weekly on food. Per man.	Expenditure weekly on food. % of income.	Calories per penny.	Diet per man per day. Proteins.	Diet per man per day. Fats.	Diet per man per day. Carbo-hydrates.	Diet per man per day. Calories.
		£ s. d.	s. d.	s. d.			gm.	gm.	gm.	
II	6·52	1 10 0	4 7¼	4 6	97·5	308·4	62·9	59·7	380·2	2,372
IV	7·19	2 2 6	5 11	4 2¾	71·6	287·9	44·3	62·5	323·1	2,088
V	7·42	2 1 0	5 6¼	4 6¼	81·7	277·9	61·4	65·2	315·3	2,151
VII	3·83	8 6	2 2	2 11	134·3	290·9	50·9	46·0	207·6	1,488
X	4·04	1 15 0	7 9	5 1¾	66·4	242·2	77·6	65·0	357·1	2,387
XI	9·75	2 5 6	4 4½	2 7½	60·3	374·9	57·4	35·6	302·9	1,808
XII	3·5	1 7 0	4 6¼	3 0¾	67·6	333·7	83·7	94·8	428·6	2,983
Average	6.04	1 12 9½	4 11¾	3 10¼	82·8	302·3	62·6	61·3	330·7	2,182

B. *Glasgow Labouring-class Families: Employed*

It was felt that the diet of the unemployed might give a false idea of the average diet of the community studied, and for this reason in 1924 Miss MacNae undertook an investigation of the diets of nine families representative of the same social class and all engaged in work during the week of the study.

It was found difficult to procure such families since the attraction of the dole induced many who might have found employment to refrain from working.

That the families selected are typical of the class included in the main study is indicated by the short description of their conditions (see Appendix III), by the fact that their average income per person per week was 11·1*s.* as against 9·32*s.*, the average rent 5*s.* 11½*d.* as

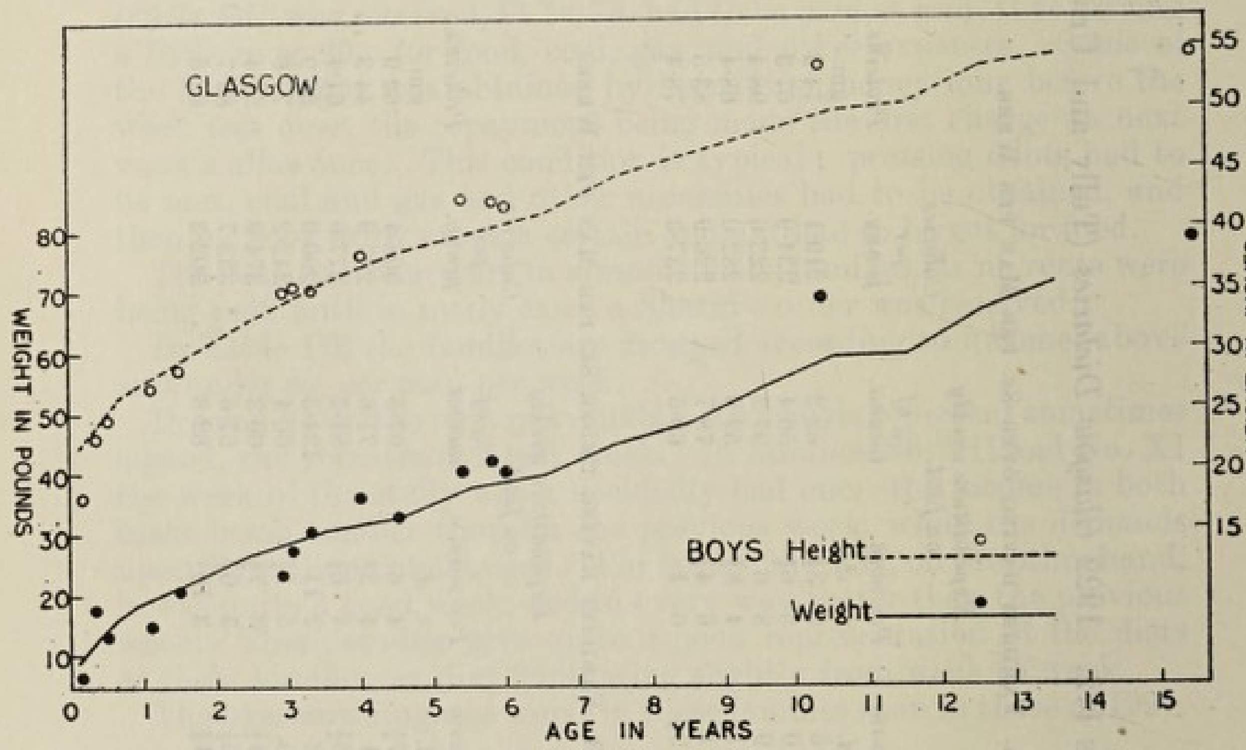


CHART XXXVIII. Heights and weights of boys in Glasgow dietary studies (1924) plotted on mean height and weight curves of Glasgow boys.

against 5*s.* 10*d.*, and the average air-space 325·05 as against 404·53 cub. ft., in the families used for the more extended study of environmental conditions, and that the weights and heights of the children corresponded closely to that of the mean for the main group (see Charts XXXVIII and XXXIX).

Table 113 gives, (i) the occupation of the father, (ii) the man value of the family, (iii) the income, (*a*) total and (*b*) per man per week, (iv) the amount spent on (*a*) food and (*b*) the percentage of income spent on food, (v) the calories purchased per penny, and (vi) the composition and energy value of the diet per man per day.

It will be seen that the calorie intake varies from 1,933·9 in No. V to 3,614·5 calories in No. VIII, with a mean of 2,626. In family V, 55·5 per cent. of the income was spent on food; in family VIII, all the income was spent on food. In the former, only 132 calories were purchased per penny; in the latter 207. The former paid 9*s.* 3½*d.* in rent, the latter only 4*s.* 2*d.* These are typical extreme examples of domestic management. The first mother sacrificed food to housing and dressing her children, the second disregarded the house and in the week of the study spent more than her income on food. Generally, however, she managed to pay rent, &c., and to avoid debt. Family IV approximates in all particulars to VII. The parents and children were large, 78·8 per cent. of the income was spent on food, and the rent was only 3*s.* 3*d.* The marketing was extraordinarily good—268 calories per penny being purchased. The diets of the other six families vary from 2,237 to 2,734 calories, averaging practically 2,430, as against 2,616, the average of the whole series.

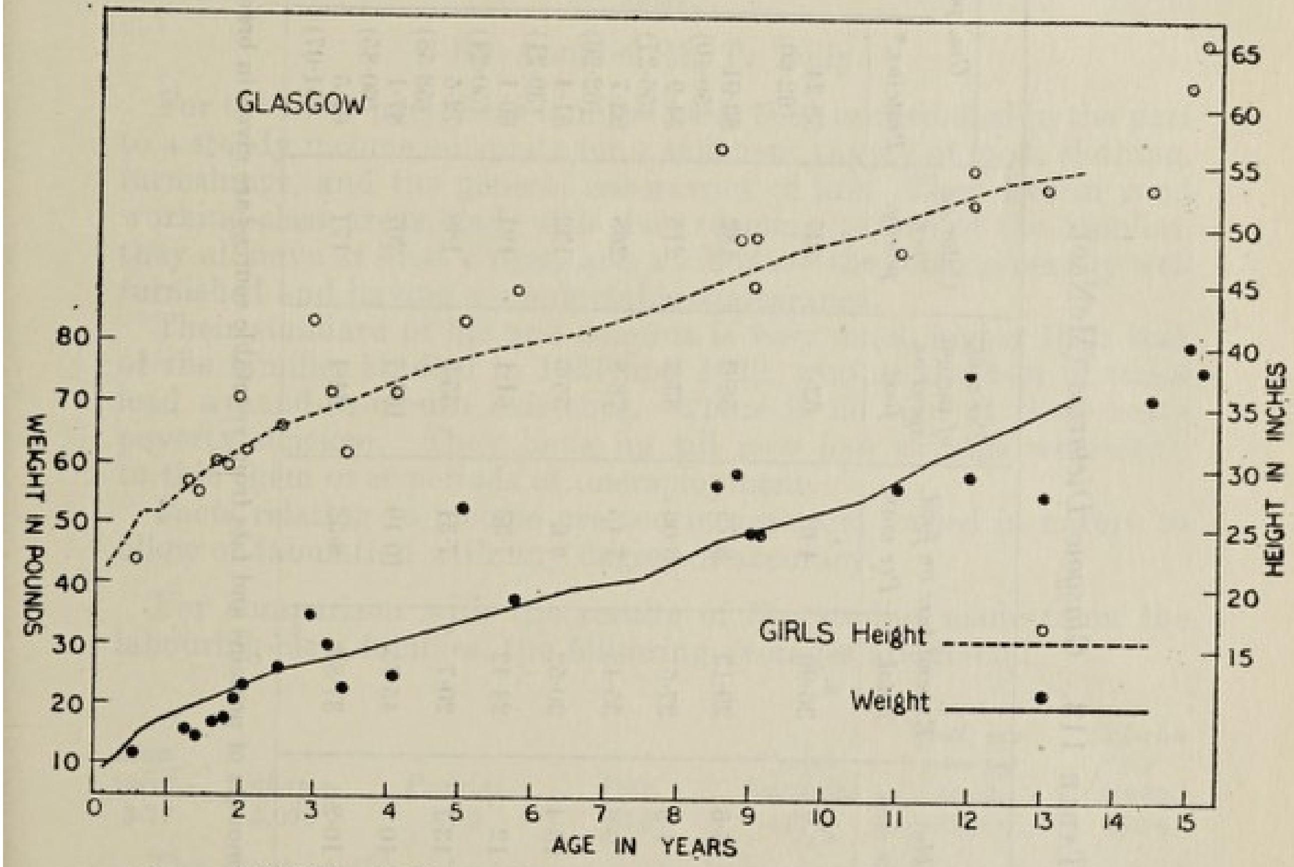


CHART XXXIX. Heights and weights of girls in Glasgow dietary studies (1924) plotted on mean height and weight curves of Glasgow girls.

It is interesting that the average income per man per week of these nine families was 8*s.* 8*d.*, as against 8*s.* 9¾*d.* in the first five of Miss Tully's and Miss Urie's series, and that the average energy value of the diet was 2,616 as against 2,605 calories in the former study.

The average percentage of income spent on food was 71·5, as against 69·4 in the previous Glasgow studies of families with incomes over 8*s.*, while in Dundee only 46·5 per cent. of income was spent on food, presumably due to the fact that in Dundee serious attempts were made to pay the rent and to discharge debts.

The most marked difference between these diets and those of the previous studies in Glasgow of the same class is the greater amount of milk used (see Table on p. 190).

TABLE 113. *Glasgow Dietaries* (McNae).

No.	Occupation.	Man value of family.	Income (weekly). Total.	Income (weekly). Per man.	Expenditure on food. Total.	Expenditure on food. Per man.	Per cent. of income spent on food.	Calories per penny.	Diet. Gm. per man per day. Proteins.*	Fats.*	Carbo-hydrates.	Calories.
			s.	s.	s.	s.						
I	Labourer (irregularly employed)	8·02	58	7·2	36·96	4·61	63·7	297	58·24 (62·60)	57·02 (50·61)	384·17	2,344·14
II	Labourer	3·33	52	15·6	29·13	8·75	56·0	182	83·01 (50·40)	82·04 (26·75)	395·25	2,723·99
III	Labourer	6·19	45	7·3	37·5	6·06	83·3	215	54·9 (56·27)	67·35 (35·71)	337·9	2,236·71
IV	Labourer	4·76	45	9·5	35·48	7·45	78·8	268	93·7 (62·26)	103·74 (44·11)	506·6	3,425·9
V	Barman	3·56	55	15·4	30·52	8·6	55·5	132	51·4 (39·21)	79·8 (6·73)	239·1	1,933·9
VI	Lamplighter	3·33	40	12	24·42	7·33	61·1	191	66·1 (50·24)	81·5 (42·48)	335·1	2,402·4
VII	Labourer	2·83	37	13·1	20·7	7·31	55·9	188	72·6 (58·58)	62·9 (35·58)	359·4	2,356·2
VIII	Labourer	4·49	45	10	45·75	10·19	101·7	207	87·1 (60·85)	92·3 (37·62)	585·1	3,614·5
IX	Labourer	4·43	45	10·2	37·86	8·55	84·1	171	67·5 (51·07)	77·9 (10·36)	366·9	2,505·6

* The percentage amounts of proteins and fats from vegetable sources are given in brackets.

C. *Glasgow Artisan Families*

For comparison with these studies of the diets of the very poor, an investigation was made of the dietaries of seventeen well-to-do artisan families in Glasgow consisting of 88 individuals. The artisan class is very different from the class of casual labourers considered in the last two papers. It is generally composed of men of energy, vigour, intelligence, who have been born in this class or who have raised themselves to it by force of character.

Abstract of Paper published in Glasgow Medical Journal, *January* 1924,

By Annabel M. T. Tully.

For the most part these families have been accustomed in the past to a steady income adequate for a sufficient supply of food, clothing, furnishings, and the general necessaries of life. They live in good working-class areas, and, with the exception of two of the families, they all have at least a room and a kitchen—the room generally well furnished and having a comfortable appearance.

Their standard of life and comfort is very much higher than that of the families studied in 1921 and 1922, who at the best of times lead a hand-to-mouth existence. There is no sign of their being poverty-stricken. They have up till now had savings wherewith to tide them over periods of unemployment.

Facts relating to income are too meagre and varied in nature to allow of tabulation with any degree of accuracy.

For comparison with the results of the studies made upon the labouring-class families, the following averages are given :

Man value.	*Calories.*	*Proteins.*	*Fats.*	*Carbo-hydrates.*	*Spent on food, per man per week.*	*Calories per penny.*
3·77	3,070	87·9	96·8	441·1	10·38*s*.	176·6

The most striking features are the larger supply of energy and of proteins and fats in the diet, the larger amount spent on food and the less amount of energy per penny purchased, due to the possibility of purchasing delicacies in addition to necessities.

Condition of children.

The weights and heights of the children are marked ○ on the charts on pp. 158 and 159.

(*b*) **Dundee Families, Labouring Class**

Dundee, as is well known, is the centre of the jute industry, an industry which, after prospering for nearly a century and specially flourishing during the war, has suffered very acutely from the subsequent trade depression and the competition of factories in India. The skilled labour in jute factories is performed chiefly by women and the unskilled labour of men and boys is consequently poorly paid. The subsidiary industry of shipbuilding is not large enough to absorb men in proportion to the women engaged in jute or in confectionery—the second subsidiary employment. (The 1921 census gives 12,579 men to 24,090 women employed in the textile industries.) In fact, Dundee has always been known as a 'women's town', females (1921 census) numbering 93,636 and males 74,679, and it is not uncommon for the men to stay at home and keep house while the women are the wage-earners.

The normal state of insufficient work and low wages for men has been very much aggravated by the pronounced trade depression, and matters were made still worse by a four weeks' lock-out of jute workers in March 1923, which for the majority of the workers meant running heavily into arrears with rent and pawning household goods

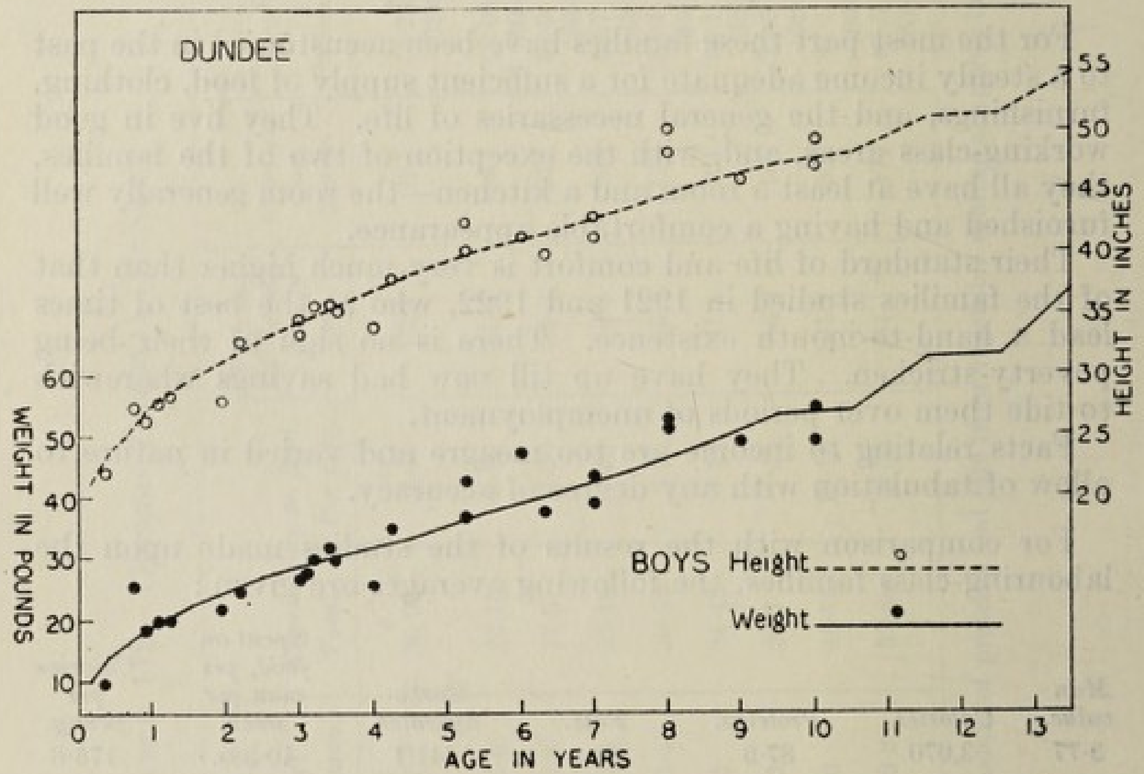


CHART XL. Heights and weights of boys in Dundee dietary studies plotted on mean height and weight curves of Dundee boys.

to obtain the barest necessaries. The dietary studies were made in May and June 1923 during a period of special privation, and the families were representative of the different types of worker studied in the main report.

That the families selected were typical of the population studied is shown by the fact that their average rent per family and average air-space per person correspond closely with those of over 1,000 families used in the more extended study:

	Air-space. c. ft.	*Rent.* *s.* *d.*
Total families investigated	421	4 9¼
Families used for dietary study	372	5 0¼

and, as will be shown later, by the fact that the weight and height of the children differ little from the mean of the whole series. (See Charts XL and XLI.)

In the 12 families there are 14 men, 13 women, 24 children over 5 years, and 28 under 5 years—in all, 79 individuals. Two of the children were visitors and are not included in the charts.

In three families (Nos. X, XI, XII) both father and mother had been unemployed for from six months to two years : in two (Nos. II, IV) the mother alone was working, while in one (No. III) both parents were working to make up for loss of savings during the lock-out. The other six families (Nos. I, V, VI, VII, VIII, IX) represent the ordinary more or less skilled worker, in fairly constant employment.[1]

The method used was that employed in the Glasgow studies, and explained by Professor Noël Paton in his introduction to the ' Report of Glasgow Dietary Studies ', carried out by Miss Lindsay in 1911–12.

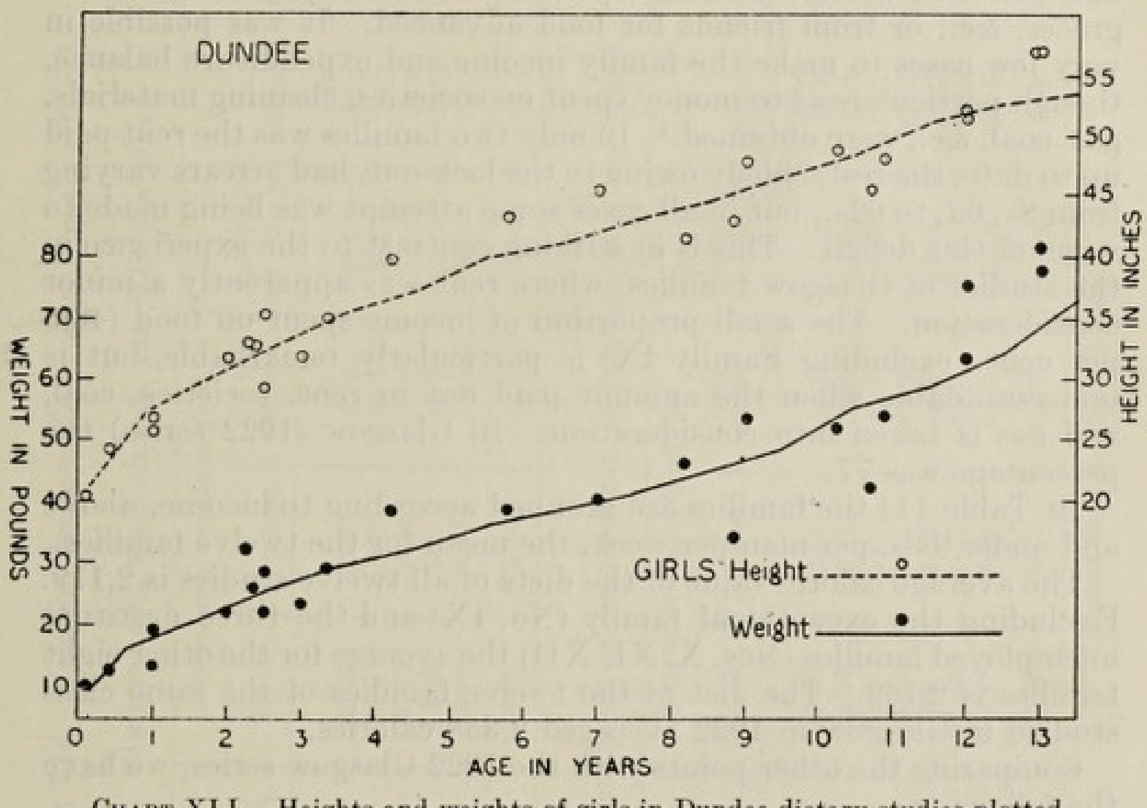


CHART XLI. Heights and weights of girls in Dundee dietary studies plotted on mean height and weight curves of Dundee girls.

The food requirements of the family are stated in terms of those of a man, using the Lusk standard. Waste and refuse were collected, examined, and weighed in each family, but although potato refuse was considerable owing to the diseased condition of the tubers, there was practically no loss of edible material, except in one case (family No. XI). Three meals are counted as one day. Any meals taken out—whether at school or in neighbours' houses—are deducted.

Since it is impossible to carry out more than a limited number of such studies, it becomes a matter of prime importance that the families chosen should be representative of the general population being studied, and that a fairly average week should be selected for study. This last is a real difficulty, because the circumstances of these families are apt to undergo sharp fluctuations and because the response to change is not always what might be expected. A sudden

[1] See Appendix IV.

prosperity may lead to an attempt to pay off debts and to no improvement in the diet, while sudden unemployment may lead to no decrease in the expenditure, at least during the first week, as is shown in one of the families in the present series (No. IX).

The income of the twelve families, with one exception, was under 12*s*. 6*d*. per man per week and averaged 9*s*. 4*d*. Family No. III had at the date of the study four wage-earners and was banking money to make up for savings spent during the lock-out. Family No. IX had a bad week, the father had been ill and off work, but the expenditure was on the usual scale, credit being obtained to the extent of nearly £2 for practically all food bought. Family No. II also overexpended its income, though only to the extent of 6*s*. 3*d*. Families No. I, XI, and XII had arrears from the previous week to pay—credit from grocer, &c., or from friends for food advanced. It was possible in very few cases to make the family income and expenditure balance, though particulars as to money spent on societies, cleaning materials, gas, coal, &c., were obtained.[1] In only two families was the rent paid up to date, the rest, chiefly owing to the lock-out, had arrears varying from 8*s*. 6*d*. to 62*s*., but in all cases some attempt was being made to wipe off this deficit. This is in striking contrast to the experience in the studies of Glasgow families, where rent was apparently a minor consideration. The small proportion of income spent on food (46·5 per cent., excluding Family IX) is particularly remarkable, but is understandable when the amount paid out in rent, societies, coal, and gas is taken into consideration. In Glasgow (1922 series) the percentage was 77.

In Table 114 the families are grouped according to income, above and under 9·3*s*. per man per week, the mean for the twelve families.

The average calorie value of the diets of all twelve studies is 2,119. Excluding the exceptional family (No. IX) and the three destitute unemployed families (Nos. X, XI, XII) the average for the other eight families is 2,169. The diet of the twelve families of the same class studied in Glasgow in 1922 averaged 2,358 calories.

Comparing the other points with the 1922 Glasgow series, we have the following :

	Glasgow.	*Dundee.*
	s. *d.*	*s.* *d.*
Mean income	35 1	43 6
,, ,, per man per week	6 7	9 3
,, percentage of income spent on food . .	77·2	46·5 *
,, energy value purchased per penny . .	275·2	247·9

* This excluded family IX on Table 114.

In six of the families (Nos. I, II, IV, V, VI, and IX) all the individuals had all their meals at home. No. IX may be discarded as abnormal for reasons given elsewhere. The average calorie value of the remaining five is 2,131, closely corresponding to the average value of the whole twelve. In comparing these results with the old dietary studies of Atwater and others, it must be remembered that the adoption of the Lusk standard in place of the Atwater estimation of the man value reduces the result per man by about 14 per cent. for the family of average size.

[1] See Appendix IV.

Table 114. *Relation between Diets and Income* (Clark).

A. Families over Mean of 9·3*s.* per Man per Week.

Family No.	*Man value.*	*Income weekly.*		*Expenditure weekly on food.*			*Calories per penny.*	*Diet per man per day.*			
		Total.	*Per man.*	*Total.*	*Per man.*	*% of income.*		*Proteins.*	*Fats.*	*Carbo-hydrates.*	*Calories.*
		s. d.	*s.*	*s.*	*s.*	*s.*		gm.	gm.	gm.	
I	4·76	57 6	12·1	25·21	5·3	43·8	223·7	63·9	66·2	318·9	2,185
II	5·03	47 8	9·5	29·0	5·77	60·7	256·1	75·3	60·2	437·6	2,663
III	6·45	133 4	20·0	40·92	6·34	32·2	188·2	55·6	55·7	317·7	2,048
IV	2·28	29 0	12·4	11·63	5·1	40·3	194·9	59·2	72·6	258·0	1,975
VI	3·95	41 9	10·6	18·56	4·72	44·5	260·0	61·3	43·5	355·0	2,112
Average	4·49	61 10	12·9	25·06	5·45	44·3	224·6	63·1	59·6	337·4	2,197

B. Families at or below Mean of 9·3*s.* per Man per Week.

Family No.	*Man value.*	*Income weekly.*		*Expenditure weekly on food.*			*Calories per penny.*	*Diet per man per day.*			
		Total.	*Per man.*	*Total.*	*Per man.*	*% of income.*		*Proteins.*	*Fats.*	*Carbo-hydrates.*	*Calories.*
		s. d.	*s.*	*s.*	*s.*	*s.*		gm.	gm.	gm.	
V	6·42	40 0	6·2	22·56	3·51	56·5	268·8	48·6	38·2	284·9	1,723
VII	4·07	36 0	8·5	20·91	5·14	57·6	240·2	71·7	69·0	329·8	2,288
VIII	4·76	50 0	9·3	23·8	5·0	47·7	274·9	59·7	59·5	379·4	2,354
IX	4·26	9 6	2·2	34·54	8·11	368·8	240·0	101·5	88·5	547·0	3,481
X	3·24	23 0	6·5	8·9	2·75	38·8	265·6	35·9	34·5	226·2	1,396
XI	3·23	30 0	8·7	11·35	3·51	38·0	267·5	44·5	49·6	356·5	1,695
XII	4·48	25 0	5·0	12·8	2·86	51·0	294·8	31·8	45·5	233·6	1,511
Average	4·35	30 6	6·6	19·27	4·41	94·1*	264·5	56·2	55·0	336·8	2,064

* Or omitting IX, 46·5 per cent.

Three families unemployed for long periods.

Among the twelve families were three (Nos. X, XI, XII) where the fathers and mothers had been out of work for from six months to two years and who had no income but unemployment insurance benefit at the rate of 15*s.* for a man, 5*s.* for his wife (12*s.* if she herself is entitled to the insurance), and 1*s.* for each child under 14. These three families were trying to pay for all necessaries, with the following result as to their average diets :

Average calories per man per day	1,534
,, proteins ,, ,,	37·4 gm.
,, fats ,, ,,	43·2 gm.
,, carbohydrates per man per day	272·1 gm.
,, income per week	26*s.*
,, ,, per man per week	6·7*s.*
,, ,, spent on food per man per week	2·83*s.*
,, percentage of income spent on food	43·3*s.*
,, energy value purchased per penny	276

These families did very little cooking, the main diet consisted of bread and margarine, in fact most of the pots and pans had been pawned. Fire was chiefly used for warmth, as clothes and bedclothes were very scanty. In two families the fathers spent a relatively large amount on tobacco (1*s.* 8*d.* and 1*s.* 11*d.*), while in the third he retained 7*s.* out of the 18*s.* paid to him, leaving his wife with 11*s.* and her own 12*s.* for all the family expenses. The fathers declared that tobacco served them instead of food and that the children therefore were able to eat a larger proportion of the food bought. The state of these children, compared to the other families, rather bore out that declaration. The 10 children (1–13) in the three unemployed families averaged in age 5·7 years, with a deficiency in weight of 6·89 per cent., and in height of 4·94 per cent., as against the general Dundee deficiency of 9 per cent. in weight and 5 per cent. in height compared with the standard used in previous studies.

Housing.

The following table shows the conditions of housing :

Group A. Over the mean of 9·3s. per man per week.

Average number of rooms per family	1·8
,, ,, inmates per family	6·6
,, ,, ,, per room	3·7
,, air-space per inmate	470 c. ft.
,, rent per week	5*s.* 6½*d.*

Group B. At or below the mean of 9·3s. per man per week.

Average number of rooms per family	1·6
,, ,, inmates per family	6·6
,, ,, ,, per room	4·2
,, air-space per inmate	301 c. ft.
,, rent per week	4*s.* 7¾*d.*

This indicates a marked difference in rent and air-space between the two groups, whereas the Glasgow 1922 groups above and below a mean of 8*s.* practically coincided in these two points, i. e. over 8*s.* per man per week, rent 6*s.* 7*d.*, air-space 298 c. ft. ; *under* 8*s.* per man per week, rent 6*s.* 9¼*d.*, air-space 276 c. ft.

TABLE 115. *Weight of Children to Income.*

A. FAMILIES OVER MEAN OF 9·3*s*. PER MAN PER WEEK.

					Average percentage of standard.					
					Above.		*Below.*		*Above.*	*Below.*
Family.	*Boys.*	*Girls.*	*Total.*	*Average age.*	*Boys.*	*Girls.*	*Boys.*	*Girls.*	*Boys and girls.*	*Boys and girls.*
I	1	3	4	6·3	7·1	—	—	20·2	—	13·4
II	1	4	5	5·3	—	—	3·5	4·5	—	4·3
III	—	1	1	2·2	—	24·5	—	—	24·5	—
IV	1	—	1	2·1	—	—	8·4	—	—	8·4
VI	2	1	3	4·3	—	0·9	9·1	—	—	5·8

Average deficiency of 14 children in weight below standard, 5·5 per cent.

B. FAMILIES AT OR BELOW MEAN OF 9·3*s*. PER MAN PER WEEK.

Family.	*Boys.*	*Girls.*	*Total.*	*Average age.*	*Above. Boys.*	*Above. Girls.*	*Below. Boys.*	*Below. Girls.*	*Above. Boys and girls.*	*Below. Boys and girls.*
V	5	2	7	7·5	—	—	8·0	13·4	—	9·5
VII	2	2	4	5·8	—	—	1·2	8·6	—	4·9
VIII	3	3	6	6·0	—	—	19·9	18·8	—	19·3
IX	2	2	4	5·7	—	—	10·3	21·9	—	16·1
X	1	2	3	5·6	7·0	0·7	—	—	2·8	—
XI	2	1	3	3·7	—	—	18·4	2·4	—	13·1
XII	3	1	4	7·8	—	—	10·8	5·7	—	9·5

Average deficiency of 31 children in weight below standard, 10·8 per cent.

TABLE 116. *Height of Children to Income.*

A. FAMILIES OVER MEAN OF 9·3*s.* PER MAN PER WEEK.

					Average percentage of standard.					
Family.	*Boys.*	*Girls.*	*Total.*	*Average age.*	*Above. Boys.*	*Above. Girls.*	*Below. Boys.*	*Below. Girls.*	*Above. Boys and girls.*	*Below. Boys and girls.*
I	1	3	4	6·3	—	—	5·1	6·0	—	5·8
II	1	4	5	5·3	1·1	1·2	—	—	1·2	—
III	—	1	1	2·2	—	—	—	0·4	—	0·4
IV	1	—	1	2·1	—	—	2·9	—	—	2·9
VI	2	1	3	4·3	—	—	6·4	1·2	—	4·7

Average deficiency of 14 children in height below standard, 2·5 per cent.

B. FAMILIES AT OR BELOW MEAN OF 9·3*s.* PER MAN PER WEEK.

Family.	*Boys.*	*Girls.*	*Total.*	*Average age.*	*Above. Boys.*	*Above. Girls.*	*Below. Boys.*	*Below. Girls.*	*Above. Boys and girls.*	*Below. Boys and girls.*
V	5	2	7	7·5	—	—	2·3	4·4	—	2·9
VII	2	2	4	5·8	—	—	4·9	2·6	—	3·8
VIII	3	3	6	6·0	—	—	9·3	10·1	—	9·7
IX	2	2	4	5·7	—	—	6·9	11·0	—	8·9
X	1	2	3	5·6	—	—	6·2	1·0	—	2·7
XI	2	1	3	3·7	—	—	10·2	6·9	—	9·1
XII	3	1	4	7·8	—	—	4·2	1·4	—	3·5

Average deficiency of 31 children in height below standard, 5·8 per cent.

Table 117. *Weight of Children to Amount spent on Food.*

A. Families over Mean of 4·72*s.* per Man per Week spent on Food.

Family.	*Boys.*	*Girls.*	*Total.*	*Average age.*	Average percentage of standard. Above. *Boys.*	Above. *Girls.*	Below. *Boys.*	Below. *Girls.*	*Above. Boys and girls.*	*Below. Boys and girls.*
I	1	3	4	6·3	7·1	—	—	20·2	—	13·4
II	1	4	5	5·3	—	—	3·5	4·5	—	4·3
III	—	1	1	2·2	—	24·5	—	—	24·5	—
IV	1	—	1	2·1	—	—	8·4	—	—	8·4
VII	2	2	4	5·8	—	—	1·2	8·6	—	4·9
IX	2	2	4	5·7	—	—	10·3	21·9	—	16·1

Average deficiency of 19 children in weight below standard, 7·5 per cent.

B. Families at or below Mean of 4·72*s.* per Man per Week spent on Food.

Family.	*Boys.*	*Girls.*	*Total.*	*Average age.*	Above. *Boys.*	Above. *Girls.*	Below. *Boys.*	Below. *Girls.*	*Above. Boys and girls.*	*Below. Boys and girls.*
V	5	2	7	7·5	—	—	8·0	13·4	—	9·5
VI	2	1	3	4·3	—	—	0·9	9·1	—	5·8
VIII	3	3	6	6·0	—	—	19·9	18·8	—	19·3
X	1	2	3	5·6	7·0	0·7	—	—	2·8	—
XI	2	1	3	3·7	—	—	18·4	2·4	—	13·1
XII	3	1	4	7·8	—	—	10·8	5·7	—	9·5

Average deficiency of 26 children in weight below standard, 10·3 per cent.

TABLE 118. *Height of Children to Amount spent on Food.*

A. FAMILIES OVER MEAN OF 4·72*s.* PER MAN PER WEEK SPENT ON FOOD.

					Average percentage of standard.					
					Below.		*Above.*		*Above.*	*Below.*
Family.	*Boys.*	*Girls.*	*Total.*	*Average age.*	*Boys.*	*Girls.*	*Boys.*	*Girls.*	*Boys and girls.*	*Boys and girls.*
I	1	3	4	6·3	—	—	5·1	6·0	—	5·8
II	1	4	5	5·3	1·1	1·2	—	—	1·2	—
III	—	1	1	2·2	—	—	—	0·4	—	0·4
IV	1	—	1	2·1	—	—	2·9	—	—	2·9
VII	2	2	4	5·8	—	—	4·9	2·6	—	3·8
IX	2	2	4	5·7	—	—	6·9	11·0	—	8·9

Average deficiency of 19 children in height below standard, 3·8 per cent.

B. FAMILIES AT OR BELOW MEAN OF 4·72*s.* PER MAN PER WEEK SPENT ON FOOD.

Family.	*Boys.*	*Girls.*	*Total.*	*Average age.*	Below *Boys.*	Below *Girls.*	Above *Boys.*	Above *Girls.*	Above *Boys and girls.*	Below *Boys and girls.*
V	5	2	7	7·5	—	—	2·3	4·4	—	2·9
VI	2	1	3	4·3	—	—	6·4	1·2	—	4·7
VIII	3	3	6	6·0	—	—	9·3	10·1	—	9·7
X	1	2	3	5·6	—	—	6·2	1·0	—	2·7
XI	2	1	3	3·7	—	—	10·2	6·9	—	9·1
XII	3	1	4	7·8	—	—	4·2	1·4	—	3·5

Average deficiency of 26 children in height below standard, 5·5 per cent.

Table 119. *Weight of Children to Calories in Family Diet.*

Family.	Boys.	Girls.	Total.	Average age.	Above. Boys.	Above. Girls.	Below. Boys.	Below. Girls.	Above. Boys and girls.	Below. Boys and girls.
A. Families having over Mean of 2,119 Calories per Man per Week. Mean of Group A, 2,594 Calories.					Average percentage of standard.					
I	1	3	4	6·3	7·1	—	—	20·2	—	13·4
II	1	4	5	5·3	—	—	3·5	4·5	—	4·3
VII	2	2	4	5·8	—	—	1·2	8·6	—	4·9
VIII	3	3	6	6·0	—	—	19·9	18·8	—	19·3
IX	2	2	4	5·7	—	—	10·3	21·9	—	16·1
Average deficiency of 23 children in weight below standard, 12·0 per cent.										
B. Families having below Mean of 2,119 Calories per Man per Week. Mean of Group B, 1,780 Calories.										
III	—	1	1	2·2	—	24·5	—	—	24·5	—
IV	1	—	1	2·1	—	—	8·4	—	—	8·4
V	5	2	7	7·5	—	—	8·0	13·4	—	9·5
VI	2	1	3	4·3	—	0·9	9·1	—	—	5·8
X	1	2	3	5·6	7·0	0·7	—	—	2·8	—
XI	2	1	3	3·7	—	—	18·4	2·4	—	13·1
XII	3	1	4	7·8	—	—	10·8	5·7	—	9·5
Average deficiency of 22 children in weight below standard, 6·2 per cent.										

TABLE 120. *Height of Children to Calories in Family Diet.*

A. FAMILIES HAVING OVER MEAN OF 2,119 CALORIES PER MAN PER WEEK. MEAN OF GROUP A, 2,594 CALORIES.

					Average percentage of standard.					
					Above.		Below.		Above.	Below.
Family.	*Boys.*	*Girls.*	*Total.*	*Average age.*	*Boys.*	*Girls.*	*Boys.*	*Girls.*	*Boys and girls.*	*Boys and girls.*
I	1	3	4	6·3	—	—	5·1	6·0	—	5·8
II	1	4	5	5·3	1·1	1·2	—	—	1·2	—
VII	2	2	4	5·8	—	—	4·9	2·6	—	3·8
VIII	3	3	6	6·0	—	—	9·3	10·1	—	9·7
IX	2	2	4	5·7	—	—	6·9	11·0	--	8·9

Average deficiency of 23 children in height below standard, 5·5 per cent.

B. FAMILIES HAVING BELOW MEAN OF 2,119 CALORIES PER MAN PER WEEK. MEAN OF GROUP B, 1,780 CALORIES.

Family.	*Boys.*	*Girls.*	*Total.*	*Average age.*	Above. *Boys.*	Above. *Girls.*	Below. *Boys.*	Below. *Girls.*	Above. *Boys and girls.*	Below. *Boys and girls.*
III	—	1	1	2·2	—	—	—	0·4	—	0·4
IV	1	—	1	2·1	—	—	2·9	—	—	2·9
V	5	2	7	7·5	—	—	2·3	4·4	—	2·9
VI	2	1	3	4·3	—	—	6·4	1·2	—	4·7
X	1	2	3	5·6	—	—	6·2	1·0	—	2·7
XI	2	1	3	3·7	—	—	10·2	6·9	—	9·1
XII	3	1	4	7·8	—	—	4·2	1·4	—	3·5

Average deficiency of 22 children in height below standard, 4·0 per cent.

Condition of the children.

The children were weighed and measured in indoor clothing without shoes.

The poor economic conditions had existed in Dundee for over two years when the dietary study was made, and the tables give some indication of the physical development of the children in these families. In Tables 115–120 are given weight and height and the percentage of each family above and below the average standard [1] for children of these ages of all classes. In no family do all the children reach the standard in both weight and height, though in No. III the two children are well above weight standard. Even in the families (Nos. VII, VIII, X, XII) where some of the children are getting school dinners the standard in weight is not reached by all. Families Nos. IV, V, VII, IX, X, XI, XII receive free milk (1–2 pints daily), but for which their calorie supply would be even poorer. Family No. VIII is specially far below in both weight and height, although the energy value of the diet is above the mean. The mother is careful and a good marketer and the children are now well looked after, but she suffered from a severe illness some months earlier.

Table 119 shows that there is not the direct correlation between the weight of the children and the calorie value of the family diet which might have been expected. Factors other than diet apparently are of significance.

Table 121 is a detailed examination of the children (babies excepted) under school age, and shows an average deficiency for all groups of 5·4 per cent. in weight and 4·4 per cent. in height under the standard adopted.[1]

Table 121. *Children 1–5 Years. Percentage above or below Emerson Standard.*

Group A. Families over Mean of 9·3*s*. per Man per Week.

Family.	*Age.*	*Sex.*	*Weight per cent.*	*Height per cent.*
I	$3\frac{4}{12}$	F	−16·3	−5·4
	$1\frac{11}{12}$	M	+ 7·1	−5·1
II	$5\frac{9}{12}$	F	− 0·3	+6·6
	$4\frac{2}{12}$	F	+ 7·7	−0·7
	*2	F	−13·2	−4·2
III	$2\frac{2}{12}$	F	+24·5	−0·4
IV	*$2\frac{1}{12}$	M	− 8·4	−2·9
VI	$4\frac{3}{12}$	M	− 3·9	−3·2
	$2\frac{4}{12}$	F	+ 0·9	−1·2

9 children. Average difference from standard in weight = −0·2
" " " " height = −1·8

* Indicates rickets.

[1] Standard of Emerson and Manny (1920) from 1–4 years for U.S.A. and that of Anthropometric Committee of British Association (1883) from 5 to 14 years. These standards are for the general population and not for the special population now dealt with.

GROUP B. FAMILIES AT OR BELOW MEAN OF 9·3s. PER MAN PER WEEK.

V	$5\frac{3}{12}$	M	− 7·3	− 1·8
	$3\frac{2}{12}$	M	− 7·7	− 4·7
	$1\frac{3}{12}$	M	− 1·2	− 3·4
VII	$3\frac{3}{12}$	M	0·0	− 4·7
	$1\frac{1}{12}$	M	− 2·4	− 5·1
VIII	4	M	−30·1	−13·9
	3	F	−13·8	−13·5
	1	F	−31·7	−10·5
IX	*$3\frac{1}{2}$	M	− 6·2	− 5·3
	*$2\frac{1}{2}$	F	−13·2	−11·7
X	$2\frac{1}{2}$	F	+11·2	+ 6·3
XI	3	M	−16·9	−10·7
	1	F	− 2·4	− 6·9
XII	5	M	+ 7·8	+ 4·3
	3	M	−13·8	− 8·0

15 children. Average difference from standard in weight = −8·5
„ „ „ „ height = −6·0

* Indicates rickets.

To show how far the children of these families corresponded with the great mass of Dundee children, Table 122 is given, which shows that from 1 to 5 years the children of the families studied are very slightly below the average Dundee weight and height. The families thus seem to be representative of the whole number studied.

TABLE 122. *Children 1–5 Years. Percentage above or under the average of 1,850 Dundee children living in similar surroundings, 1921–3.*

BOYS. *Age.*	*Weight. Percentage above or under Dundee data.*	*Height. Percentage above or under Dundee data.*	*No. of children.*
1	−6·4	−3·5	3
2	−8·1	−0·3	1
3	−3·6	−1·1	5
4	−5·7	−5·0	2
5	+9·3	+4·0	2
	Average weight = −2·9		
	„ height = −1·4		
GIRLS.			
1	−18·6	−8·6	2
2	+ 4·4	+0·9	5
3	− 9·0	−4·8	2
4	+19·6	+6·1	1
5	+10·6	+9·8	1
	Average weight = −0·3		
	„ height = −0·6		

Infants

In the families studied there were only five infants under one year, and the good condition of four of these was very marked, weight standard being specially good. The only one badly below standard had a hernia and was to be operated on very soon.

Summary

1. That these twelve families are typical of the whole series is shown by the correspondence in the average rent and air-space and

in the average weight and height of children between one and five years of age, in them and in those of the larger study.

2. The average energy value of the diets was very low—2,119 calories per man per day (Lusk's Standard) as compared with 2,358 in the same class in Glasgow in 1922.

3. There was a certain, but not very close, correspondence between the income and the energy value of the diets, the families with an income above the mean having an average energy value of 2,197 calories, those below of 2,064 calories.

4. The children averaged 9·1 per cent. in weight and 4·8 per cent. in height below the generally accepted standards of Emerson and Manny and the British Anthropometric Committee.

5. The children of the families with incomes below the mean fell short of this standard in weight by 10·8 per cent. and in height by 5·8 per cent., while those of the families with incomes above the mean fell short by 5·5 per cent. in weight and 2·5 per cent. in height.

6. When arranged in families spending more than the mean and those spending less than the mean upon food, the difference is less marked, weight 7·5 per cent. and height 3·8 per cent. below the former; weight 10·3 per cent. and height 5·5 per cent. below the latter.

7. When divided into families with a diet above the mean of 2,119 calories per man per day and those below, it was found that the children of the former averaged 12 per cent. in weight and 5·5 per cent. in height below the standard, while those of the latter were in weight 6·2 per cent. and in height 4·0 per cent. below.

8. These results seem to indicate that factors other than food supply played a part in determining the unsatisfactory state of nutrition of these children.

(c) Three Successive Studies, over three Years, of one Family's Diet and Growth of Children.

On p. 151, in dealing with the stability of the diet in different families and the validity of dietary studies of one week's duration, the calorie values of one family during three separate periods between April 1921 and September 1924 are given. They are as follow:

TABLE 123. *Calorie Values of three Studies on one Family.*

Date of study.	*Calorie value.*
April 1921	2,766
June 1922	2,088
September 1924	2,344

The average is practically 2,400, rather lower than the average of all our dietary studies in Glasgow (p. 186).

The family was a large one, consisting of father (5 ft. 6 in.), mother (5 ft. 5 in.), and nine children under fifteen years of age. The weights of these children, and in the later studies the heights, were recorded and from these data curves of growth have been constructed.

TABLE 124. *R. Family Weights and Heights.*

		15 Mar. 1921.			7 July 1922.			29 Sept. 1924.		
	Sex.	*Age.*	*Weight (lb.).*	*Height (in.).*	*Age.*	*Weight (lb.).*	*Height (in.).*	*Age.*	*Weight (lb.).*	*Height (in.).*
A	m.	$11\frac{9}{12}$*	64	—	13*	66	51	$15\frac{4}{12}$	78	54·5
B	f.	$10\frac{6}{12}$*	49	46	$11\frac{9}{12}$	54	48	$14\frac{1}{12}$	72	53·5
C	f.	$9\frac{1}{12}$*	46	44	$10\frac{4}{12}$	46·75	46	$12\frac{8}{12}$	59	52
D	f.	$7\frac{4}{12}$	39	40	$8\frac{7}{12}$	44	44	$10\frac{11}{12}$	57	48
E	f.	$5\frac{4}{12}$	30	38	$6\frac{7}{12}$	38·25	40·75	$8\frac{11}{12}$	49	45
F	m.	$2\frac{11}{12}$	23·5	34	$4\frac{2}{12}$	29	38	$6\frac{6}{12}$	40	42
G	m.	$\frac{9}{12}$	—	—	2	27·75	33·5	$4\frac{4}{12}$	36	38
H	f.	—	—	—	$\frac{5}{12}$	14·5	26·5	$2\frac{9}{12}$	26	33
I	m.	—	—	—	—	—	—	$\frac{4}{12}$	18	23

* A, B, and C had suffered from slight ailments in 1921 and 1922.

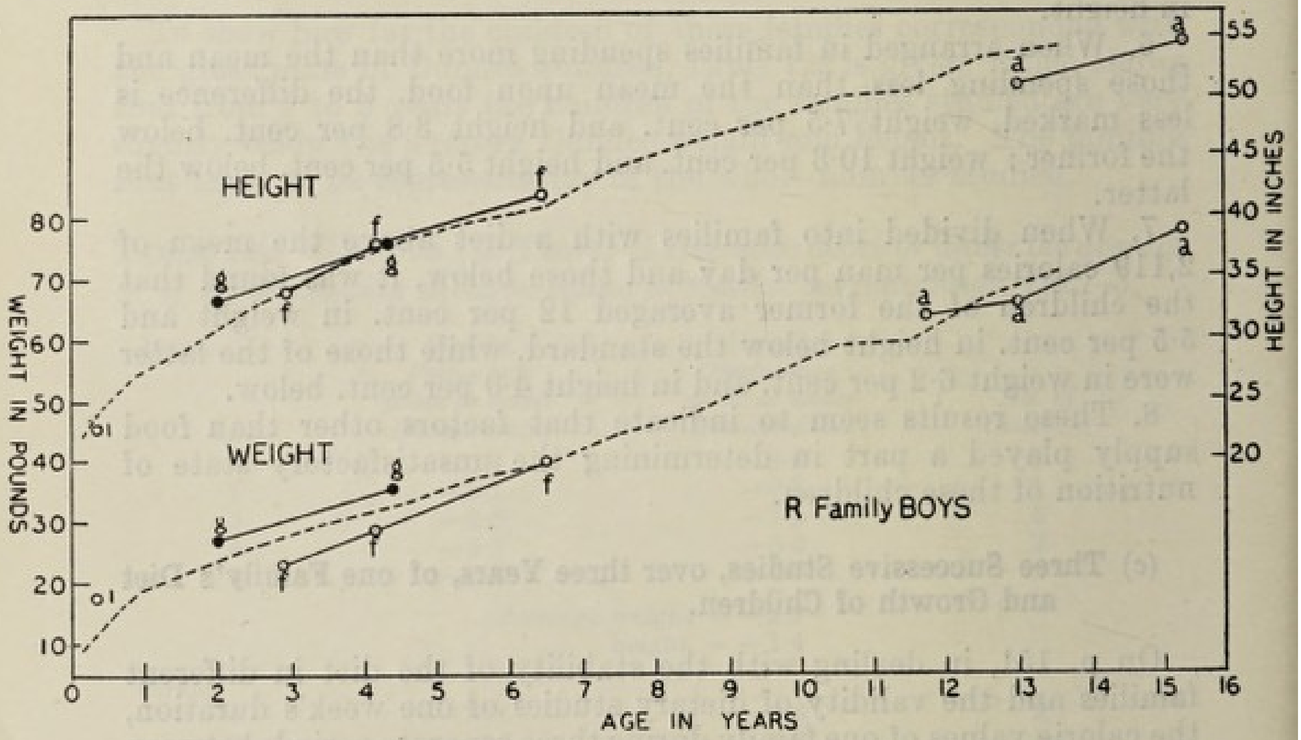


CHART XLII. Curves of growth in height and weight of the boys in R. family plotted on mean height and weight curves of Glasgow boys.

It will be seen from the parallelism of the lines in Charts XLII and XLIII that the rate of growth of these children corresponds to the mean growth of all the Glasgow children studied by us. There is, however, a tendency for the heights and weights of the older children to be below the mean, while the younger members of the family approximate closely to it.

(*d*) Families of Agricultural Labourers.

Studies of the dietaries of thirty typical families of the agricultural labouring class were made between May 1923 and March 1924, in

Portrait of R. family.

To face p. 180.

Ayrshire, Perthshire, Stirlingshire, and Forfarshire, where extended studies of environmental conditions had been conducted.

Of the thirty studies made the eight in Forfarshire and seven in Ayrshire were carried out with a high degree of accuracy. Of the fifteen studies made in Perthshire and Stirlingshire, on examination twelve were rejected as not being reliable and the remaining three cannot be considered as of the same value as the fifteen carried out in Ayrshire and Forfarshire. The number of individuals included in 18 families is 115.

As indicated in the report prepared by Dr. Somerville (see p. 283), the conditions under which these people live are very much better than those of the urban poor. Although wages are low, perquisites

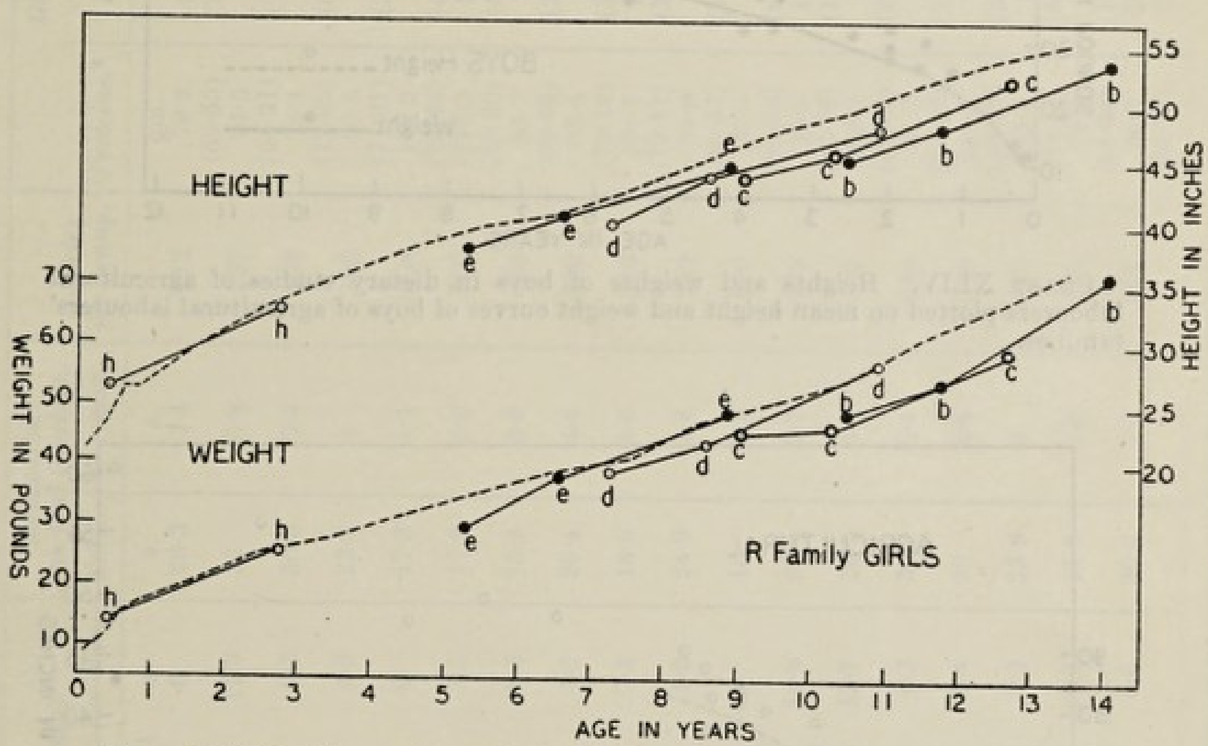


CHART XLIII. Curves of growth in height and weight of the girls in R. family plotted on mean height and weight curves of Glasgow girls.

in food and rent-free house make them financially in a much better position.

The children at every age are taller and heavier than urban children (see Charts XIV to XVII), the parents are on an average bigger, and all are constantly exposed to wind and weather and lead an active outdoor life. Their energy requirements are thus larger than those of the urban dweller.

That the families used for these dietary studies are representative of the whole group studied by us is shown by the fact that the size of the children, as compared with the mean size of all the agricultural group, is very similar. This is indicated in Charts XLIV and XLV.

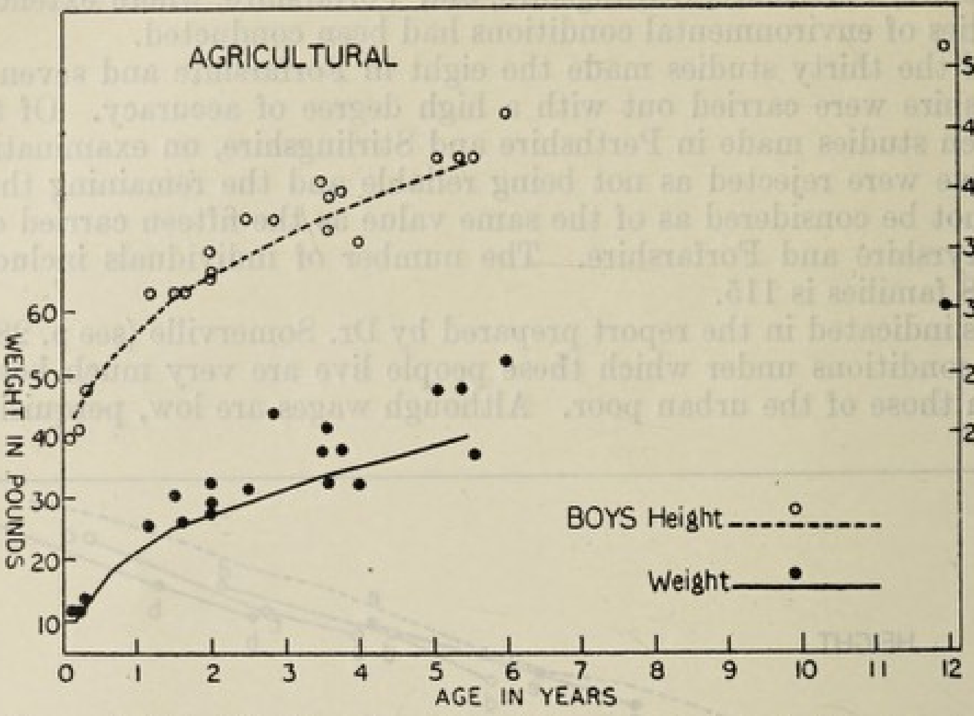


CHART XLIV. Heights and weights of boys in dietary studies of agricultural labourers plotted on mean height and weight curves of boys of agricultural labourers' families.

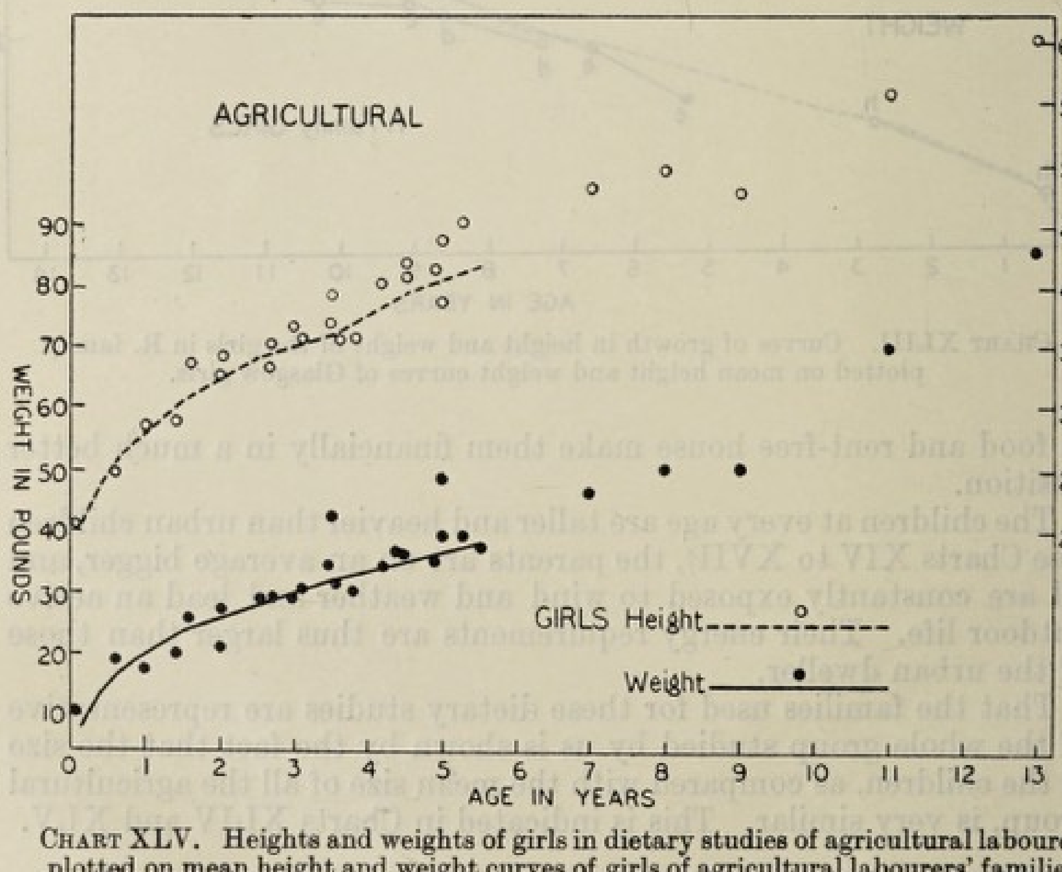


CHART XLV. Heights and weights of girls in dietary studies of agricultural labourers plotted on mean height and weight curves of girls of agricultural labourers' families.

TABLE 125. *Diets of Agricultural Labourers.*

No.	Occupation.	Man value.	Income (weekly). Total.	Income (weekly). Per man.	Expenditure on food (weekly). Total.	Expenditure on food (weekly). Per man.	Calories per penny.	Diet per man per day. Proteins.*	Diet per man per day. Fats.*	Diet per man per day. Carbo-hydrates.	Diet per man per day. Calories.	
				s.	*s.*	*s.*		gm.	gm.	gm.		
I	Ploughman	3·83	23*s.* + perquisites	6	28·3	7·4	212	79·8 (59·55)	63·0 (20·81)	555·9	3,192·1	Urie (Perthshire)
II	Labourer	5·43	62*s.* 6*d.*	11·5	37	6·8	257	94·5 (68·31)	82·7 (30·60)	535·5	3,352·5	Urie (Perthshire)
III	Ploughman	6·69	42*s.*	6·3	36·5	5·4	298	78·4 (72·66)	74·9 (55·10)	464·8	2,924·1	Urie (Perthshire)
IV	,,	5·86	25*s.* + perquisites	4·3	23·2	4	195	66·6 (71·21)	71·7 (26·08)	382·9	2,509·7	MacNae (Forfarshire)
V	,,	4·16	25*s.* + ,,	6	17·3	4·1	258	102·2 (73·46)	57·8 (42·94)	668·6	3,698·1	MacNae (Forfarshire)
VI	,,	3·33	25*s.* + ,,	7·5	17·9	5·9	206	116·3 (59·20)	100·1 (41·36)	567·9	3,736·0	MacNae (Forfarshire)
VII	,,	3·93	25*s.* + ,,	6·3	15·4	3·9	186	94·7 (66·92)	77·7 (28·89)	571·6	3,454·9	MacNae (Forfarshire)
VIII	,,	5·69	25*s.* + ,,	4·3	26·4	4·6	200	86·4 (79·19)	63·2 (35·19)	515·0	3,053·9	MacNae (Forfarshire)
IX	,,	3·43	25*s.* + ,,	7·3	18·8	5·5	210	104·7 (70·11)	115·6 (36·19)	588·2	3,915·9	MacNae (Forfarshire)
X	,,	5·69	30*s.* + ,,	5·3	24·9	4·4	259	93·0 (89·57)	77·8 (42·65)	594·5	3,543·1	MacNae (Forfarshire)
XI	,,	6·09	25*s.* + ,,	4	15	2·5	260	67·9 (82·65)	41·9 (64·82)	417·1	2,378·8	MacNae (Forfarshire)
XII	,,	3·53	38*s.* + ,,	10·8	27·4	7·7	219	94·2 (46·75)	125·8 (11·82)	443·7	3,375·7	Blair (Ayrshire)
XIII	,,	2·83	36*s.* + ,,	12·7	24·5	8·7	239	106·3 (58·81)	99·5 (22·95)	604·7	3,840·8	Blair (Ayrshire)
XIV	,,	5·69	47*s.* + ,,	8·3	30·9	5·4	256	81·7 (64·26)	63·3 (22·22)	451·6	2,775·4	Blair (Ayrshire)
XV	,,	4·16	35*s.* + ,,	8·4	20	4·8	306	111·5 (50·29)	93·3 (26·74)	473·3	3,265·5	Blair (Ayrshire)
XVI	,,	3·93	38*s.* + ,,	9·6	23·8	6	259	83·7 (68·11)	85·7 (51·52)	466·8	3,053·9	Blair (Ayrshire)
XVII	Dairyman	3·53	65*s.* + ,,	18·4	15·8	4·5	270	79·0 (64·34)	78·2 (10·64)	413·7	2,747·6	Blair (Ayrshire)
XVIII	Ploughman	3·93	38*s.* + ,,	9·6	30·2	7·7	211	86·3 (39·78)	105·0 (8·64)	442·0	3,142·5	Blair (Ayrshire)

* The percentage amounts of proteins and fats from vegetable sources are given in brackets.

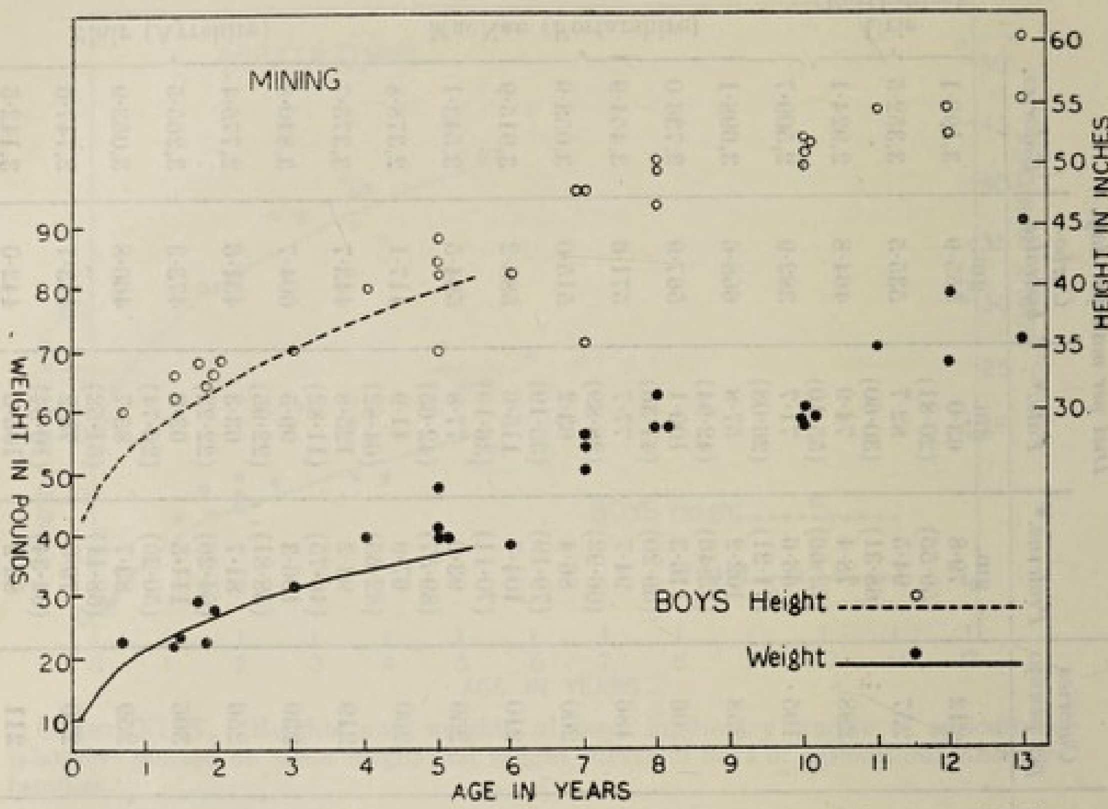


Chart XLVI. Heights and weights of boys in dietary studies of miners (Stirlingshire) plotted on mean height and weight curves of boys of rural miners' families.

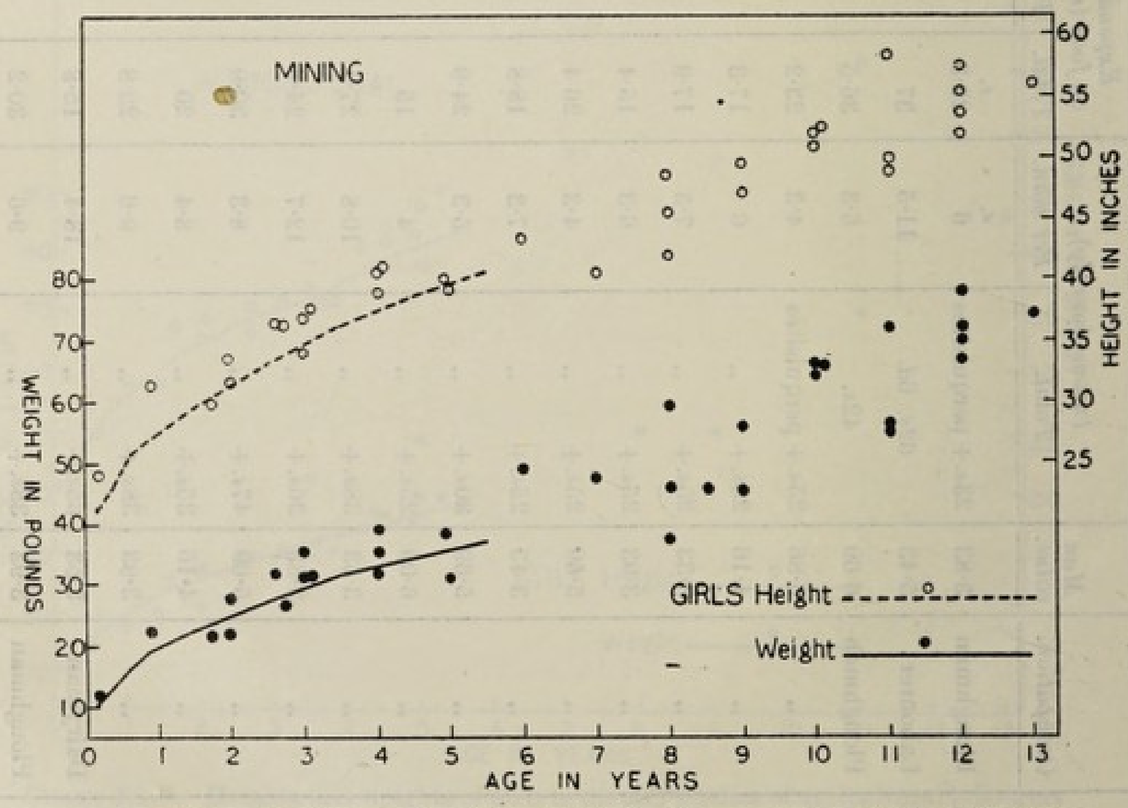


Chart XLVII. Heights and weights of girls in dietary studies of miners (Stirlingshire) plotted on mean height and weight curves of girls of rural miners' families.

TABLE 126. *Miners' Diets (Stirlingshire).*

No.	Occupation.	Man value.	Income (weekly). Total.	Income (weekly). Per man.	Expenditure on food (weekly). Total.	Expenditure on food (weekly). Per man.	Per cent. of income spent on food.	Calories per penny.	Diet per man per day. Proteins.*	Diet per man per day. Fats.*	Diet per man per day. Carbo-hydrates.	Calories.
			s.	s.	s.	s.			gm.	gm.	gm.	
I	Miner	5·16	111·75	21·7	64	12·4	57·14	159	96·9 (48·71)	128·9 (16·93)	459·3	3,479·5
II	,,	10·48	114·3	10·9	79·4	7·6	69·72	206	71·5 (58·47)	78·9 (46·54)	406·6	2,693·4
III	,,	6·19	140	22·6	77	12·4	54·87	164	78·9 (52·37)	160·9 (14·52)	435·0	3,603·3
IV	,,	8·29	95·25	11·5	74·8	9	78·26	244	98·9 (68·61)	100·6 (33·34)	593·5	3,774·1
V	,,	2·65	48	18·1	35·6	13·4	74·03	158	99·7 (60·27)	107·6 (19·03)	541·2	3,628·0
VI	,,	7·89	129	16·3	63·4	8	49·08	212	73·0 (66·95)	108·4 (45·29)	392·0	2,914·6
VII	,,	6·26	62·75	10	40	6·4	64·00	279	78·8 (65·23)	99·6 (44·85)	456·1	3,119·1
VIII	,,	5·73	73·5	12·8	34	5·9	46·09	239	64·1 (65·10)	86·2 (48·88)	340·0	2,458·1
IX	,,	4·03	54	13·4	24·8	6·2	46·27	264	86·7 (56·88)	75·0 (34·87)	457·2	2,927·5
X	,,	5·56	96	17·3	53·4	9·6	55·49	205	93·4 (64·90)	85·4 (28·34)	539·7	3,389·9
XI	,,	7·84	52	6·6	36·5	4·7	71·21	248	54·8 (69·63)	57·3 (29·95)	311·5	2,035·2
XII	,,	5·06	55	10·9	38·1	7·5	68·81	180	68·1 (55·55)	75·0 (19·79)	329·2	2,326·0
XIII	,,	3·58	60	16·8	33	9·2	54·76	235	87·3 (69·31)	85·3 (28·78)	624·7	3,712·7
XIV	,,	5·53	53·25	9·6	17·9	3·2	33·33	359	47·7 (85·09)	40·0 (82·14)	346·7	1,989·5
XV	,,	4·93	46·5	9·4	17·5	3·5	37·23	315	47·9 (82·36)	36·0 (74·74)	339·4	1,922·9
XVI	,,	6·82	42·2	6·2	27·1	4	64·52	278	44·0 (76·29)	42·3 (56·68)	333·2	1,939·9
XVII	,,	3·33	50·7	15·2	24·6	7·4	48·68	289	85·1 (83·57)	73·7 (38·79)	644·3	3,676·0

* The percentage amounts of proteins and fats from vegetable sources are given in brackets.

(*e*) **Families of Rural Coal-miners.**

Since a series of dietary studies of miners' families in Stirlingshire had been made in connexion with the investigation into the Nutrition of Miners and their Families (1924) published by the Medical Research Council, it was not considered necessary to make further investigations and the details of 17 families studied in Stirlingshire are published here.[1] The number of individuals included in these families was 131.

The heights and weights of the children in these families have been plotted on the mean curves for weight and height for the present series of miners' families (Charts XLVI and XLVII).

The investigation on the nutrition of miners and their families (1924) showed that the 33 boys and 33 girls included in the study of the 17 families in Stirlingshire were generally heavier and taller than the mean of the total 261 boys and 253 girls included in all the dietary studies in the mining areas of England and Scotland.

A comparison of the averages of these dietary studies of agricultural labourers and of rural miners with the averages of the Glasgow slum studies from November 1917 to 1924 is given in the table which follows.

TABLE 127. *Glasgow, Agricultural Labourers', and Miners' Diets compared.*

Studies.	Income. No. of families.	Income. Per man per week.	Per cent. spent on food.	Diet. Proteins (gm.).	Diet. Fats (gm.).	Diet. Carbohydrates (gm.).	Diet. Calories.	Calories purchased per penny.
		s. d.						
Glasgow, 1917–24	52	8 6*	76·3*	76	72·8	384·4†	2,564	241
Miners (Stirlingshire)	17	13 6	57·7	75·1	84·8	444·1	2,917	237
Agricultural labourers (Scotland)	18	8 2‡	67·1‡	90·4	82·1	508·8	3,220	239§

* Recorded 41 cases. † Estimated.
‡ Without perquisites.
§ Perquisites in kind—potatoes, meal, flour—yielded the cheaper calories. Hence, money was used to purchase more expensive calories.

(*f*) **Correlation of Weight with Energy Value of Diet.**

An attempt has been made by Dr. P. L. MacKinlay to ascertain if any direct correlation could be determined between the weight of the child and the energy value of the diet. He submits the following report upon this and upon the proportion of the proximate principles and their source.

(i) *Correlation of Size of Child and Energy Value of Diet*

To determine whether any direct relationship between the nutrition of children and the calorie content of the diet exists, an analysis of certain of the dietary studies made in Scotland and of the results of the dietary studies of families of miners in Derbyshire (1924) has been undertaken. The former consisted of 21 families in the slums

[1] On going over these studies it was found necessary to make one or two minor corrections.

of Glasgow investigated by (1) Miss Tully and Miss Urie and (2) Miss MacNae, and of 15 families of agricultural labourers in Ayrshire and Forfarshire studied by Dr. Blair and Miss MacNae. The Derbyshire miners' group consisted of 41 families. The Glasgow families included 48 boys and 80 girls: the agricultural families, 40 boys and 35 girls: the miners' families, 69 boys and 70 girls.

The method adopted was to take into account the three variables —weight, age, and calorie content of the diet; to determine each of the coefficients of correlation involving these variables; and, finally, to deduce the partial correlation of weight and calorie value of the diet for age constant. The results are shown in Table 128.

TABLE 128. *Partial Correlations. Weight and Calories for Constant Age.*

Study.	*Sex.*	
Glasgow and Agricultural	Boys	·3085±·062
" " "	Girls	·2700±·058
Glasgow alone	Boys	·2150±·093
" "	Girls	·3591±·066
Miners, Derbyshire	Boys	·0844±·081
" "	Girls	−·0124±·081

These results show that with the slum and agricultural labourers' families taken together and with the slum families taken separately there is a small positive and apparently significant correlation between the weight of children and the calorie value of the diet; whereas no such relationship is manifest in the case of the Derbyshire miners' families. The interpretation of the correlation is doubtful. It may either mean that the children are heavier because their diet is more liberal, or that the bigger and more active children require and get the larger diet.

(ii) *Correlation of Size of Child with Proximate Principles of Diet*

From the material analysed, it was thought that some light might be thrown upon the significance of the three proximate principles in relation to nutrition, but the results (see Table 129) are so irregular that it is impossible to draw any definite conclusions.

TABLE 129. *Correlations. Weight of Child and Proportions of Proximate Principles in Diets.*

		Weight—per cent. protein.	*Weight—per cent. carbo-hydrate.*	*Weight—per cent. fat.*
Glasgow and Agricultural	Boys . .	−·0442±·069	·0022±·069	−·0019±·069
	Girls . .	·2003±·060	·1942±·061	−·3753±·054
Glasgow alone	Boys . .	−·0523±·097	−·3046±·088	·3311±·087
	Girls . .	·2513±·071	·3687±·065	−·4558±·060
Miners, Derbyshire	Boys . .	—	—	—
	Girls . .	·0920±·080	−·0088±·081	·0061±·081

(iii) *Correlation of Size of Child with Calories purchased per Penny*

Further, the goodness of the marketing, as represented by the calories purchased per penny, seems to have little relation to the weights of the children, as will be seen from Table 130.

TABLE 130. *Correlations. Weight of Child and Calories per Penny.*

Glasgow and Agricultural	Boys	−·4218 ± ·057
,, ,, ,,	Girls	−·1226 ± ·062
Glasgow alone	Boys	−·1080 ± ·096
,, ,,	Girls	−·1521 ± ·074
Miners, Derbyshire	Girls	−·1003 ± ·080

The coefficients, although negative in sign, are, except in one instance, insignificant. The energy as purchased per penny, however, is more significant of the type of food bought than of either the total calorie value of the diet or of the efficiency of the mother, as is shown by the following results :

TABLE 131. *Calories per Penny and Proportion of Proximate Principles.*

Calories per penny to per cent. protein	·0860 ± ·146
,, ,, ,, carbohydrate	·5021 ± ·110
,, ,, ,, fat	−·5530 ± ·102

Thus, where the energy purchased per penny is high the diet has a higher proportion of carbohydrates and a smaller proportion of fats. It is, of course, well known that carbohydrates, especially in the form of bread, are the cheapest source of energy, while fats are the dearest, and hence the finding is not to be wondered at. This is well shown in the following correlations between income and the type of diet (see also p. 142).

(iv) *Income and Constituents of Diet*

TABLE 132. *Correlations. Income and Constituents of Diet.*

Income to per cent. protein	−·1117 ± ·111
,, ,, carbohydrate	−·6203 ± ·069
,, ,, fat	·4108 ± ·093

The expected negative association with carbohydrates and the positive correlation with the more expensive fats is shown. The proportion of protein, however, seems to be independent of income, and the diets of the poor, however deficient in total calorie value, are quite well balanced with regard to this, the essential constituent (Table 133). This is a point of some interest in view of the fact that fats and carbohydrates can, within wide limits, replace one another as sources of energy.

(v) *Percentage of Protein and Fat in various Diets*

TABLE 133. *Percentage of Protein and Fat in Various Diets.*

Study.	*Class and income per man.*	*Percentages.* *Protein.*	*Fat.*
Glasgow, 1921	Labouring, income over 8*s.* weekly	12·12	29·27
,, ,,	,, ,, under 8*s.* weekly	10·49	27·21
,, 1922	,, ,, over 8*s.* weekly	12·34	31·31
,, ,,	,, ,, under 8*s.* weekly	11·76	26·13
,, 1924	,, ,, 11*s.* 1*d.* weekly (average)	11·05	27·84
,, 1923	Artisan, ,, not estimated	11·74	29·32
Dundee, ,,	Labouring, ,, 12*s.* 9*d.* weekly (average)	11·78	25·23
,, ,,	,, ,, 6*s.* 6*d.* weekly (average)	11·16	24·78
Miners .	Miners (Stirling) ,, 13*s.* 6*d.* weekly (average)	10·55	27·04
Agricultural .	Labouring, ,, 8*s.* 2*d.* weekly (average) with perquisites	11·51	23·56

(vi) *Source of Proteins and Fats in relationship to Income*

But the *source* of the proteins and fats seems to be affected by the available income. The proportion of protein and fat derived from the vegetable kingdom has been worked out for the various sets of families studied, and the average percentages for the whole of each set, and for the families above and below the mean income for the group, are collected in Table 134.

TABLE 134. *Proportion of Proteins and Fats (Vegetable) in Diets.*

		Miners.			*Urban.*			
	Agricultural.	*Stirlingshire.*	*Derbyshire.*	*Co. Durham.*	*Glasgow, 1924.*	*Glasgow, 1921.*	*Glasgow, 1922.*	*Dundee.*
I. Average percentage vegetable protein .	65·70	66·43	60·84	70·65	54·61	66·37	62·70	61·71
(*a*) Families below mean income	72·45	68·32	63·16	74·64	58·61	71·68	67·53	64·46
(*b*) Families above mean income	52·81	63·73	57·56	67·49	49·61	60·01	55·94	57·86
II. Average percentage vegetable fat . .	32·73	39·03	—	—	32·22	49·27	45·61	46·10
(*a*) Families below mean income	39·30	47·18	—	—	35·68	52·64	51·50	52·87
(*b*) Families above mean income	25·42	27·38	—	—	27·89	45·23	37·36	36·63

The results show quite clearly that where the income is low the proportion of vegetable protein and fat is higher than is the case where a higher income is available—in the case of fats due mainly to the greater use of the less expensive margarine. P. L. McK.

The statistical investigation of the relationship of the nutrition of the child to the energy value of the diet throws no fresh light upon what is revealed by an examination of the weights of children as given, and the energy value of the diets shown in the preceding tables.

(*g*) **Milk Consumption in Families of Different Groups studied.**

In the House of Commons, on 3rd August 1925, the Minister of Agriculture stated that the milk consumption of the country amounted to only 20 gallons per head per year. It is possible from the census to calculate the man value of the population and thus to determine the milk consumption per man per day. This works out at nearly 0·6 pint.

Since the action of milk, and more especially of milk fats, in promoting growth in young rats upon a fat-free diet has been demonstrated, there has been a tendency to ascribe the lesser size of the town child to a deficient use of milk in the diet.

In the preceding dietary studies notes were kept of the amount of fresh milk used in the various families, and the average of this has been calculated in fractions of a pint per man per day. The results are given in Table 135.

TABLE 135. *Milk used in various Families whose Diets were recorded.*

Dietary study.	*Milk used per man per day (pints).* *Average.*	*Lowest.*	*Highest.*
(1) Glasgow, 1921	0·274	0·08	0·62
(2) ,, 1922	0·336	0·15	0·86
(3) ,, 1924	0·58	0·35	0·92
(4) Dundee, 1923	0·359	0·13	0·57
(5) Miners, 1922–3	0·34	0·02	0·8
(6) Agricultural, 1924	0·87	0·45	2·06
Perth	0·64	—	—
Forfar	0·64	—	—
Ayr	1·31	—	—

In comparing the town dietaries with those of agricultural labourers the amount of milk used by the former is small, and the figures might therefore seem to justify the conclusion that the defective supply of milk is a factor of importance in modifying growth. But the amount of milk used by the rural miners is as small as that used by urban families and yet the height and weight of the children of the miners are greater, so that the amount of *butter fat* would not seem to be the really important factor in securing the different degrees of growth and nutrition in the different classes of children studied.

(iii) CONCLUSIONS FROM DIETARY STUDIES

(1) The evidence seems to show that even upon the low intake of something less than 2,600 calories per man per day and a supply of only about 0·4 pint of milk, the city slum child, at least after 18 months of age, grows at the same rate as the country child with its 3,250 calories per man per day.

Age for age the country child from 1 to 5 years is some 10–11 per cent. heavier than the slum child. It leads a more active life and is more exposed to wind and weather. How far the difference in weight is the result and how far the cause of the more liberal diet is not revealed.

(2) It would seem that the usually accepted 3,000 calories by Lusk's standard as the minimum requirement per man per day for the family diets of our population, more than 80 per cent. of whom are town dwellers, is excessive and that from 2,500 to 2,700 calories is nearer the correct figure, i. e. that the standard might be reduced by 10, or possibly 20 per cent.

(3) The comparatively high correlation of calories in the diet and income (p. 140) and the absence of any correlation between the weights of the children and income (p. 129) seem to indicate that the diet is not the all-important factor in determining growth which it is often supposed to be. On the other hand, some evidence is afforded that below a certain energy intake there is a small correlation between the size of the child and the calorie value of the diet. This may be an example of the law that the effects of changes in any factor may be manifest over a comparatively small range (p. 113).

One of us (D. N. P.) has in the past too readily accepted the general view that the small size and weight of the town child is caused by the deficient diet, and has ignored the possible influence of heredity in determining height and weight as well as the smaller demands of the smaller and less active bodies of these town children. In the studies previously carried out the heights and weights were compared with a somewhat arbitrary standard based upon the data of Emerson and Manny (1920) and the Anthropometric Committee of the British Association (1883) which refer to the general population. In the light of the present investigation, the conclusions previously drawn appear hardly to be warranted.

(2) BREAST AND ARTIFICIAL FEEDING

(i) Preliminary Considerations

Much has been written regarding the relative merits of breast and artificial feeding, but a want of appreciation of wherein lie the differences between them is often evident.

Breast feeding owes its value to two different sets of circumstances. In the first place breast milk contains the various nutritive elements in what is probably the optimum proportions for the infant, and in a condition which permits of the optimum activity of digestion and absorption. There is, at any rate, no doubt that the protein of human milk is relatively better utilized than that of cow's milk, and, so far as calcium is concerned, utilization is not only relatively but absolutely better in the case of human milk than in that of cow's milk. In this way a certain amount of human milk may go further to supply the infant's needs than the same amount of cow's milk. There are undoubtedly other chemical differences between the two types of milk, but on these there is at present insufficient knowledge to permit of any useful discussion.

But there is another factor which is certainly of equal and possibly of more importance in differentiating these two types of feeding than any difference in the chemical composition of the milks themselves. This is the fact of the sterility of breast milk which is ingested by the infant without any opportunities being given for contamination.

It is the frequency with which the artificial diet is contaminated by pathogenic organisms, and so produces gastro-enteritis, an eminently fatal disease in infancy, and the varying death-rates from this malady in breast-fed and bottle-fed infants, which form the strongest argument in favour of the superiority of breast-feeding. It would seem wellnigh impossible for the poor to take sufficient precautions to prevent the risk of contamination, and consequently in their case natural feeding of the infant is necessarily safer. The well-recognized fall in infantile mortality during periods of industrial trouble and times of distress, as e. g. during the cotton famine in Lancashire, is most probably to be accounted for by the fact that under such circumstances the mothers are forced to give their children the cheapest and at the same time the cleanest form of nourishment, viz. breast milk.

Nevertheless, other things being equal, and more especially if precautions are taken against the possibility of contamination, it is doubtful if better results are obtained by natural than by artificial feeding, unless possibly during the first few weeks of life. No doubt it is easier to feed the child rationally at the breast than with the bottle, but the conditions as they prevail among the better classes do not lend support to the contention that breast-feeding is superior. Not only is the infantile death-rate in the upper classes lower than in the case of the poor, but the children age for age are on the average heavier and taller, and yet breast-feeding is certainly not so frequently practised, and, when practised, carried on for so long a period. Of course the general environment in the two classes is totally different.

It is held by some writers that breast-fed children maintain in later childhood the superior health which they are supposed to enjoy during infancy. This teaching has especially gained ground since Truby King inaugurated his campaign in favour of breast-feeding. It has been asserted by him and by his followers—Pritchard and Jewsbury—that the high protein diet, as presented in the form of cow's milk, damages the digestive and excretory organs (intestine and kidneys) and lays the foundation for much disease in childhood. So far as we are aware there is no valid evidence of any such phenomenon: Russow and Porter, who are both quoted below, have certainly touched on this question, but their findings do not lend any great support to the contention, and the results of Norman, also quoted later, in children of school age are distinctly against it.

In the present study, all the families investigated belong to the one social class, and the good environmental conditions of the upper classes are not present to counteract the disadvantages of bottle-feeding. Hence it might emerge that an inferiority in nutrition would be evident in the bottle-fed child. Definite proof would be required that this did not result from the prevalence of gastro-intestinal troubles in consequence of infection, so common in this class, before concluding that breast milk was superior. A survey of the comparative death-rates of the breast- and bottle-fed babies would almost certainly, however, reveal a great advantage with the former (see Hay, p. 198).

It must, of course, be borne in mind that the type of feeding which the infant receives depends on other factors, so that the question of bottle-feeding *versus* breast-feeding is not so direct and straightforward as it at first sight appears. For instance, a weakly child, or one not thriving at the breast, but suffering from some non-primary nutritional ailment, is likely to be weaned, or again, a child may be artificially fed because the mother is industrially employed, and so, from the consequent neglect of the home and the child being looked after by an incompetent individual, the question of efficient care becomes involved.

Although there is a fairly extensive literature on the relation of the nutrition of the infant to the type of feeding, little of it is of a nature suitable for comparison with the present study. Much of it deals with the effect of different types of milk mixtures in the treatment of definitely pathological states. Unfortunately, too, in many of the communications dealing with the general question now under discussion, the various interdependent factors mentioned above have been ignored. In some investigations boys and girls are massed, though the average weight and height of the two sexes are different, even from early intra-uterine life. In others, the relative length of time breast-feeding and bottle-feeding have been carried out has not been taken into account.

(ii) Previous Work

In 1881 Russow (1881) published the results of a study of the effect of different kinds of feeding in infancy, basing his conclusions on 4,100 observations of children from 15 days to 1 year. He also gives records of heights and weights of older children, grouped according to whether they were breast-fed or artificially fed during infancy. Unfortunately, however, like so many of the other investigators, he does not separate the sexes in giving his results. He found that not only were breast-fed babies taller and heavier than those artificially fed, but also that the deficiency in height and weight among those artificially fed continued throughout childhood. His results are given in Tables 136, 137, and 138.

Table 136. *Heights of Infants (in cm.) and Types of Feeding* (Russow).

Age.	*Mixed feeding.*	*Breast-feeding.*
15 days	49	51
1 month	53·5	55
2 months	58·5	58
3 ,,	58	61
4 ,,	60	63
5 ,,	62·5	65
6 ,,	64	67
7 ,,	65	68
8 ,,	65	68·5
9 ,,	67	69
10 ,,	67·5	70
11 ,,	68·5	71·5
12 ,,	69	73

Table 137. *Weights of Infants (in gm.) and Types of Feeding* (Russow).

Age.	*Artificial.*	*Mixed.*	*Breast.*
15 days	2,900	2,928	3,027
1 month	3,047	3,090	3,148
2 months	3,405	3,585	3,792
3 ,,	4,089	4,143	4,225
4 ,,	4,339	4,382	4,610
5 ,,	4,620	4,774	5,246
6 ,,	4,744	5,598	5,775
7 ,,	4,833	5,469	6,060
8 ,,	5,140	5,225	6,486
9 ,,	5,254	5,932	6,490
10 ,,	5,668	5,850	6,849
11 ,,	5,719	6,213	6,941
12 ,,	6,128	6,823	7,910

Table 138. *Weights and Heights of Children* 1 *to* 8 *Years* (Russow).

	Weights (gm.).		*Heights (cm.).*	
Age in years.	*Breast-fed.*	*Artificially fed.*	*Breast-fed.*	*Artificially fed.*
1	10,934	7,436	73	66
2	11,135	8,674	83	75
3	12,669	10,540	89	83
4	14,212	12,044	93	87
5	15,353	13,425	100	98
6	17,092	15,718	106	102
7	18,257	15,910	110	105
8	20,704	18,368	116	113

Camerer (1901) published in 1901 the results of the weighing of 133 infants. They were weighed regularly each week for the first year of life, and grouped according to the weight at birth and also according to the type of feeding. His results do not indicate any marked superiority in breast-feeding over artificial feeding so far as weights of the infants are concerned, but they do show quite definitely the failure of the child of low birth weight to make good the original deficiency, irrespective of the type of feeding. Table 139 gives his results in each group for (*a*) weight at birth, (*b*) weight at 26 weeks, and (*c*) weight at 52 weeks.

It will be seen from this table that in the case of the smaller children at the age of 6 months the advantage lies with the child at the breast and the child getting mixed feeding. This is probably to be accounted for in part by the amount of food supplied. A child at the breast gets as much as it will take, provided, of course, there is a sufficiency, whereas a bottle-fed child, at least as a rule, only gets the supposed optimum amount. On the other hand, by the time the children had reached the age of 1 year the best results, also in the case of the lighter children, were obtained with artificial feeding. This, again, was probably a matter of quantity, since after nine months the activity of the breasts diminishes. In the case of the heavier children (those with a birth weight over 2,750 gm.), the best results were obtained at all ages with breast-feeding. It might, of course, be argued that those artificially fed children were in a specially advantageous position, being under the constant supervision of a physician, and so do not represent the average artificially fed infant. While this may be so, the figures do seem to indicate that artificial feeding when properly carried out is not of necessity a handicap to the infant.

TABLE 139. *Weights of Infants (gm.)* (Camerer).

Age.	*Breast-fed.*	*Artificially fed.*	*Mixed feeding.*
Children over 2,750 gm. at birth.			
Birth	3,433	3,467	—
26 weeks	7,505	7,278	—
52 ,,	10,141	9,624	—
Children from 2,000 to 2,750 gm. at birth.			
Birth	2,500	2,250	2,244
26 weeks	2,653	2,565	2,624
52 ,,	2,798	2,810	2,803
Children under 2,000 gm. at birth.			
Birth	1,174	1,159	1,170
26 weeks	1,551	1,489	1,527
52 ,,	1,744	1,789	1,764

In an earlier paper (1893), the data of which are included in the article quoted above, Camerer gives graphs which show that artificially fed infants, after a period during which growth in weight is retarded, gradually reach the weight of those children who are breast-fed.

Camerer, Junior (1908), concludes that 'at the end of the first year the artificially fed infants reach about the same weight as the breast-fed ones, provided the feeding has been rational'. He gives a series of infants' weights which seem to confirm his conclusions.

Baldwin (1921) quotes Hillenberg (1912–13) as finding no significant differences in the development of breast-fed and artificially fed infants. Whatever advantage there seemed to be, according to Hillenberg, was on the side of the breast-fed children in the city and the bottle-fed in the country, where breast-fed children are apt to be irregularly fed through the mothers working in the fields.

Pooler (1913), from a study of infants attending the Birmingham Child Welfare Centres, gave the weights of infants grouped according to the type of feeding. These figures show with great regularity increased weight associated with breast-feeding. It is unfortunate that birth weights are not given, as it appears possible that the lesser weight of the bottle-fed infants given in these results might be due to an initial low weight. His results are given in Tables 140 and 141.

Table 140. *Weights of Birmingham Infants,* 1908 *to* 1913 (Pooler).

	3 wks.	*13 wks.*	*26 wks.*	*39 wks.*	*52 wks.*
	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.
Breast-fed	8 4	11 5	14 10	17 0	19 1
Mixed feeding	7 11	10 4½	12 15	15 11	17 13½
Bottle-fed	7 1	9 5½	11 11½	14 7½	16 4

Table 141. *Weights of Birmingham Infants,* 1913 (Pooler).

	3 wks.	*13 wks.*	*26 wks.*	*39 wks.*	*52 wks.*
	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.
Breast-fed	8 2	11 3	14 7	16 13	18 6
Mixed feeding	7 12	9 13	13 2	15 12	17 5
Bottle-fed	7 4	9 2	11 13½	14 5	16 9

Variot and Fliniaux, in 1914 (1914), reported on an investigation on the relationship between the height and weight of infants and the kind of feeding they received. For each month of the first year of life 25 boys and 28 girls who were entirely breast-fed, 20 boys and 20 girls who were on mixed feeding, and 41 boys and 32 girls who were entirely artificially fed were weighed and measured. The results of the investigation are given in Table 142. It will be seen that only a small difference was found between the weight and height of the breast-fed and the weight and height of the artificially fed, and Variot concludes—'Contrairement aux idées admises d'après les observations anciennes, il n'y a qu'une différence minime entre le poids et la taille des enfants élévés au sein ou au biberon, si l'on applique à ces derniers les perfectionnements modernes de l'allaitement artificiel.' The better results on the whole with mixed feeding raise questions as to the sufficiency of the breast milk.

Baldwin (1921), basing the statement apparently on a small number of observations, says that 'artificially fed babies as a rule weigh less than breast-fed babies. This is particularly true during the first few months.' He, however, admits that 'changing feeds' of delicate babies is customary, and so it may be delicacy rather than type of feeding which yields the lighter weight. This appears likely in view of the apparent lessening of the correlation between feeding and light weight which he found in the later months of the first year.

Salvetti and Segagni (1922), quoted in the *Journal of the American Medical Association*, 1922, studied 127 infants, and came to the conclusion that the difference in weight between breast, mixed, and artificially fed infants is so slight that the inferiority of bottle-feeding is not demonstrated.

Holt (1923) states that with the breast-fed infants there is usually a more rapid gain during the early months.

Lane Claypon (1916) reports the results of an investigation made by Dr. Norman of the London County Council into the effect of different kinds of feeding in infancy on the physique of children whose ages ranged from three to eight years. It was noticed that it was the poorest class child who had most usually been breast-fed, and hence the artificially fed child would have better surroundings than many breast-fed infants. Discussing Dr. Norman's results, Miss Lane Claypon says—'It may be noted that, without exception, the range both of height and weight in the groups of breast-fed children is greater than that among the bottle-fed children. This may indicate that the poorer specimens among the breast-fed children survived, while those in a corresponding condition among the bottle-fed ones did not do so. The inference, however, cannot be pressed too far. The weeding out of the sickly bottle-fed babies is referred to by Dr. Norman in his conclusions, which are as follow: 'The superiority of breast-fed children as compared with bottle-fed ones is not so well marked at school age as one would be led to expect. It is during the early years of life, prior to school age, that the great advantage of breast-feeding over bottle-feeding is so apparent. The bottle-fed children of the poor that survive appear to overtake their disadvantages, and by the time we find them in school show no inferiority physically to their breast-fed fellows.' Dr. Norman's own data refer to children of 4 years and upwards, and in the earlier years of which he tabulates results the percentage

TABLE 142. *Relative Heights and Weights of Breast-fed and Artificially Fed Children* (Variot and Fliniaux).

Age in months.	*Breast-fed.*				*Mixed feeding.*				*Artificially fed.*			
	Boys.		*Girls.*		*Boys.*		*Girls.*		*Boys.*		*Girls.*	
	Weight.	*Height.*	*Weight.*	*Height.*	*Weight.*	*Height.*	*Weight.*	*Height.*	*Weight.*	*Height.*	*Weight.*	*Height.*
	gm.	cm.	gm.	cm.	gm.	cm.	gm.	cm.	gm.	cm.	gm.	cm.
1	3,600	53	3,580	53	3,690	53·6	3,500	53·2	3,582	52·8	3,560	52·7
2	4,330	57·3	4,320	55·6	4,350	55·9	4,200	55·5	4,290	56·6	4,160	56·5
3	5,030	59	4,960	58	4,925	58·7	4,845	57·5	4,820	58·6	4,600	57·6
4	5,670	61·5	5,360	60·5	5,710	61·5	5,490	61	5,760	61·2	5,350	60·5
5	6,180	63·2	6,140	62	6,450	62·5	6,000	62	6,000	62·8	5,830	61·5
6	6,800	65·5	6,720	64	6,885	64·5	6,505	64	6,380	64	6,300	63·5
7	7,100	66	7,050	65	7,420	66·9	6,910	66·2	6,940	65·2	6,800	64·5
8	7,620	67	7,580	66	7,960	67·6	7,580	67·1	7,370	66·5	7,200	66
9	8,220	68·2	8,000	68	8,300	69·3	7,995	68·2	7,500	67·5	7,450	67
10	8,600	70	8,525	69·8	8,980	70·5	8,440	9·5	8,000	68·2	7,945	68
11	8,800	70·7	8,750	70·5	9,100	71·2	8,970	0·9	8,450	69·5	8,400	69·5
12	8,950	72	8,900	71·5	9,330	72·3	9,175	2·2	8.810	71	8,780	71

under normal both in height and in weight is rather greater among the breast-fed in infancy than among those who were artificially fed. We have been unable to trace any data—if we except Russow's early work (1881)—which support the assertion by Dr. Norman just quoted that 'It is during the early years of life, prior to school age, that the great advantage of breast-feeding over bottle-feeding is so apparent'.

Lane Claypon also gives the results of an analysis of the weights of German infants grouped according to whether they were breast-fed or fed on boiled cows' milk. She says, 'Both series show an extreme irregularity in the rate at which the weight increases, but after the first two estimations it would be difficult to point out any marked difference between the values of the two series.'

In the Annual Reports for the City of Dundee Dr. Scott Dickson has published an interesting analysis of the relative weights of infants grouped according to the kind of feeding. In the Report for 1922 the children entirely or partly breast-fed show a much smaller proportion of underweight cases than the children artificially fed, but it must be remembered that in Dundee a large proportion of the mothers are industrially employed, and hence to group wholly and partly fed children in one class may lead to erroneous conclusions.

Brailsford Robertson, writing on growth and development in Abt's *Pediatrics*, gives the results of a study of the growth of children attending the School for Mothers Institute, Adelaide. These children were grouped according to whether they had been breast-fed, but irrespective of the period during which they had been so fed, and artificially fed. One hundred and fifty-nine normal infants, none of whom was suffering from definite ailments requiring medical attention, were studied. Roughly, about two-thirds were breast-fed and one-third artificially fed. Weighings extended over the first year of life. The results of the study are given in Table 143.

TABLE 143. *Relative Weights of Breast-fed and Bottle-fed Australian Infants (ounces)* (Brailsford Robertson).

Age in months.	*Boys.* *Breast-fed.*	*Boys.* *Bottle-fed.*	*Girls.* *Breast-fed.*	*Girls.* *Bottle-fed.*
1	155	117	153	120
2	187	141	168	137
3	206	169	188	156
4	224	193	209	179
5	254	226	224	184
6	270	242	253	198
7	287	267	263	212
8	300	329	270	239
9	311	280	300	259
10	326	298	315	252
11	333	322	335	265
12	330	335	345	288

It is very questionable, however, if these figures are of any great value. Curiously, though Brailsford Robertson in his article comments at length on the complexity of the problem, and on the objections to the majority of the statistics due to the mixing of data relating to the two sexes, the unreliability of weighings because they have been carried out by inexperienced workers, and the inclusion of sickly and diseased infants, he fails to see quite as serious an objection to the adoption of the figures he quotes. In these the only distinction between the two groups is whether the children had ever received breast milk or not, without any relation to the length of time the breast-feeding had been carried out. Presumably, therefore, a child which was breast-fed for one week only would be included among the breast-fed children, which would obviously lead to erroneous conclusions.

Karn and Pearson (1922), in their study of the data obtained from a Welfare Centre in a manufacturing town in the north of England, state that the influence of breast-feeding on the health of the infant is not so important as is generally asserted. They introduce another factor and consider that artificial feeding is a secondary result, associated with poor health of the mother. From their data they found that as the mother passes from strong to weak, so the months of breast-feeding decrease. They also found that the nature of the feeding during infancy had little influence on the weight of boys, but that it has considerably more effect on the weight of girls. They suggest that this appears to be part of what may possibly be a general principle, that girls respond more to environment, particularly maternal environment, than boys do.

The evidence so far adduced does not seem to warrant the conclusion that growth and nutrition are more satisfactory in breast-fed infants than in those fed upon substitutes for the milk of the mother. When, however, the effect on the child, as indicated by the infantile mortality rates, of breast as contrasted with artificial feeding is considered, the evidence seems to point strongly in favour of breast-feeding. This, of course, as previously mentioned, is due to the difference in sterility of the two milks. In the case of the poor uncontaminated cow's milk is a rarity, and infection of the gastro-intestinal tract an almost daily occurrence.

Newman in his *Infant Mortality*, pp. 221 et seq., gives a long series of examples drawn from the observations in many countries, including Britain, from which it is only possible to deduce a very much higher rate of infantile mortality associated with artificial feeding. For instance, in discussing an investigation into the subject he points out that ' the probability of death from diarrhoea is forty-eight times as great among infants fed on cow's milk and *ninety-four* times as great among infants fed on condensed milk as among those which are breast-fed'. . . . ' In Birmingham Dr. Robertson calculates that the infant mortality rate for wholly breast-fed infants is 7·8 per 1,000 births, for breast-fed and otherwise fed children 26·5, and for children having no breast milk 252·3. . . . Seventy-nine per cent. of infants under six months of age dying in the third quarter of 1904 were bottle-fed with tube-bottles and 21 per cent. with boat-bottles.'

Woodbury (1922) in discussing the relation between breast and artificial feeding in infantile mortality is quoted by Holmes (1924), who says, ' Data obtained by the Children's Bureau of the United States Department of Labour, on the mortality of more than 22,000 live-born infants in eight representative cities of the eastern United States and extending from birth to the first birthday, show that artificial feeding, as actually practised in typical American city populations, is associated with an infant mortality between three and four times as high as the mortality among breast-fed infants. The relation appears in all nationalities and in all income groups, though with variations depending probably on particular conditions prevailing in the groups. If the first nine months were considered rather than the first year, artificial feeding was accompanied by a fivefold death-rate, as compared with breast-feeding. The ratio was higher (6·31) in the group with earnings of 1,250 dollars and over.' This finding is rather remarkable and would not seem to be the case in this country.

Hay (1908) carried out a very interesting investigation in Aberdeen into the effects of the different kinds of infant feeding, as shown by the infant mortality. He gives results from a study of the effects as shown in different social grades of the population which seem to show that (*a*) artificially fed infants in the poorer classes have a definitely higher infant mortality rate than breast-fed infants, and (*b*) that there is no appreciable difference between the infantile mortality rates of breast-fed and artificially fed infants among the well-to-do classes, thus suggesting that the effects of artificial feeding lie rather in the method than in the material used—that where rational care is taken the artificially fed infant has an equal chance of survival with the breast-fed infant.

(iii) Present Investigation

The data collected from the Child Welfare Centres afforded material calculated to throw light upon the relationship of the size of the infant to the character of the feeding. The number of Edinburgh infants for which returns were available was too small to allow of reliable statistical analysis, and hence the material from Glasgow and Dundee only was investigated by Dr. MacKinlay.

The material studied consisted not only of children who attended the Welfare Centres regularly but also of infants who attended only once. For this reason it was thought that the total returns from these centres might not represent a homogeneous population. It seemed possible that the so-called 'revisit' children, i. e. children attending the Welfare Centre more than once, would be a specially selected population and of a different type to those attending only once. It is conceivable that if the child were thriving a mother might consider the time absorbed in subsequent visits wasted, and hence the sample of children studied would contain an undue proportion of weaklings. On the other hand, the inducement of a gratuitous supply of milk and infant foods might be an incentive for the worst type of mother to attend more frequently and at the same time act as an inducement to premature weaning.

A study of the records, however, shows that the mean duration of breast-feeding in the children observed once (first visit) and in the children observed more than once (revisits) is 4·9762 ± ·2372 months and 4·1389 ± ·2283 months respectively. The difference of ·8373 months in favour of primary visits is not significant, the probable error being ± ·3292. Nor does the health of the mother herself appear to influence the number of times the child visits the clinic. The proportion of mothers of poor health attending on one occasion is 31·46 per cent., and of mothers attending regularly is 33·68 per cent.; (these percentages are calculated on all women attending with children of 9 to 12 months of age). The difference in the proportion of mothers in poor health is thus also insignificant (2·22 per cent. ± 3·54). It seems then that the group of children attending regularly is not adversely selected either with regard to the condition of health of the child or of the mother.

The following variables have been analysed: weight, height, duration of breast-feeding, health of the mother during pregnancy, and industrial employment of the mother. The duration of breast-feeding was taken as (1) total breast-feeding—the number of months in which the child is reputed to have had no other food; (2) 'partial' breast-feeding—the number of months in which the child received any breast milk.

The means, standard deviations, and coefficients of variation of weights and heights are given on p. 32 for comparison with those of first-visit infants.

The mean duration of breast-feeding in the various groups is evidently not a very reliable quantity, the percentage variability being anything from 70 to 90 per cent. of the mean value.

TABLE 144. *Duration of Breast-feeding in Months.*

	Boys.			Girls.		
Age (months).	*Average duration in Months.*	*Standard deviation.*	*Coefficient of variation.*	*Average duration in Months.*	*Standard deviation.*	*Coefficient of variation.*
4+	2·1005	1·6031	76·32	2·3125	1·7036	73·67
5+	2·4607	2·0176	81·99	3·7926	1·6033	42·27
6+	2·7182	2·4142	88·82	3·0634	2·3614	77·08
7+	3·4502	2·6489	76·77	3·2556	2·7106	83·26
8+	3·4850	2·8225	80·99	3·3880	2·9993	88·53
9+	3·8268	3·2293	84·39	3·7129	3·3212	89·45
10+	3·5377	3·2163	90·91	4·1100	3·3083	80·49
11+	3·4907	3·1156	89·25	3·9236	3·3935	86·49
12+	3·7311	3·2065	85·94	3·6711	3·2554	88·68
1 year	4·1389	3·5170	84·97	3·8870	3·4791	89·51

The distribution of length of time of breast-feeding gives more reliable information. Chart XLVIII indicating length of 'total' and 'partial' breast-feeding shows a well-marked bimodal distribution, the peaks being more marked in the case of the latter. It seems as if *the majority of mothers feed their infants during the first month and, if suckling is not then discontinued, they usually manage to carry on with total breast-feeding till the 6th–9th months, and, when supplemented with cow's milk, till the 10th–11th months ; it is the minority of women who discontinue breast-feeding in the intervening months.*

There is no difference between males and females regarding the length of time they had been breast-fed.

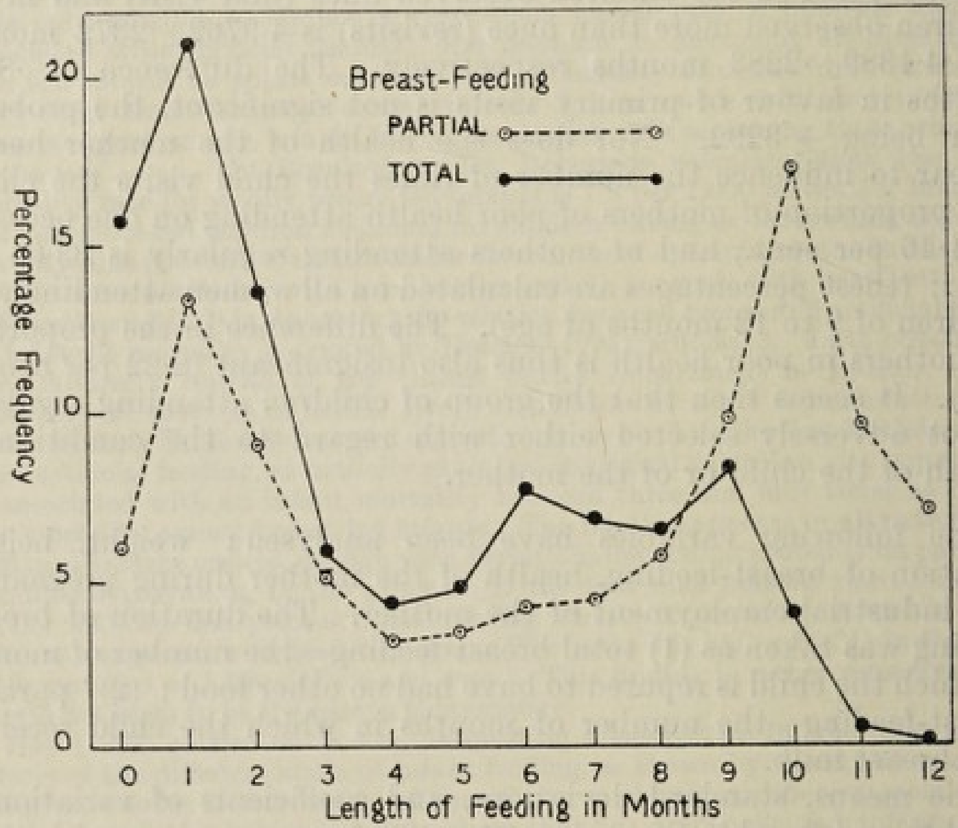


CHART XLVIII. Showing percentage frequency distribution of different durations (in months) of the two classes of breast-feeding.

From Table 145 it is seen that the correlation of weight of infant to duration of breast-feeding shows *quite a significant positive relationship up to the 9th month, but after this age no sensible relationship is demonstrable. After the 9th month duration of breast-feeding seems to have no effect, infants who were longer breast-fed losing their superiority over those weaned earlier.*

Height is less closely associated with duration of breast-feeding than is weight. There is a small positive correlation in infants up to 9 months, after which no relationship seems to be present. There is no difference between males and females.

Charts XLIX and L give the weights of infants entirely breast-fed and of those not entirely breast-fed from birth to ten months. They show the superiority of the former group up to nine months, but not beyond it.

TABLE 145. *Correlations. Weight to Duration of Breast-feeding.*

	Age (months)	4+	5+	6+	7+	8+	9+	10+	11+	12+	1 year.
Boys	Glasgow	·3151 ±·043	·3415 ±·043	·3778 ±·038	·3962 ±·036	·1986 ±·046	·2628 ±·047	·1775 ±·045	·1308 ±·052	·0765 ±·061	·0191 ±·065
Boys	Dundee	·1941 ±·056	·2345 ±·064	·1053 ±·070	·2697 ±·066	·2504 ±·074	·1153 ±·081	·0232 ±·085	·0112 ±·069 = 11–13 months combined		
Girls	Glasgow	·2490 ±·046	·3294 ±·044	·3563 ±·041	·2179 ±·039	·2828 ±·046	·2481 ±·044	·0807 ±·047	·0635 ±·054	·0731 ±·054	−·0805 ±·062
Girls	Dundee	·3034 ±·058	·1431 ±·066	·1893 ±·076	·2654 ±·070	·0369 ±·086	−·0187 ±·089	−·0181 ±·059 = 10–13 months combined			

Height to Duration of Breast-feeding.

	Age (months)	4+	5+	6+	7+	8+	9+	10+	11+	12+	1 year.
Boys	Glasgow	·1285 ±·047	·1700 ±·047	·2653 ±·042	·2600 ±·040	·1309 ±·047	·2993 ±·046	·0636 ±·046	·1397 ±·052	·0142 ±·062	−·0019 ±·065
Boys	Dundee	·0941 ±·058	·1928 ±·066	·1069 ±·070	·2010 ±·068	·2287 ±·075	·0838 ±·080	·0142 ±·085	·1752 ±·067 = 11–13 months combined		
Girls	Glasgow	·1307 ±·048	·1641 ±·048	·1942 ±·045	·1776 ±·040	·1182 ±·049	·2227 ±·044	·0952 ±·047	·0548 ±·054	·0618 ±·054	−·1182 ±·062
Girls	Dundee	·1755 ±·061	·1510 ±·066	·1673 ±·076	·1450 ±·074	·1989 ±·083	·0026 ±·089	−·0118 ±·059 = 10–13 months combined			

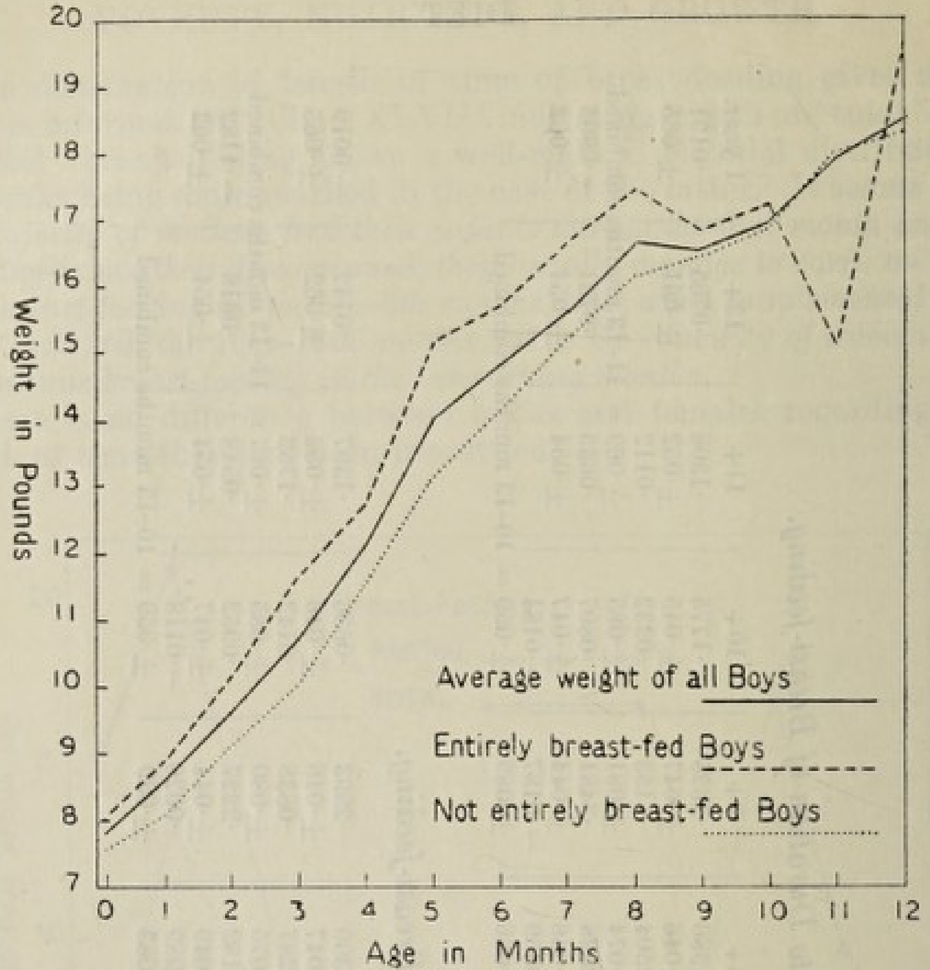


CHART XLIX.[1] Showing average weights at different ages of boys (1) entirely breast-fed and (2) not entirely breast-fed.

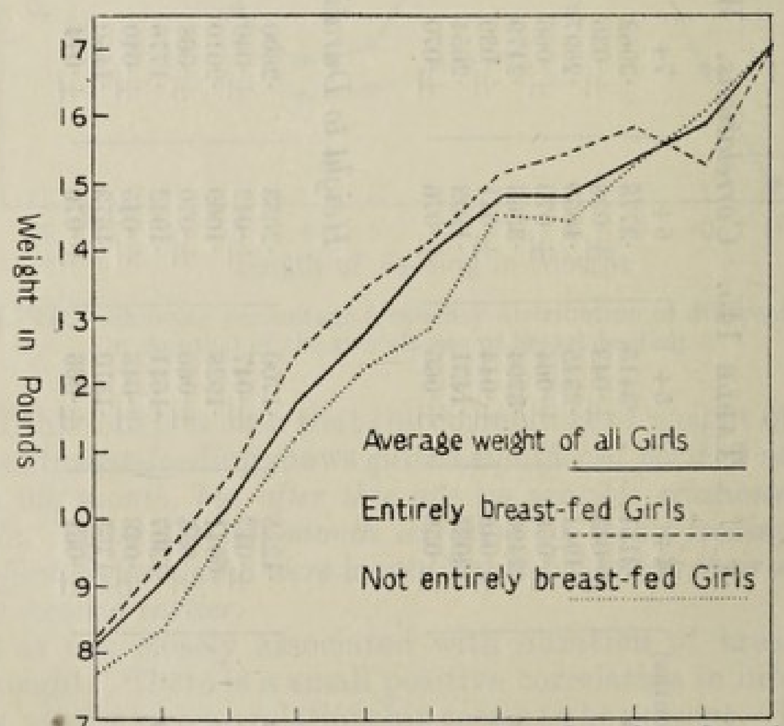


CHART L.[1] Showing average weights at different ages of girls (1) entirely breast-fed and (2) not entirely breast-fed.

[1] Owing to a small error in the above diagrams, the weights of boys and girls aged 0 month begin at birth instead of at 1 week.

The interpretation of these quite plausible correlations and Charts is open to great fallacies. These results might be adduced as evidencing the marked superiority of breast over any other type of infant feeding, but the exclusion of concomitant variations in other influential factors must first be considered. A positive correlation (about 0·30 in magnitude) can in no sense be considered the result of a stringent comparison of the relative values of various types of infant feeding when we think of the social class of the community investigated. The method of administering artificial foods leaves much to be desired ; the times for feeding, the quantities, the composition and dilution of the food-stuffs, and the infinite sources of contamination of the food and containers by infective organisms, being all variables which may adversely influence the health and nutrition of the infant.

As already indicated, the death-rate from infantile diarrhoea has been shown to be higher among artificially fed than among breast-fed infants, yet this disease is relatively much less prevalent in better social classes where the ratio of breast to artificially fed infants is much smaller than it is in poorer classes. This, of course, points to the fact that it is not the food, but another factor—infection—which is the influential variable. So, too, in regard to nutrition, caution must be exercised in interpreting these results, as we are not comparing breast-feeding and artificial feeding *per se*, but rather breast-feeding and artificial feeding plus its possible harmful associated factors. Again, it is known that an infant may be taken off the breast when its health is below par, and put on artificial feeding. Therefore a positive correlation between duration of breast-feeding and weight might simply mean that infants who were not thriving from any cause were taken off the breast.

After the 9th month the correlation coefficient is insignificant. The correlation ratio (η) has therefore been calculated to exclude the possibility that there is some association, but the regression is non-linear. The ratio, however, is also insignificant or indeterminate ; so that *in our sample a child who has not been breast-fed at all is, after the usual period of weaning, as good a child as that which has been breast-fed during the whole time.* Two possible reasons might account for this :

(1) A higher death-rate among the artificially fed infants with a consequent survival of the fittest would lead to a comparison of the *healthiest* of the non-breast-fed with the *average* of the breast-fed ; this of course would be favourable to the former.

(2) There might be some retardation in growth from the change of feeding which would have been recovered from in those who had been weaned earlier.

The *health of the mother* might conceivably influence the period of suckling, but here also there does not appear to be any relationship. Mothers in good health and mothers in poor health on the average suckle their children for the same length of time (Table 146).

Occupation of the mother is another factor which might affect the infant by reducing the length of time of breast-feeding, but on the other hand the money earned by the mother might have a beneficial effect. There appears, however, to be no relationship of weight to income (p. 129), and the length of time of breast-feeding is only to

TABLE 146. *Correlations. Duration of Breast-feeding to Maternal Health during Pregnancy.*

	Age (months)	4+	5+	6+	7+	8+	9+	10+	11+	12+	1 year.
Boys	Glasgow	−·2040 ±·046	·0946 ±·048	·1215 ±·045	·0918 ±·042	·0439 ±·048	·0272 ±·050	·0207 ±·046	·1180 ±·052	·1885 ±·060	·0888 ±·065
Boys	Dundee	−·0650 ±·058	−·0320 ±·068	·1657 ±·069	·0332 ±·071	·1184 ±·078	·1653 ±·080	·0520 ±·085	·2954 ±·063 = 11–13 months combined		
Girls	Glasgow	·0754 ±·048	·0127 ±·049	·0007 ±·047	·0843 ±·041	−·0615 ±·050	·1780 ±·045	·0627 ±·047	−·1039 ±·053	−·0038 ±·055	·0380 ±·063
Girls	Dundee	·1901 ±·061	·0291 ±·068	−·0353 ±·078	·1210 ±·074	·1091 ±·085	·1246 ±·087	−·0421 ±·059 = 10–13 months combined			

TABLE 147 (a). *Correlations. Duration of Breast-feeding to Occupation of Mother.*

	Age (months)	4+	5+	6+	7+	8+	9+	10+	11+	12+	1 year.
Boys	Glasgow	·0019 ±·048	·0819 ±·048	·1612 ±·042	·1030 ±·042	·2792 ±·044	·0948 ±·050	·3373 ±·041	−·0157 ±·053	·1747 ±·060	·3025 ±·059
Boys	Dundee	−·0741 ±·058	−·0836 ±·068	·0175 ±·071	−·2415 ±·067	−·0167 ±·079	−·1027 ±·080	·1437 ±·083	−·2750 ±·064 = 11–13 months combined		
Girls	Glasgow	−·0255 ±·049	·1149 ±·049	·5119 ±·035	·1535 ±·040	·3774 ±·043	·1635 ±·045	·2223 ±·045	·2417 ±·051	·2103 ±·052	·1730 ±·061
Girls	Dundee	−·0895 ±·063	·0774 ±·067	−·0958 ±·078	−·0895 ±·075	·0774 ±·086	·1350 ±·087	·0888 ±·059 = 10–13 months combined			

Table 147 (b). *Correlations. Maternal Health during Pregnancy to Industrial Occupation of Mother.*

	Age (months)	1	2	3	4	5	6	7	8	9
Boys	Glasgow	·177 ± ·030	·117 + ·040	·270 ± ·065	·080 ± ·137	·253 ± ·102	·077 ± ·101	·220 ± ·115	·269 ± ·144	·563 ± ·092
	Edinburgh	·243 ± ·070	·162 ± ·071	·057 ± ·083	·454 ± ·069	·069 ± ·110	·302 ± ·099	·157 ± ·110	—	—
	Dundee	·045 ± ·043	·040 ± ·058	− ·005 ± ·059	·045 ± ·059	− ·079 ± ·067	·440 ± ·057	·009 ± ·071	− ·009 ± ·079	− ·209 ± ·078
Girls	Glasgow	·373 ± ·028	− ·109 ± ·040	·443 ± ·056	·453 ± ·084	—	—	·431 ± ·079	·009 ± ·104	—
	Edinburgh	·747 ± ·035	·351 ± ·069	·528 ± ·062	—	—	·223 ± ·105	·475 ± ·081	—	·204 ± ·109
	Dundee	·167 ± ·045	·030 ± ·061	·161 ± ·058	·180 ± ·061	·280 ± ·062	− ·204 ± ·076	− ·083 ± ·074	− ·235 ± ·081	·238 ± ·083

a small degree influenced by employment (Table 147 (a)). These coefficients (duration of suckling to occupation) are almost all positive, but are of a low order of magnitude and quite insignificant.

The correlations of health of the mother during pregnancy to industrial occupation during pregnancy are shown in Table 147 (b). In this table a minus sign indicates that the mothers who are working are in better health than those who are not working. A positive sign indicates that the mothers who stay at home have the better health. Glasgow and Edinburgh, with one exception, show plus signs, while Dundee, in the later months, shows a greater proportion of minus signs. The correlation coefficients, however, are too irregular in value to permit of any deduction being drawn from the results.

The Dundee results on the whole confirm the observations from the Glasgow Welfare Centres. The magnitude of the correlations of weight to duration of breast-feeding are somewhat smaller than those found in Glasgow, but up to the 8th month are all positive in sign. Height to breast-feeding also shows a uniform series of small positive correlations. The health of the mother during pregnancy and occupation during pregnancy have no demonstrable relation to the period during which the infant is breast-fed (Tables 146, 147 (a)).

P. L. MacK.

PART VI. PARENTAL FACTORS.

CONTENTS

A. THE MOTHER

B. THE FATHER

A. *THE MOTHER*

THE dependence of the child on its mother is one of the most evident of physiological facts. During antenatal life the child is really a part of her and shares in her nutrition. In postnatal life, though the association is less intimate, the child is still dependent on its mother for care and for its nourishment, alike when the mother fulfils her natural duty or supplies it with a substitute for her milk. Even after the child is weaned it does not become independent of maternal care. This intimate relationship naturally suggests the possibility that the condition of the mother, not only from the physical but also from the mental and moral aspects, may play a part in determining the growth, nutrition, and development of the child. The absence of any difference between the wastage from miscarriage, from still-birth, and from neonatal deaths in the different classes of society (Agnew, 1922) and the very high death-rate of illegitimate children is strong evidence of the preponderating influence of maternal care as a factor in at least preserving the life of the child.

(1) THE HEALTH OF THE MOTHER

The health and vigour of the mother may react upon the child in various ways. The child, of course, receives a certain quota of its inheritance from its mother, and in the case of haemophilia it inherits its weakness entirely through the female line. In the case of infective disease of the mother, from its connexion through the placenta, the child may and frequently does become infected. But it is also possible that a certain influence may be inherited in a more general sense. If, for example, the mother does not enjoy good health during pregnancy the nutrition of the foetus may be prejudicially affected and a small and weakly child may result. A certain school of obstetricians have stressed the importance of this, but very little direct evidence has been adduced to prove the contention.

Again, a woman with inherent poor general health and nutrition, although not suffering from specially bad health during pregnancy, may transmit to her child, by the laws of heredity, her own want of vigour.

But there is yet another way in which indifferent health of the mother may influence the child. It is possible that a feeble and ailing mother may not have the energy to give her children and her house adequate attention, and that her efficiency in rearing her children may thus be reduced.

Two questions are thus involved: (i) the antenatal, and (ii) the postnatal influence of the health of the mother.

(i) Previous Work

(a) Birth Weights.

Vierordt (1906) quotes Fourman (1901) as giving the following birth weights to show an apparent influence of the size and of the health of the mother on the physique of the child at birth.

Table 148. *Birth Weights of Infants* (Fourman).

With large mother	3,433 gm.
With small mother	3,054 gm.
With strong mother	3,335 gm.
With weakly mother	2,995·4 gm.

Discussing infantile mortality as an indication of the relative effects of maternal health on the offspring, the Paris letter of the *Lancet* (1924, i. 972) states: '. . . it is under discussion whether the children of tuberculous mothers are born with a diminished coefficient of vitality as France, Landouzy and Barbier have maintained. In contravention of this view, Debré thought it possible to establish that these children are born with a weight of about 3,250 gm., i.e. a weight little if any below the average. Quite recently Professor Coubelaire (1923), who has made a study of children born from tuberculous mothers brought up by foster parents and withdrawn from contact with their mothers, has revealed to the Society of Obstetrics and Gynaecology at Paris the very high mortality among them, viz. 38 per cent. in the first month. Most of the infants died from no demonstrable cause—one might say that they went out like lamps without oil. Dr. Vignes (1924) laid down at one of the meetings of the Society of Biology that, save in a few exceptions, if one sets down the weight of children born of tuberculous mothers at the exact term of gestation and compares it with the average weight among the new-born in Paris, one finds some instances of weights superior to the average, or approaching the average, and a very great number of children who are inferior in weight—that inferiority in weight being more accentuated among children of multiparae than among those of primiparae. The results of this work are, however, in contradiction to those of another communication by the same author to the French Association for the Study of Cancer (Séance, March 1924) on children born of cancerous mothers. These children, even if the cancer were grave, Vignes found, had generally a weight fairly approaching the average.'

Dr. Eicholz, before the Privy Council Committee on Physical Deterioration in 1904, 'recalled a medical factor of great importance, viz. the small proportion of unhealthy births among the poor . . . the poorest and most ill-nurtured women bring forth as hale and strong looking babies as those in better condition.' Dr. Eicholz was supported in this conclusion by Dr. Cunningham. On the other hand investigators, such as Prochownick (1901), quoted by Noël Paton (1903), point to a direct relation between the nutrition of the mother and the condition of the offspring. Prochownick and others have adduced evidence that by dieting women who had previously great difficulty at childbirth, infants were born quite normally on account of their being smaller than those which the women had previously borne. Abel (1925), in a recent study, gives statistics showing lower weights of the new-born babies of under-nourished mothers. It is however interesting to note in this connexion that during the period of greatest shortage of food during the Great War, there is no evidence of a reduction of the birth weight of the children in the Central Powers (Austria and Germany). (See Jackson, 1925.)

(*b*) After Birth

Karn and Pearson (1922), in considering the weights of one-year-old babies grouped according to the health of the mothers during pregnancy, give the following table of mean weights of boys and girls for each health category:

TABLE 149. *Relationship Weight of Child of one Year to Health of the Mother* (Karn and Pearson).

Mother's health during pregnancy.	*Weights (lb.).*	
	Boys.	*Girls.*
Strong	17·87	17·55
Good	19·28	17·66
Indifferent	18·46	16·45
Poor	18·20	16·25
All categories	19·00	17·21

They say, 'Now, while there is on the whole a quite sensible falling off in the average weight of the baby as the mother's health passes from "good" to "poor", yet in both cases the weight of the babies of "strong" mothers is less than that of babies of mothers of "good" health, and in the case of boys the "strong" mothers have the lightest babies at a year of all classes. The data are too slender to be conclusive, but they certainly do not demonstrate in a marked manner that the women who are strong during pregnancy will have in an equally marked manner fine babies as judged by weight at the end of the year.' They conclude: 'A study of the relation to Baby's Health of Mother's Health before pregnancy, during pregnancy, and after confinement indicates that the first is the most important, and suggests that we are dealing with a true hereditary factor, which would be more marked could we associate parents' and infants' healths at the same ages.'

In considering their data on the effect of the mother's health on the health of the infant, these authors state: 'Mother's health has something like twice the influence of crowding, clothing, cleanliness, feeding, or economic conditions on the baby's health.' In considering the effect of the health of the mother during pregnancy on the health of the baby, they further state: 'It would appear that for women of constant health before pregnancy, the woman with the worse health during pregnancy has the child of better health. The result of this indicates that the health of the woman during pregnancy is only a sign of the health of her baby in that it is highly correlated with her health before pregnancy. However much discomfort or ill health during pregnancy there may be, if it is not an indication of bad health before pregnancy, there is little or no detriment to the infant. If the woman is going to have a healthy infant, it probably means a big and active baby, and the resulting discomfort to the mother will be classed as "bad health during pregnancy". The paradox therefore that for a mother of given health before pregnancy, the health will be worse the healthier the baby, is not so inexplicable as it may seem, and the discomfort and ill health of some women during pregnancy may have their compensating advantages in a healthier boy born.'

The small amount of evidence so far available thus tends to indicate that while the general health of the mother may have some influence on the health of the baby, her health during pregnancy has no influence.

(ii) Present Investigation

In the present investigation an attempt has been made to study (i) the relationship of the *health of the mother during pregnancy* and the growth and nutrition of the child as determined during the first year of life from the records of the Welfare Centres in Glasgow, Edinburgh, and Dundee; (ii) the relationship of the mother's *general health* to the height and weight of children at different ages, as ascertained by the records obtained in house-to-house visitation in the three towns.

(*a*) The Relationship of Health during Pregnancy to the Height and Weight of the Child.

Correlation of Health of Mother during Pregnancy with Height and Weight of Child during the First Year of Life

The proportion of mothers in good and in indifferent health was much the same in the three towns (Table 150).

Table 150. *Per cent. of Mother's Health during Pregnancy.*

	Glasgow.	*Edinburgh.*	*Dundee.*
	Per cent.	Per cent.	Per cent.
Health good . . .	67·46	70·08	68·54
Health poor . . .	32·54	29·92	31·46

The question of the propriety of treating apart the measurements and weighings (*a*) of infants brought to the Centres for the first time, and (*b*) of those brought back for subsequent visits, has been considered on p. 31, where it has been shown that there is no reason for such separate treatment. In the study of the influence of maternal health in pregnancy, first visits and revisits had been already dealt with separately in the case of Glasgow and in Dundee during the second month of life when there was at first some suspicion that these were giving somewhat different results.

The correlations of the health of the mother during pregnancy with the height and weight of the child are given in the following tables:

TABLE 151. *Correlations of Maternal Health during Pregnancy to Weight of Child (Welfare Centre Records).*

	Age (mths.)	−1 m.	1 m.	2 m.	3 m.	4 m.	5 m.	6 m.	7 m.	8 m.	9 m.	10 m.	11 m.	12 m.	1 year.
Boys	Glasgow	·4361 ±·100	·1344 ±·030	·1936 ±·037	·0340 ±·069	−·1854 ±·115	−·0205 ±·105	−·0071 ±·096	·4674 ±·087	·1821 ±·136	·0358 ±·121	−·0052 ±·125	−·0988 ±·136	−·5570 ±·129	—
Boys	Edinburgh	—	·1189 ±·073	·1171 ±·072	−·0103 ±·083	·1143 ±·086	−·1081 ±·110	−·0665 ±·109	·1022 ±·111	·2328 ±·100	·7893 ±·047	·3134 ±·132	·5193 ±·105	−·4339 ±·112	·3981 ±·118
Boys	Dundee	−·0284 ±·119	·0928 ±·042	·2528 ±·055	·0100 ±·059	·1412 ±·058	−·0855 ±·067	·0925 ±·070	−·0686 ±·071	·0215 ±·079	·0188 ±·082	−·4666 ±·066	·0518 ±·109	−·1506 ±·111	−·2889 ±·129
Girls	Glasgow	·6207 ±·093	·0547 ±·033	·1491 ±·039	·1150 ±·069	−·4553 ±·084	−·1761 ±·112	·1739 ±·096	·3589 ±·085	·3136 ±·094	·0589 ±·132	−·3794 ±·107	·3252 ±·123	−·6991 ±·074	—
Girls	Edinburgh	—	−·0710 ±·080	·3042 ±·071	·1742 ±·084	−·1018 ±·095	−·2692 ±·095	−·0499 ±·111	−·0274 ±·104	−·0478 ±·130	·4512 ±·091	−·0230 ±·164	·6600 ±·085	·3730 ±·130	−·1787 ±·142
Girls	Dundee	−·2229 ±·134	·2067 ±·044	·0246 ±·061	·2559 ±·056	·0082 ±·063	−·0249 ±·067	−·2373 ±·074	·0355 ±·075	−·1557 ±·084	·0528 ±·088	·0485 ±·101	·2122 ±·105	−·0548 ±·121	·3341 ±·122

TABLE 152. *Correlations of Maternal Health during Pregnancy to Height of Child (Welfare Centre Records).*

	Age (mths.)	−1 m.	1 m.	2 m.	3 m.	4 m.	5 m.	6 m.	7 m.	8 m.	9 m.	10 m.	11 m.	12 m.	1 year.
Boys	Glasgow	·1140 ±·122	·0631 ±·031	·1012 ±·038	·0014 ±·069	−·0880 ±·118	−·1418 ±·103	·1442 ±·094	·1128 ±·109	−·1322 ±·138	·3693 ±·105	−·2202 ±·119	−·3162 ±·124	·5501 ±·130	—
Boys	Edinburgh	—	·0380 ±·074	·0671 ±·073	−·2380 ±·082	·1187 ±·086	−·1219 ±·109	·0269 ±·109	·0092 ±·112	−·0230 ±·105	·5391 ±·089	·2770 ±·125	−·0221 ±·144	−·3116 ±·124	·2369 ±·133
Boys	Dundee	·1120 ±·118	·0153 ±·043	·0907 ±·058	·0297 ±·059	·1263 ±·058	−·0134 ±·068	·0018 ±·071	−·0924 ±·070	·0237 ±·079	·1756 ±·079	−·3661 ±·074	·0454 ±·109	−·1352 ±·112	·1644 ±·137
Girls	Glasgow	·4141 ±·123	·0502 ±·033	·0914 ±·040	·2008 ±·067	−·2715 ±·098	−·1246 ±·114	·0760 ±·099	·2875 ±·089	·1373 ±·102	−·2013 ±·127	·0188 ±·125	·5585 ±·095	−·4848 ±·110	—
Girls	Edinburgh	—	−·1451 ±·078	·0491 ±·078	−·1023 ±·085	−·1767 ±·093	−·3294 ±·092	−·0200 ±·111	−·0062 ±·104	−·1394 ±·127	·4010 ±·096	−·2101 ±·157	·3164 ±·136	−·1590 ±·147	−·2900 ±·135
Girls	Dundee	−·3048 ±·128	·2459 ±·043	·2760 ±·056	·2146 ±·057	·0978 ±·063	·1002 ±·066	−·3022 ±·071	−·0474 ±·075	−·1404 ±·084	·2280 ±·083	·4335 ±·083	·3495 ±·096	·2163 ±·115	·3194 ±·124

TABLE 153. *Correlations of Maternal Health during Pregnancy to Weight of Child (Glasgow Welfare Centre Records—Revisits).*

Age (months):	4 m.	5 m.	6 m.	7 m.	8 m.	9 m.	10 m.	11 m.	12 m.	1 year.
Boys . . .	·0653	·1906	·0233	·1099	·5093	·0901	·1673	·1499	·0480	·5668
	±·048	±·047	±·045	±·042	±·035	±·050	±·045	±·052	±·062	±·044
Girls . . .	·0133	·0327	−·0264	·1503	·0880	·2548	·0936	·1228	·1061	·1206
	±·049	±·049	±·047	±·040	±·049	±·044	±·047	±·053	±·054	±·062

Maternal Health to Height of Child.

	4 m.	5 m.	6 m.	7 m.	8 m.	9 m.	10 m.	11 m.	12 m.	1 year.
Boys . . .	·1342	·1841	−·0261	·2450	−·0279	·0669	·1376	·1547	·1695	·0736
	±·047	±·047	±·045	±·040	±·048	±·050	±·045	±·052	±·060	±·065
Girls . . .	·0781	·1019	·0237	·1072	·0894	·1709	·1027	·0700	·0714	−·0284
	±·048	±·049	±·047	±·041	±·049	±·045	±·047	±·054	±·054	±·063

The correlations of both weight and height with maternal health during pregnancy are practically all insignificant and *reveal no distinct relationship between the height and weight of the infant and the health of the mother during pregnancy*, thus confirming Pearson's findings already quoted (Tables 151, 152, and 153).

(*b*) The Relationship of the General Health of the Mother to the Height and Weight of the Child.

The mothers in the intensive studies were arranged in two groups, i. e. (i) those with good health and (ii) those with poor health. The terms 'good' and 'poor' health require definition. A woman was classed as of good health if she appeared to be robust and active and had no symptom of any disease whose nature was likely to be in any way a handicap to the accomplishment of her maternal duties. A woman was classed as having 'poor' health if she had an ailment which hindered her in the discharge of her duties as a house-mother. For instance, if the woman, otherwise fit, was in a minor degree anaemic, she was classed with the women of 'good' health, but if the anaemia was of such severity as to render her inactive and listless, she was classed as of 'poor' health. In general, it may be taken that practically none of the mothers classed as of 'good' health had any physical defect, while all the mothers classed as of 'poor' health had some definite ailment, although its severity might not be great.

Percentage of Mothers having 'good' Health

The subjoined table gives the percentage of mothers of all children of pre-school age having 'good' health in the three cities studied. It will be noted that Edinburgh has the highest percentage of mothers with 'good' health, and Dundee the lowest percentage, while in this respect Glasgow occupies an intermediate position.

TABLE 154. *Percentages of Mothers with Good Health.*

Age (years).	*Glasgow.*	*Edinburgh.*	*Dundee.*
		BOYS.	
1+	72·90	86·21	61·76
2+	74·68	78·33	63·43
3+	68·75	88·18	61·33
4+	71·17	79·59	67·57
5+	79·09	82·35	66·36
		GIRLS.	
1+	78·83	88·39	60·63
2+	75·84	86·41	57·87
3+	79·59	85·95	57·74
4+	72·82	89·11	70·87
5+	81·03	84·29	57·69

		No. of families.	*Mother's health good.*
			Per cent.
Average percentages	Glasgow	789	75·41
	Edinburgh	608	85·69
	Dundee	865	61·27

TABLE 155. *Correlations. Maternal Health to Height of Child.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	—	—	—	—	·1405 ±·064	·1473 ±·053	·1098 ±·063	−·1606 ±·062	·1252 ±·063
	Edinburgh	·1179 ±·128	−·0072 ±·114	·0523 ±·112	·3348 ±·096	·1007 ±·062	·1797 ±·060	−·1652 ±·063	·0692 ±·068	−·1052 ±·081
	Dundee	·0895 ±·070	−·0291 ±·078	·2422 ±·074	·1471 ±·076	·1822 ±·050	·2536 ±·048	·0221 ±·055	·1265 ±·063	·0755 ±·064
Girls	Glasgow	—	—	—	—	−·0532 ±·057	·0794 ±·055	·1141 ±·055	·0742 ±·066	·1044 ±·062
	Edinburgh	·0350 ±·117	·0658 ±·105	−·0896 ±·122	·6058 ±·073	·0973 ±·063	−·0499 ±·066	·1304 ±·060	·0929 ±·067	−·2858 ±·074
	Dundee	·1479 ±·069	·1160 ±·070	·2711 ±·075	·0037 ±·080	·0350 ±·053	·1195 ±·050	·1098 ±·051	·1642 ±·058	·0479 ±·066

TABLE 156. *Correlations. Maternal Health to Weight of Child.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	·0537 ±·064	·0863 ±·069	·2070 ±·073	·2322 ±·079	·1055 ±·064	·0124 ±·054	·1991 ±·061	−·0216 ±·064	·1790 ±·062
	Edinburgh	−·0118 ±·130	−·1338 ±·112	·3245 ±·101	·6094 ±·068	·1565 ±·061	·1581 ±·060	·0210 ±·064	·0043 ±·068	−·2172 ±·078
	Dundee	·1886 ±·068	·1457 ±·077	·4554 ±·063	·2378 ±·073	·0432 ±·052	·0917 ±·051	·0133 ±·055	·0718 ±·064	−·1219 ±·063
Girls	Glasgow	·2220 ±·064	−·1146 ±·074	·1216 ±·073	−·0320 ±·096	−·0787 ±·057	·0402 ±·055	·2754 ±·051	−·1879 ±·064	·0145 ±·063
	Edinburgh	·3117 ±·106	−·2074 ±·101	−·1639 ±·120	·6513 ±·067	·3603 ±·055	·2662 ±·062	·2215 ±·058	·1085 ±·066	−·0962 ±·080
	Dundee	·2284 ±·067	·1316 ±·070	·2856 ±·075	·0910 ±·079	·0200 ±·053	−·0234 ±·051	−·0704 ±·052	·0310 ±·060	·0000 ±·066

The average figures, given separately, contrast markedly, except in the case of Edinburgh, with those for the mothers of the rural, mining, and agricultural classes, where the percentages for good health are 92·8 and 90·6 respectively.

The correlations of the general health of the mothers and the height and weight of the children of pre-school age are shown in Tables 155 and 156.

The correlations between the height and weight of the children and the general health of the mother are thus, on the whole, insignificant. With regard to height, in Dundee the correlations show some evidence of slight association under one year, but the results in Glasgow and Edinburgh are so discordant that it is not possible to say that a significant correlation exists. In height no relationship is shown. Over one year, in both height and weight the correlations are insignificant.

We are thus unable to find any relationship between the general health of the mother and the height and weight of the child.

Since no correlation was established during the pre-school age period it was not considered necessary to deal with the children of school age, 6 to 14.

(*c*) The Relationship of the General Health of the Mother to Poverty and Overcrowding.

Although maternal health is not directly correlated with the weight and height of the child, it seemed desirable to investigate whether it is in any way related to the environmental conditions such as poverty and overcrowding as represented by the income per person, air-space per person, and size of the family.

The correlations of maternal health to the following variables were investigated :

1. Income per person,
2. Air-space per person,
3. Size of family,

and are given in Tables 157, 158, and 159.

These results give no support to the idea that the health of the mother as defined above is influenced to any significant extent by overcrowding or poverty, the coefficients, although mainly positive in sign, being quite insignificant. *Nor does the size of the family appear to be a factor of much importance in determining the health of the mother.* The correlations of health of mother and size of family given in Table 159 are for the most part negative in sign, the mothers with the smaller families being on the average in slightly better health than those with larger families ; but the size of the coefficients does not justify the conclusion that the size of the family is a factor detrimental to the health of the mother. We must again emphasize the fact that the conclusions of this paragraph, like all the others, apply to the material we have studied and cannot properly be generalized. Not only is one grade of society involved, but the measure of 'health' is necessarily crude : it is, however, the only measure available.

TABLE 157. *Correlations. Maternal Health and Income.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	·4193 ±·054	−·0748 ±·069	−·2949 ±·069	·2293 ±·079	·0055 ±·065	·1401 ±·053	−·0415 ±·064	−·0773 ±·064	·2539 ±·060
	Edinburgh	−·3622 ±	·2136 ±·109	·1457 ±·110	·4969 ±·081	·2276 ±·059	·1107 ±·061	·3796 ±·055	·2914 ±·062	·0695 ±·081
	Dundee	·0384 ±·071	·1821 ±·076	·1634 ±·077	−·0345 ±·078	·1766 ±·050	−·0321 ±·051	·2138 ±·053	·2604 ±·060	−·0073 ±·064
Girls	Glasgow	·2051 ±·064	·1137 ±·074	−·1080 ±·074	−·2516 ±·090	·0868 ±·057	−·0219 ±·055	−·0321 ±·056	−·0939 ±·066	·0408 ±·063
	Edinburgh	·1508 ±·115	·1111 ±·104	·2384 ±·116	·5396 ±·082	−·1484 ±·062	·3207 ±·060	·0557 ±·061	·0956 ±·066	·1984 ±·077
	Dundee	·0451 ±·070	·0224 ±·071	·0990 ±·080	·2016 ±·078	·0877 ±·053	·1545 ±·049	−·0182 ±·052	·0072 ±·060	−·0123 ±·066

These correlations were obtained by the biserial method, and are less reliable than product moment *r*'s.

TABLE 158. *Correlations. Maternal Health and Air-space.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	·2348	−·0847	·1173	·2065	·0323	·0385	·0085	·0387	·2168
		±·061	±·069	±·075	±·080	±·065	±·054	±·064	±·064	±·061
	Edinburgh	·2688	·3216	·0089	−·1503	·3068	·2192	·2307	·1933	·2893
		±·120	±·102	±·112	±·106	±·057	±·059	±·061	±·066	±·075
	Dundee	·1631	·3475	·3065	·1592	·1142	·0735	·3938	·2028	·2424
		±·069	±·069	±·072	±·076	±·051	±·051	±·047	±·061	±·061
Girls	Glasgow	−·0334	·3820	−·0142	−·3328	·0382	·1915	·1460	·1707	·2430
		±·068	±·064	±·074	±·086	±·058	±·053	±·054	±·065	±·059
	Edinburgh	−·3240	·2455	·1088	·0282	·1177	·3012	−·3710	·0490	·2143
		±·105	±·099	±·122	±·116	±·063	±·060	±·053	±·067	±·077
	Dundee	·2296	·1339	·1188	·4423	·1780	·1615	·0593	·1130	·1196
		±·067	±·070	±·080	±·064	±·052	±·049	±·052	±·059	±·065

TABLE 159. *Correlations. Maternal Health and Number of Living Children.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	−·3450	−·2038	−·1977	−·0281	−·0348	−·1893	−·0155	·0044	−·0307
		±·057	±·067	±·073	±·084	±·065	±·052	±·064	±·064	±·064
	Edinburgh	−·1689	·6824	·0556	−·3321	−·4133	−·1329	−·1927	−·0956	−·2058
		±·126	±·061	±·112	±·096	±·052	±·060	±·062	±·068	±·078
	Dundee	−·0134	−·2782	−·3345	−·0229	−·1110	·0890	−·3112	−·2520	−·1803
		±·071	±·072	±·070	±·078	±·051	±·051	±·050	±·060	±·062
Girls	Glasgow	−·1656	−·3523	−·1406	·4585	−·0639	−·2206	·0881	−·0232	−·3033
		±·065	±·066	±·073	±·076	±·057	±·053	±·055	±·066	±·057
	Edinburgh	·0926	−·2510	−·1095	−·5058	·0271	−·2830	−·0809	−·2353	−·0526
		±·116	±·099	±·122	±·086	±·064	±·061	±·061	±·063	±·080
	Dundee	·0242	·0157	−·2318	−·0831	·0163	·0306	−·0181	·0123	·0826
		±·070	±·071	±·077	±·080	±·053	±·051	±·052	±·060	±·066

(2) SUCKLING DURING PREGNANCY

Closely associated with the possible influence of the health of the mother during pregnancy is the possible influence of suckling during pregnancy. This is supposed to be practised by the poorer classes with the idea that it prevents conception. On this subject no previous work appears to have been done, but the information which we have collected on this subject at the Welfare Centres would seem to show that *there is relatively little occurrence of this practice among mothers attending the clinics.* Out of 9,546 mothers only 303 stated that they had suckled the previous child during pregnancy, or 3·2 per cent. of the total number questioned, and in the majority of these cases suckling was practised only during the first three months of pregnancy. Such figures as have been collected by us are unfortunately too few to allow of a statistical examination of the possible effect of the practice on the physique of the infant.

(3) THE RELATIONSHIP OF THE INDUSTRIAL OCCUPATION OF THE MOTHER DURING PREGNANCY TO THE HEIGHT AND WEIGHT OF THE CHILD

The relationship between the condition of the child and the doing of gainful work by the mother, i. e. factory work, charing, &c., may be twofold. The infant's antenatal development may be prejudiced by the exhausting character of the work, or its postnatal development may be affected by the lack of care given by the overworked mother or by her absence from the home during working hours.

It is extremely difficult to compare the amount of strain on the prospective mother among the working classes due to her tasks in a factory, as compared with her normal work if she remains at home.

(i) Previous Work

Macord and Minster (1921) state that all books on obstetrics and all directions for the hygiene of the pregnant woman recommend exercise and fresh air. Paradise (1919) points out that 'ordinary housework and many of the chores on the farm afford mothers the opportunity for necessary exercise'. Whether housework, which is the invariable lot of the working-class mother who lives at home, represents a reasonable amount of energy output by the pregnant woman, and how far the energy output on housework is comparable to that in a factory, are points on which specific information is scanty. Langworthy (1920–1), however, after experimental examination has offered the following figures as representing the energy output on ordinary household tasks. (See Table 160.)

Table 160. *Energy expended on Household Tasks* (Langworthy).

Type of work.	*Heat elimination in cals. per hour per kilo body weight.*
Resting	1·22
Knitting	1·42
Crocheting	1·39
Sewing	1·40
Dressing infant	1·72
Sweeping floor	2·06
Washing floor	1·82
Washing towels	2·22
Ironing towels	1·75
Dish-washing	1·75

Rosenheim (1919) gives the following figures as representing the energy output on light, medium hard, and hard lathe work of various kinds. (See Table 161.)

TABLE 161. *Energy expended in different Types of Industrial Work* (Rosenheim).

Description of work.	*Calories of heat produced per hour per kilo body weight.*
Light (turning)	1·38
,, (screw chasing)	1·61
,, (parting)	1·59
,, (parting)	2·00
,, (screw chasing)	2·09
,, (screw cutting)	2·37
,, (recessing)	2·26
,, (screw chasing)	2·32
,, (turning)	2·17
,, (parting)	1·99
,, (turning)	2·03
,, (screw cutting)	1·98
Medium hard (boring)	1·89
,, ,, (rough turning)	1·91
,, ,, (turning)	1·99
,, ,, (boring)	2·19
,, ,, (turning)	2·00
,, ,, (boring)	2·15
,, ,, (boring)	2·31
,, ,, (rough turning)	2·39
,, ,, (boring)	2·44
Hard (12 turns of capstan)	2·54
,, (boring)	3·44
,, (boring from headstock)	2·61
,, (rough turning, hand feed)	2·77
,, (10 turns of capstan)	2·59
,, (boring)	2·43

If these figures are taken as representing light factory work in general, then it seems reasonable to infer that the output of energy on factory tasks is little if any greater than that upon ordinary household tasks, and to deduce that factory work is not, of itself, necessarily more hurtful to the expectant mother than is the usual routine of a household. It must be remembered, however, that the duties of a household are intermittent and varied and that the element of strain is less likely to be present than in factory work. On the other hand, the wives of certain classes of workmen undoubtedly have very strenuous household tasks to perform. For instance, the wives of miners must, of necessity, have extremely laborious washing of their husbands' clothing, and it has been suggested that the high infantile mortality in mining areas may possibly be associated with this heavy work.

Letourneur (1897), quoted by Vierordt (1906), gives the following birth weights as showing the association of heavy work on the part of the mother with relative lightness of weight of the infant at birth. (See Table 162.)

TABLE 162. *Birth Weights* (Letourneur).

	Birth weight. gm.
Mother with heavy occupation	3,081·9
Mother with lighter occupation	3,130

Fuchs (1899), also quoted by Vierordt (1906), gives the following birth weights of infants grouped according to the work of the mother. (See Table 163.)

TABLE 163. *Birth Weights* (Fuchs).

Occupation of mother.	*Birth weight.*
	gm.
Light employment	3,251
Factory workers	3,036
Milkmaid and worker in fields	3,339
Housemaids	3,361·2
Married women—housekeepers	3,397·3

Vierordt (1906) also quotes Nikes (1902), who gives the following birth weights as apparently affected by the occupation of the mother. In both of these sets of data, however, it may be that the social class of the mother and its relative amenities, rather than the actual type of work done, is associated with the size of the new-born infant. Nikes's figures are given in Table 164.

TABLE 164. *Relation of Type of Work of Mother to Birth Weight of Infant* (Nikes).

Mother and type of occupation.	*Birth weight.*
	gm.
Factory worker	3,305·6
Milkmaid, field worker	3,308·8
Servant, housemaid	3,289·4
Married woman, housekeeper	3,431·15

Letourneur (1897) considered that the weight of the infant was affected by the period of rest taken by the working mother before the birth of the child. (See Table 165.)

TABLE 165. *Relationship between Period of Rest during Pregnancy and Birth Weight of Infant* (Letourneur).

Period of rest taken by mother.	*Birth weight.*
	gm.
Worked up to birth	3,010
Rested for at least 10 days before birth	3,290
Rested before birth in antenatal clinic	3,366

Pinard (1888), quoted by Vierordt, who does not indicate the numbers dealt with, found an increase of 300 gm. in the birth weight of those infants whose mothers rested from 2 to 3 months before the birth. How far this increase of birth weight of the infant is due to the type of work done and how far the result of social and economic conditions which allowed the mothers to rest may be questioned.

According to the data of Fehling, quoted by Camerer, Junior (1908), without giving the numbers dealt with, the birth weight of the children of women working in factories is the lowest; then follow those of the children of servant girls, seamstresses, and shop girls. Here, again, one may ask if the class of the worker or the economic pressure which compelled continuance at the more laborious work were not the factors which influenced the weight of the new-born infant, rather than the work itself.

Carmagano (1920), quoted by the *Journal of the American Medical Association*, states that she found more unfavourable conditions among the children of women doing gainful work in their own homes than among the children of those employed in factories. Home workers are notoriously poorly paid, so that it was possibly economic conditions which exerted the determining influence on the children.

Since 1920, in the Annual Reports of the Public Health Department of Dundee, Dr. Scott Dickson (1920 et seq.) has published figures based on the weights of children under one year, which are grouped into (*a*) those whose mothers are working, i. e. habitually engaged in industrial work which was continued for at least part of the pregnancy, and (*b*) those whose mothers are not habitually engaged in industrial work and did not work during pregnancy. She gives the percentage of the children in each group which are above and below the average weight for all the children examined. In some instances these figures give inconclusive results, but, on the whole, they tend to show that the children of mothers industrially employed are heavier than those of mothers who do not work in the factories.

When the effect of industrial employment of the mother on the health of the child, as indicated by the mortality rate, is considered, the results of various investigators are not in harmony with each other. Jones (1894) concluded most definitely that 'the pregnant woman should not be employed in industrial occupation'. Reid (1906) contrasted the somewhat higher infantile mortality rate of North Staffordshire, where many married women work in the potteries, with that of South Staffordshire, where there is little or no factory labour for women. He does not allude to the fact that the high infantile mortality rates among the offspring of married women pottery workers may be due to poisoning from the lead glaze, and it would appear that his conclusions are not necessarily applicable to women employed in non-dangerous trades.

At the National Conference on Infantile Mortality in 1906 Miss Sharples, Chief Lady Inspector, Leeds, gave the results of a special inquiry by Dr. Cameron in that city, into the causes of the deaths of children under two years, when the mortality rate of children of working and non-working mothers was found to be 7·3 and 7·2 respectively—a negligible difference. Nevertheless at the same conference Dr. M. J. Rhodes stated that Barnsley, in which more women were employed than in any other town in England, had the highest infantile mortality.

In discussing the effect of the industrial employment of women, Newman (1906), after giving data showing the high infantile mortality prevailing in the textile towns, says: 'Statistical returns do not entirely support the assertion that factory employment of women is the main cause of high infantile mortality. . . . In Preston and Blackburn the employment of women has been declining since the census of 1891, but the infantile mortality has been increasing . . . in the Durham coalfield and in the South Wales districts, in which women are not much engaged in industrial occupation, infant mortality has been increasing since the middle of last century and now stands among the highest rates, whereas in the West Riding of Yorkshire, where women are much employed in the mills, the infant mortality has been declining within the same period. . . . No doubt the factory plays a part, but the home plays a vastly greater part in the causation of infantile mortality.'

In 1910 Robertson (1910), in investigating the effect of the industrial employment of married women in Birmingham, caused all the infants in two poor-class quarters of that city, where about 50 per cent. of the mothers went out to work, to be visited regularly by a doctor during the first year and weighed at the end of the year. The mothers, 1,212 in number, consisted of 601 who were industrially employed and 611 who were not so employed. All were in similar circumstances. The mortality among the *infants* born in 1908 of all mothers employed before or after childbirth was at the rate of 190 per 1,000, while among those mothers who were not industrially employed it was 207 per 1,000. Among *infants* of mothers employed or not employed during pregnancy the mortality was practically the same. Among *infants* of mothers employed after confinement the mortality was 139; among those of mothers not so employed it was 225, probably due to the fact that the great majority of cases of infant mortality occur in the first month of life, before the mother has returned to work. Dr. Robertson says, 'In many cases the additional income brought in by the mother had an important influence in the prevention of poverty, which is the great cause of our high infant mortality. . . . It must be remembered that much of the work is light and regular, often much lighter and more wholesome than that done by many mothers with large families in their own homes.'

Blagg (1910), in a statistical analysis of infant mortality in the United Kingdom, quotes the Registrar-General as pointing out that 'those divisions of the country that comprise the districts of the mining, textile, and pottery industries show very badly in the tables of infantile mortality'. She says, in considering the effect of the employment of married women on the death-rate of infants, 'Few women go out to work in Glamorganshire and Durham, yet the county rates are 136 and 135,'—third and fourth in the list of counties having high infant mortality rates.

The question—Does employment affect the health of infants born to working women ?—was discussed at the International Conference on Infantile Mortality in London in 1913, when the following conclusions were come to: (i) No special harm results in pregnancy, so long as the mother does not do hard manual work right up to the day of her confinement; (ii) After the child's birth it may suffer (*a*) if weaned prematurely, and (*b*) if it misses the mother's care while she is at work.

In *Married Women's Work*, edited by Clementina Black (1915), it is stated that in Manchester the infant mortality rate among the children of working-class mothers unemployed during the child-bearing period was 267 per 1,000, while the rate among children of mothers who worked in a factory during pregnancy was 214 per thousand. These figures certainly suggest that the very high rate of infant mortality among the cases investigated cannot be explained only by the fact that the majority of the women were in some kind of industrial employment at the time their children were born. The question arises whether, when the income is small, possible disadvantages of employment during pregnancy are counteracted by the additional comfort derived from the consequent addition to the household income.

Boyd Dawson (1918), in an investigation into the quality of maternity in relation to industrial occupation, gives figures obtained from general practitioners, lying-in hospitals, matrons, midwives, health visitors, and superintendents of Child Welfare Centres, showing the effect of industrial employment on maternity, dividing her material under two heads—viz. the effect on the child as shown by the rate of infantile mortality, sickness, still-births, &c., and the effect on the mother, as shown by difficult and dangerous confinements, inability to suckle, and impaired power of recovering from childbirth. She gives the figures in columns 1 and 3 of the following table, and in columns 2 and 4 we have estimated the percentage loss from the total number of pregnancies given, as showing the relative loss by death and by still-birth of the children of mothers industrially employed and mothers not so employed.

TABLE 166. *Relation of Number of Living and Dead Children to Mothers' Industrial Occupation* (Boyd Dawson).

	Mothers industrially employed.		*Mothers not industrially employed.*	
	No.	*Percentage of total pregnancies.*	*No.*	*Percentage of total pregnancies.*
Number of women	331	—	572	—
Living children	901	76·62	1,675	73·56
Dead children	209	17·77	446	19·59
Still-births	66	5·61	156	6·85
Number of women with 25 per cent. or more lost children	48	14·5	84	14·7

TABLE 167. *Relation of Health of New-born Infants to Industrial Occupation of the Mother* (Boyd Dawson).

	Mothers industrially employed.	*Mothers not industrially employed.*
Number of women	253	338
Number of women whose children were not born healthy	41 = 16·2 %	55 = 16·27 %

Table 168. *Relation of Type of Confinement to Industrial Occupation of the Mother* (Boyd Dawson).

	Mothers industrially employed.	*Mothers not industrially employed.*
Number of women . . .	265	470
Number of women having 'bad' confinements . . .	28 = 10·57 %	52 = 11·06 %

After fully discussing the various factors which complicated these results, including the fact that possibly the women not industrially employed included a number of those not strong enough for the customary married women's work in their district, Mrs. Boyd Dawson comes to the conclusion that the advantages due to better food and comfort and freedom from financial anxiety in consequence of the industrial occupation of the pregnant woman outweigh any strain entailed in the occupation.

Adamson and Palmer Jones (1918) found that expectant mothers doing suitable work in a factory were healthy and fully earned their wages. In the same year Deacon (1918) reported that the results of employing pregnant women in the factory on graded work certainly did not seem to point to an injurious effect on the mothers or on the children.

The Report of the War Cabinet Committee on Women in Industry (1919) states: 'The regular employment of the mother necessarily deprives her infant of its natural food, which is the greatest safeguard to its healthy growth and development, and also of the careful and constant attention which is so necessary to its successful nurture. On the other hand, poverty or an insanitary environment may have an even more injurious effect than the mother's absence. This is borne out by the low infant mortality rates in 1916 and 1917, years during which a continually increasing number of married women was being employed. Indeed, it is significant that the infant mortality rate has shown its most rapid decline in the last decennium, during which industrial employment of women has increased. . . . It will be found that the areas of highest infantile mortality are (i) the mining and (ii) the manufacturing districts. Now, there is little or no employment of mothers in the mining districts. . . . Housing and sanitation are notably defective, domestic work of women is arduous, and the general hygienic standard is low. . . . Medical witnesses are agreed that light factory work is not in itself objectionable and that it is better to work than to be underfed.' In contrast to the above, Macord (1921) quotes a report of the United States Bureau of Labour, published in 1919, and dealing with preventable death in the cotton manufacturing industry, in which it is stated that 'between the ages of 15 and 24 the death hazard, complicated with parturition, is seven times as great for operatives as for non-operatives; between the ages of 25 and 34 the death hazard is three times as great; and between the ages of 35 and 44 the death hazard is equal'. The conclusion of the whole report is that 'employment in cotton mills for mothers of child-bearing age is generally inimical to longevity of mothers'.

Rochester (1923), too, found a detrimental effect in industrial work during pregnancy by mothers. She found a higher rate of infantile mortality among mothers who worked outside their homes. These working mothers were on the whole poorer and the proportion of Polish and Negro mothers was high, but, even when due allowance was made for the influence of these factors, an excessive mortality seemed to be related to the fact of the mother's employment from home. She gives the following figures. (See Table 169.)

Table 169. *Infantile Mortality and Occupation of the Mother* (Rochester).

	Infant mortality rate.
Mothers not employed during pregnancy . .	93·4
Mothers employed gainfully at home . .	94·5
Mothers employed away from home . . .	179·8

This writer draws similar conclusions regarding the gainful employment of married women after confinement and concludes, 'The figures . . . do serve to sum up the general fact that, in actual practice, under existing conditions, employment of married women outside their homes involves danger to their babies.'

At the request of the Manufacturers' Association of Northern France, a study was made in 1924 in Lille—an important industrial centre of France—of infantile mortality in relation to the mother's occupation. It was found that the percentage of deaths among live-born children before the end of the 1st year of life was 23 for children of mothers working in factories, 15 for children of mothers employed in small workshops, and 9 for mothers working at home.

The previous work thus gives no clear indication that industrial work by the mother has any effect on the child.

(ii) Present Investigation

For the investigation of the relationship of the industrial employment of the mother during pregnancy, and the height and weight of the child, the conditions in Dundee afford valuable material. As already pointed out (p. 166) a large proportion (some 40 to 60 per cent.) of the women are engaged industrially in the jute mills.

Proportion of Women industrially employed during Pregnancy.

Table 170 has been drawn up from data collected at the Child Welfare Centres in Glasgow, Edinburgh, and Dundee, the information at the first visit alone being employed so that there is no question of reduplication of cases. It shows the percentage of mothers industrially employed during pregnancy.

Table 170. *Percentage of Industrial Employment during Pregnancy.*

	Glasgow.	*Edinburgh.*	*Dundee.*
	Per cent.	Per cent.	Per cent.
Working during pregnancy	12·47	8·09	47·32

These percentages show that in Dundee the proportion of expectant mothers industrially employed is very much greater than in either of the other two cities. This is in spite of the fact that the proportion of women working in Dundee was probably lower than usual owing to the fact that when the data were collected in that city very many of the mothers who had worked during previous pregnancies were, on account of a shortage of employment in the mills, unemployed when interrogated.

The correlations of mother's industrial occupation during pregnancy and height and weight of the children were calculated from the records obtained at the Child Welfare Centres and are given in Tables 171, 172, and 173.

The correlations of height and weight of the child to the industrial occupation of the mother throughout the series in the three towns, not only for first visits but also for subsequent visits, are quite insignificant and give absolutely no evidence that industrial occupation of the mother is detrimental to the growth and nutrition of the child. These results support the contention of those previous investigators who concluded that any disadvantage to the children due to the absence of the mother from the home is counterbalanced by the reduction of financial distress.

TABLE 171. *Correlations. Industrial Occupation of Mother during Pregnancy to Height of Child (Welfare Centre Records).*

	Age (mths.)	−1 m.	1 m.	2 m.	3 m.	4 m.	5 m.	6 m.	7 m.	8 m.	9 m.	10 m.	11 m.	12 m.	1 year.
Boys	Glasgow	·0177 ±·121	·0490 ±·031	·2161 ±·038	·1372 ±·069	−·1860 ±·133	·4889 ±·082	−·1748 ±·099	·0744 ±·120	·7735 ±·062	·4137 ±·112	·4509 ±·112	−·3202 ±·151	−·7800 ±·084	—
	Edinburgh	—	−·1207 ±·073	−·2649 ±·068	·5567 ±·056	·2834 ±·079	−·0069 ±·111	−·0315 ±·109	·0318 ±·112	·4387 ±·085	·1807 ±·121	·0626 ±·134	−·3557 ±·126	·6548 ±·079	−·1502 ±·137
	Dundee	−·0384 ±·106	·0673 ±·039	−·0229 ±·055	·0467 ±·056	·1863 ±·054	−·0247 ±·063	−·1439 ±·066	−·0924 ±·067	·1322 ±·073	·1149 ±·075	·2131 ±·078	·0791 ±·102	−·1351 ±·110	−·4444 ±·111
Girls	Glasgow	·0625 ±·150	·1141 ±·032	−·0021 ±·040	−·0344 ±·069	·3009 ±·096	·7491 ±·049	·2809 ±·092	·0015 ±·097	·0137 ±·042	—	−·1976 ±·120	−·2165 ±·129	·7481 ±·062	—
	Edinburgh	—	−·5333 ±·057	−·1599 ±·076	−·0615 ±·086	−·0947 ±·095	−·0917 ±·102	·1955 ±·107	·3936 ±·088	−·3301 ±·116	·3021 ±·163	—	—	·8541 ±·041	·2208 ±·140
	Dundee	·2479 ±·122	·1357 ±·042	·0778 ±·057	·0942 ±·058	·4443 ±·049	−·0420 ±·065	·1593 ±·074	·0077 ±·071	−·0260 ±·082	·1203 ±·084	−·1555 ±·097	−·0275 ±·104	·3812 ±·102	·0356 ±·135

TABLE 172. *Correlations. Industrial Occupation of Mother during Pregnancy to Weight of Child (Welfare Centre Records).*

	Age (mths.)	−1 m.	1 m.	2 m.	3 m.	4 m.	5 m.	6 m.	7 m.	8 m.	9 m.	10 m.	11 m.	12 m.	1 year.
Boys	Glasgow	·3583 ±·106	·0070 ±·031	·1666 ±·039	·1211 ±·069	−·4899 ±·105	·5383 ±·077	−·2791 ±·094	·1426 ±·119	·5177 ±·113	−·3670 ±·117	·5434 ±·099	−·4570 ±·133	−·9938 ±·003	—
	Edinburgh	—	−·2130 ±·071	−·0462 ±·073	·5865 ±·054	·3714 ±·075	·0440 ±·111	·0865 ±·109	−·2590 ±·105	−·5186 ±·077	·0275 ±·125	·1026 ±·133	−·5084 ±·107	−·4665 ±·108	−·0955 ±·139
	Dundee	·0345 ±·107	·0908 ±·039	−·0005 ±·055	·0428 ±·056	·0005 ±·056	−·2338 ±·059	−·0480 ±·067	−·1522 ±·066	·1490 ±·073	·0473 ±·076	·0961 ±·080	·0857 ±·102	−·1465 ±·110	·0354 ±·138
Girls	Glasgow	·3353 ±·134	·0629 ±·033	·0600 ±·040	−·1714 ±·067	·1386 ±·103	·6405 ±·067	−·0381 ±·099	−·3800 ±·083	−·2958 ±·095	—	−·3598 ±·109	−·0536 ±·135	·4044 ±·118	—
	Edinburgh	—	·0210 ±·079	·3376 ±·069	·1741 ±·084	−·0021 ±·095	−·1307 ±·101	−·0914 ±·110	·1036 ±·103	−·3399 ±·115	−·1077 ±·113	—	—	—	−·0320 ±·147
	Dundee	·4078 ±·108	·1175 ±·043	·0627 ±·057	·1810 ±·056	·0919 ±·061	−·1916 ±·063	·1221 ±·075	·1806 ±·069	·1792 ±·080	·0838 ±·085	·0340 ±·099	−·0810 ±·103	·3085 ±·109	−·0271 ±·135

TABLE 173. *Correlations. Industrial Occupation of Mother during Pregnancy to Weight of Child (Glasgow Welfare Centre Records—Revisits).*

Age (months)	4 m.	5 m.	6 m.	7 m.	8 m.	9 m.	10 m.	11 m.	12 m.	1 year.
Boys	·0364 ±·048	·0533 ±·049	−·1955 ±·044	−·1252 ±·042	·0395 ±·048	−·0252 ±·050	−·1725 ±·045	−·2190 ±·051	−·0241 ±·062	−·1967 ±·062
Girls	−·0899 ±·048	−·1130 ±·049	·0862 ±·047	·0039 ±·041	−·0216 ±·050	·0348 ±·047	−·1415 ±·047	−·0198 ±·054	−·0484 ±·054	·0122 ±·063

Industrial Occupation of Mother during Pregnancy to Height of Child.

Age (months)	4 m.	5 m.	6 m.	7 m.	8 m.	9 m.	10 m.	11 m.	12 m.	1 year.
Boys	·1227 ±·047	−·1645 ±·047	−·0875 ±·045	−·1173 ±·042	·0093 ±·048	·0537 ±·050	·0803 ±·046	−·1497 ±·052	·1017 ±·061	·2572 ±·061
Girls	·0448 ±·049	−·0420 ±·049	−·0604 ±·047	−·0244 ±·041	−·1225 ±·049	·1917 ±·045	·0097 ±·048	·0141 ±·054	−·0832 ±·054	·1938 ±·061

(4) THE EFFICIENCY OF THE MOTHER

Even among animals there are good mothers and bad mothers—good mothers who rear a large proportion of their young and bad mothers who neglect or are indifferent to their offspring.

Ashby (1915) states that the most careful investigations have been made in New York as to the effects of the various agencies at work to reduce mortality, and that the unanimous opinion of the doctors who made the observations was that neither the surroundings of the infant, nor the exact character of the milk consumed, were as important factors in the health of the infant as the intelligent care of the mother.

Comparatively little attention has been paid by previous investigators to the effect on the child of the quality of 'mothering' it receives. The factor of maternal character or efficiency is extraordinarily difficult to define and difficult to assess, but a worker of experience is able to classify mothers in this respect into good, bad, and indifferent. When the children are repeatedly found to be dirty or verminous, badly clothed and left in bed till all hours of the day, when the house is constantly dirty and uncared for, the mother, without doubt, is inefficient. It is in this sense that the term is used here.

(i) Previous Work

Karn and Pearson (1922), in their *Study of the Data provided by a Baby Clinic*, do not deal directly with the influence of maternal efficiency as such, but their observations on the cleanliness of the baby may be considered as offering some evidence of maternal efficiency and its influence on the child.

They found no marked correlation between cleanliness and the health of the baby, nor did they find cleanliness of the baby associated with the health of the mother. They did, however, find the cleanliness of the baby very substantially correlated with the orderliness of the house, thus confirming the idea that cleanliness of the baby is a fair criterion of maternal efficiency. The authors say: 'A clean home connotes in a high degree a clean baby. But, while orderliness of home and cleanliness of baby are only moderately related to the baby's health—so that they appear to be only indicative of some more potent factor—we may raise the question whether that more potent factor is not to be found in mothers' habits of which we have, in the present data, no direct appreciation. Regularity of feeding, care in the preparation and preservation of artificial food, all depend on mothers' orderliness of mind. A cave-dwelling palaeolithic ancestry may have inured infant humanity to superficial dirt. In modern civilization protection from internal dangers may be of greater importance than external dirt.' In conclusion, Pearson foreshadows the publication by Miss Elderton (1926) of the results of a study on the effects of environmental conditions on child life in which she reaches the fundamental conclusion that it is the health and habits of the parents, far more than the environmental conditions, upon which the welfare of the infant depends.[1]

Hughes and Roberts (1922) found that there was a direct association between maternal efficiency and income, the children of pre-school age in families with the higher income receiving the more adequate care.

[1] Since going to press this has appeared. It deals with mortality rates.

(ii) Present Investigation

(a) Preliminary Considerations.

1. *Relationship between Care of House and Care of Children*

Care of the children does not necessarily imply care of the house. Undoubtedly some mothers sacrifice the house for the children. But it is striking that the correlation between care of the children and cleanliness of the house should be so high, as shown in the subjoined table. The correlation was worked out by the fourfold method.

Table 174. *Correlation of Maternal Care to Cleanliness of House.* (*Children of Pre-school Age.*)

Town.	*Maternal care to cleanliness of house.*	*No. of families.*
Glasgow . . .	·770±·010	788
Edinburgh . . .	·933±·004	606
Dundee	·868±·006	864

Our results therefore confirm Karn and Pearson's finding that the 'clean house in a high degree connotes a clean baby'.

2. *Uniformity of Standard of Different Workers*

It was manifestly of the utmost importance that a common standard of maternal care should be adopted by all the various workers. There was danger that the line of demarcation between good and indifferent might vary with the observer, and that one worker might give too great prominence to the state of the children and another to the state of the house.

To obviate this danger, meetings of the workers were held from time to time and the standards used by each were very thoroughly discussed, so that, so far as possible, the personal element in making the records was eliminated. Another point of importance was the fact that the later observers had the benefit of the experience of those who had been for some time at the work.

To test further the similarity of the standards of the various workers, the data were analysed by Miss Tully with the following result. The different investigators are indicated by the letters A, B, C, and D in Table 175.

Table 175. *Comparison of the Data recorded by four Workers, A, B, C, and D, on Maternal Care and Cleanliness of the House.*

Worker.	*Maternal care.*	*Percentage of clean and of dirty houses.* *Clean.*	*Dirty.*
A	Good	83·78	16·22
	Poor	32·35	67·65
B	Good	85	15
	Poor	23·08	76·92
C	Good	60·87	39·13
	Poor	17·65	82·35
D	Good	83·33	16·67
	Poor	16·67	83·33

The results in the foregoing table would appear to be reasonably concordant, and it thus seems possible for statistical purposes to divide the mothers into two classes—(i) good, or efficient, with children and house well cared for; and (ii) bad, or inefficient, with children and house badly cared for.

3. *Maternal Efficiency in the Cities and in Rural Areas*

As already indicated, the proportion of efficient and inefficient mothers was very different in the families of the slums of the three cities and in those of the agricultural labourers and rural miners. The proportion of families with good or bad mothers in the three cities and in the agricultural and mining areas studied are given in Table 176.

TABLE 176. *Percentage of Mothers classed as Efficient.*

Area.	*Number of families.*	*Percentage of efficient mothers.*
Glasgow	789	68·3
Edinburgh	608	87·5
Dundee	865	66·8
Agricultural	1,767	90·6
Mining	1,751	92·6

The subjoined table gives the percentage of the efficient type of mothers of children at different ages studied in the three cities.

TABLE 177. *Percentage of Mothers classed as Efficient.*

Age (years).	*Glasgow.*	*Edinburgh.*	*Dundee.*
		BOYS.	
1+	62·62	86·66	65·29
2+	67·53	80·00	61·14
3+	66·96	89·09	68·00
4+	69·37	90·82	67·57
5+	70·91	83·82	70·91
		GIRLS.	
1+	78·83	84·82	63·75
2+	72·48	90·29	65·73
3+	66·67	90·08	66·67
4+	64·08	88·12	75·59
5+	68·97	82·86	69·23

(*b*) **Relationship of Maternal Efficiency to Height and Weight of Child.**

The correlations of maternal efficiency and the weight and height of the child are given in Tables 178, 179, and 180.

TABLE 178. *Correlations. Maternal Efficiency to Weight.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	·0569 ±·064	−·0353 ±·070	·3150 ±·068	·0221 ±·084	·2996 ±·059	·2080 ±·052	·4935 ±·048	·1769 ±·062	·2932 ±·059
	Edinburgh	−·0118 ±·130	−·1106 ±·113	·3443 ±·100	·5795 ±·072	·5031 ±·047	·3193 ±·055	·0790 ±·064	·0834 ±·068	·4817 ±·063
	Dundee	·2931 ±·065	·4815 ±·060	·6617 ±·044	−·0976 ±·077	·1624 ±·050	·3270 ±·046	·0562 ±·055	−·0071 ±·064	−·0412 ±·064
Girls	Glasgow	−·1999 ±·065	−·1063 ±·075	−·0541 ±·074	·4627 ±·076	·0469 ±·058	·4191 ±·046	·3340 ±·049	·0861 ±·066	·1875 ±·060
	Edinburgh	·0074 ±·117	·3703 ±·091	·0750 ±·122	·2626 ±·108	·2342 ±·060	·1548 ±·065	·1782 ±·056	·1465 ±·066	·0085 ±·081
	Dundee	·3538 ±·061	·2280 ±·067	·3432 ±·072	·4713 ±·062	·2447 ±·050	·2058 ±·048	·1002 ±·052	·1271 ±·059	·1754 ±·064

TABLE 179. *Correlations. Maternal Efficiency to Height.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	—	—	—	—	·3512 ±·057	·3252 ±·049	·4581 ±·050	·2835 ±·059	·4173 ±·053
	Edinburgh	·2799 ±·120	−·1134 ±·113	·1313 ±·110	·5389 ±·077	·3988 ±·053	·3199 ±·055	·1547 ±·063	·4166 ±·056	·2814 ±·075
	Dundee	·0256 ±·071	·3221 ±·070	·4105 ±·066	−·2482 ±·073	·2035 ±·050	·3724 ±·044	·2738 ±·051	·2186 ±·061	·0279 ±·064
Girls	Glasgow	—	—	—	—	·0808 ±·057	·4692 ±·043	·2746 ±·051	·3867 ±·057	·3320 ±·056
	Edinburgh	·7107 ±·058	·3437 ±·093	−·3503 ±·108	·0883 ±·115	·3335 ±·057	·4942 ±·050	·5295 ±·044	·3029 ±·061	·3872 ±·069
	Dundee	·2441 ±·066	−·3841 ±·061	·4476 ±·065	·3448 ±·071	·2300 ±·050	·2932 ±·046	·1723 ±·051	·4169 ±·049	·2858 ±·061

Table 180. *Correlations. Weight and Height to Maternal Efficiency for Children of 6 to 14 years. (Corrected for Age.)*

		Glasgow.	*Edinburgh.*	*Dundee.*
Boys	Weight/Maternal Efficiency	·1575 ± ·033	·2317 ± ·049	·0712 ± ·049
	Height/Maternal Efficiency	·1357 ± ·033	·2763 ± ·047	·0739 ± ·049
Girls	Weight/Maternal Efficiency	·0390 ± ·033	·2944 ± ·044	·1952 ± ·047
	Height/Maternal Efficiency	·0893 ± ·033	·1807 ± ·047	·1374 ± ·048

Charts LI and LII, based upon the mean weights found in the Dundee children of mothers of good maternal efficiency and of mothers who were inefficient, illustrate these correlation tables and suggest that within the range of age studied, i. e. up to 6 years, there is a more definite relationship between maternal efficiency and the weight of girls than in the case of the weight of boys. In boys there seems to be no relationship after they reach the age of four years.

These coefficients of correlation for ages over one year and under four years in the three towns are sufficiently large and consistent to authorize the suggestion that the measure of maternal efficiency is really correlated with the height and weight of the child.

The difference between the children below one year in Glasgow and Dundee is difficult to explain. The towns are very different in character, the facilities for the enjoyment of open air and sunshine being much greater in the latter, so that every mother has a better chance of giving her child an abundance of fresh air than has the mother in the slums of Glasgow. Thus the influence of maternal care might be more easily manifest in Dundee.

But another factor requires consideration. Since the appearance of Shaw's admirable paper in 1832 (1832) it has been generally recognized that rickets tends to cause a retardation of growth and may lead to dwarfing, and it seems possible that differences in the condition of the children may, at least in part, be due to differences in the incidence of this disease in the two cities.

Upon this subject Miss MacNae, who as Sister to the Out-Patient Department of the Royal Hospital for Sick Children in Glasgow has had a very wide experience of rickets, has made an investigation and has prepared the Report given in Appendix VII. From this it will be seen that rickets is much more prevalent and more severe in Glasgow than in Dundee. It is now recognized that the condition is associated with a deficiency of sunshine and fresh air. As is indicated on p. 16 and in Appendix VII, Dundee enjoys these to a much greater extent than does Glasgow. In the latter city it is the careful mothers alone who can secure for their children a modicum of these and who may thus succeed in rearing them free of rickets, and since its effects on height and weight become marked after the first year of life, this may in some measure explain the higher correlation between maternal efficiency and weight and height of the child in the second and third than in the first year of life in Glasgow.

Margaret Ferguson (1918) in her *Study of the Social and Economic Factors in the Causation of Rickets* does not record any measurements of the children, but suggests that in Glasgow the incidence of rickets is definitely associated with inefficiency of the mother (see p. 50 of her study).

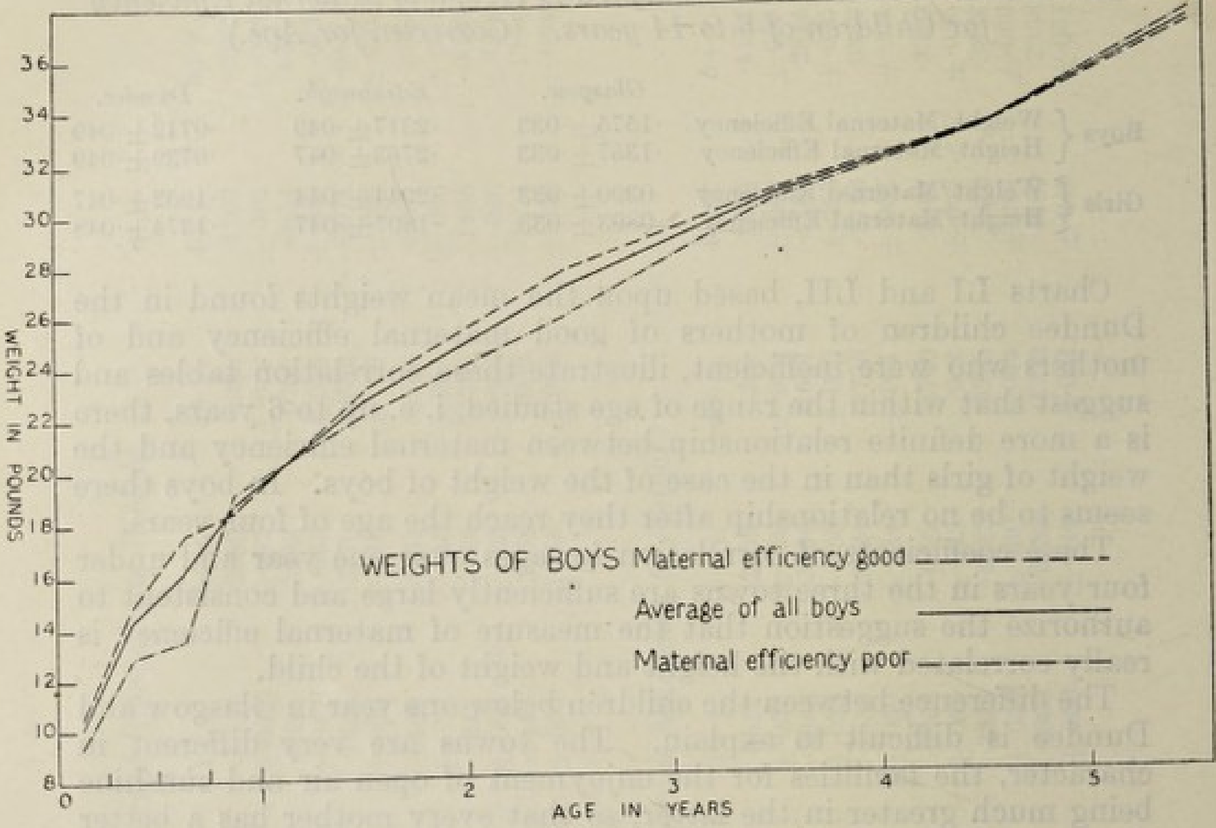


Chart LI. Showing average weights of boys at different ages in relation to types of maternal efficiency.

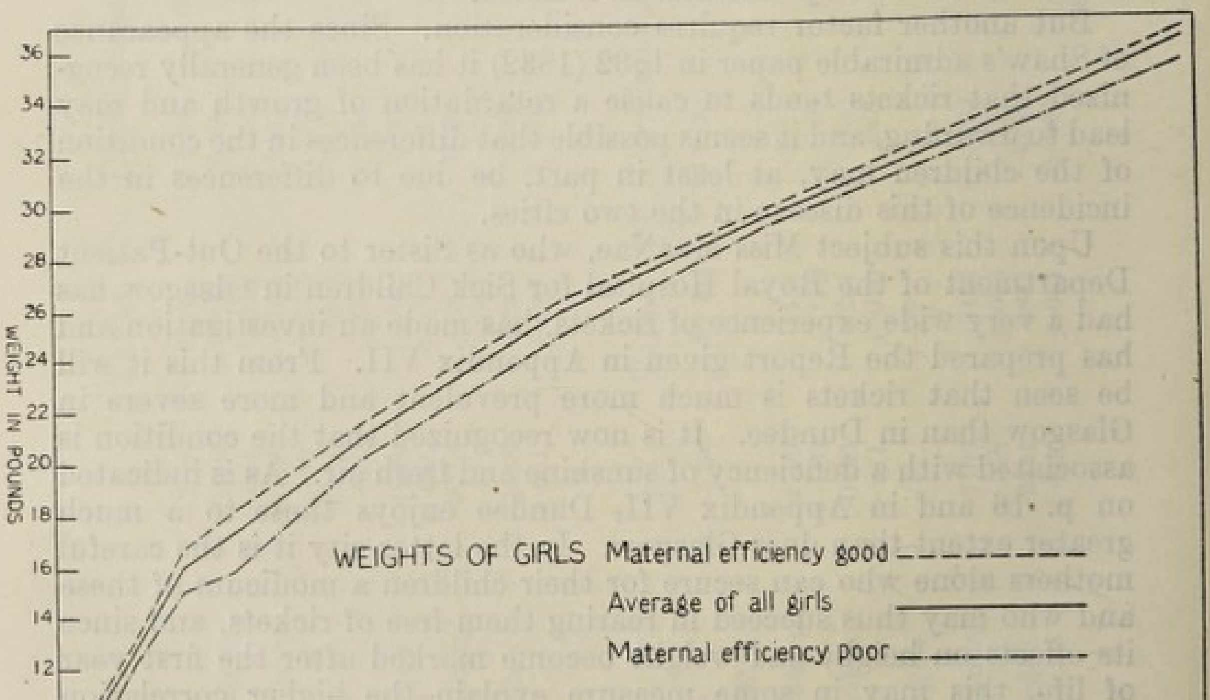


Chart LII. Showing average weights of girls at different ages in relation to types of maternal efficiency.

The investigations of the families of agricultural labourers (p. 297), and of rural miners (p. 273), also show a positive correlation between maternal efficiency and the nutrition of the children.

The efficiency of the mother is the factor so far investigated which seems to be most definitely related to the growth and nutrition of the child.

The influence of maternal efficiency must be complex, and it is not easy to analyse the relative importance of its different elements. The good mother not only attends to the cleanliness of her children and home, sees to it that they get adequate sleep and fresh air, but also secures that they are properly fed by careful marketing and cooking and by the preparation of regular meals. The inefficient mother, even when the income available is sufficient, fails in some or all of these respects, but more rarely in the matter of feeding the children than of their general care.

The question of what determines this efficiency has to be considered. Is it a natural and inborn character possessed by some women, or is it influenced by the environmental conditions ? May it be that a larger family or a certain degree of poverty with the accompanying bad housing renders it difficult or impossible for the mother to be really efficient ? May it be that bad health is a factor reducing the capacity for efficient management in the home ? Is it dependent on the nationality of the mother ? Or is it due to a lower level of intelligence ?

To investigate these various points the correlations between Maternal Efficiency and—

1. Maternal Health,
2. Poverty—Income per Person,
3. Overcrowding,
    (i) Air-space per Person,
    (ii) Number of Living Children in Family,
4. Nationality,
5. Mental Capacity,

have been studied ; the first three factors fairly fully, the last two unfortunately only on a small scale.

(c) Maternal Efficiency and Maternal Health.

The correlations of maternal efficiency and maternal health are given in Table 181.

These correlations are, with two exceptions, positive and significant. There *is thus shown a fairly high relationship between maternal health and maternal efficiency*, and this is supported by the results obtained in the studies of the families of agricultural labourers and rural miners (pp. 275 and 299). The result is what might have been expected—the ailing mother may be unable to overtake her household duties in the way possible to a strong and healthy mother.

TABLE 181. *Correlations. Maternal Efficiency to Maternal Health.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	·2549 ±·060	·3705 ±·060	·3625 ±·060	·5987 ±·054	·506 ±·049	·243 ±·051	·637 ±·038	·4965 ±·048	·520 ±·047
	Edinburgh	—	—	—	—	·520 ±·046	·185 ±·059	·4595 ±·051	·563 ±·047	·549 ±·057
	Dundee	·4365 ±·057	·5060 ±·058	·4753 ±·061	·4488 ±·062	·381 ±·044	·525 ±·037	·563 ±·038	·359 ±·056	·544 ±·045
Girls	Glasgow	·0446 ±·068	·2912 ±·069	·1263 ±·073	·0248 ±·096	·385 ±·049	·4695 ±·043	·385 ±·047	·511 ±·049	·366 ±·054
	Edinburgh	—	—	—	—	·454 ±·051	·163 ±·065	·070 ±·061	·3625 ±·058	·296 ±·074
	Dundee	·8371 ±·021	·6548 ±·041	·3857 ±·069	·5257 ±·058	·667 ±·030	·530 ±·036	·530 ±·037	·3475 ±·053	·501 ±·050

TABLE 182. *Correlations. Maternal Efficiency to Income.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	·0232 ±·065	−·0512 ±·070	·2150 ±·072	·1853 ±·081	−·0160 ±·065	·1058 ±·054	·0203 ±·064	·2176 ±·061	·2262 ±·061
	Edinburgh	·2723 ±·120	·2213 ±·109	·1080 ±·111	·4344 ±·088	·0573 ±·062	·1088 ±·061	·4630 ±·051	−·0113 ±·068	·2515 ±·077
	Dundee	·3646 ±·061	·2087 ±·075	·3576 ±·069	·0492 ±·078	·0066 ±·052	·1416 ±·050	·1611 ±·054	·4216 ±·053	·1384 ±·063
Girls	Glasgow	·0253 ±·068	·0871 ±·075	·3054 ±·068	·3353 ±·086	·0737 ±·057	−·0284 ±·055	−·0140 ±·056	−·0161 ±·066	−·2332 ±·059
	Edinburgh	·1508 ±·115	·5229 ±·077	·1950 ±·118	·1270 ±·114	·2168 ±·061	·3513 ±·058	·1462 ±·060	·2313 ±·064	·2688 ±·075
	Dundee	·0895 ±·070	·2506 ±·067	·2018 ±·078	·2030 ±·078	·2168 ±·051	·1992 ±·049	·1431 ±·051	·0232 ±·060	·1927 ±·064

(*d*) **The Relationship of Maternal Efficiency to Poverty.**

TABLE 183. *Correlations. Income to Maternal Efficiency for Children of 6 to 14 years.* (*Corrected for Age.*)

		Glasgow.	*Edinburgh.*	*Dundee.*
Boys	Income/Maternal Efficiency	·0193±·034	·2939±·047	·1347±·048
Girls	Income/Maternal Efficiency	·0589±·033	·3136±·044	·0873±·048

The correlations of maternal efficiency and income are given in Tables 182, 183. These correlations are small, but are chiefly positive in sign. Although mostly insignificant with regard to the probable error, they may indicate some slight association of maternal efficiency and income, *but evidently within the class studied income is not a dominant factor affecting the efficiency of the mother.* In the studies of the families of rural miners and agricultural labourers (pp. 276 and 299) a more definite relationship is shown.

(*e*) **Maternal Efficiency and Overcrowding.**

As already pointed out, air-space per person and size of family are both expressions of the condition of overcrowding in the home.

(1) *Maternal Efficiency and Air-space per Person*

The correlations of maternal efficiency and the air-space per person are given in Tables 184 and 185.

These correlations are practically all positive and are reasonably significant. They are, in general, higher than the correlations of maternal efficiency and income. They show that *where overcrowding is less in degree the efficiency of the mother is higher. Maternal efficiency thus seems to be associated to a slightly greater extent with overcrowding as determined by the air-space per person than with poverty as determined by income per person.*

(2) *Maternal Efficiency and Number of Living Children in Family*

The correlations of maternal efficiency to number of living children in the family are given in Table 186.

These correlations are all negative in sign, and although small are in most cases significant. There thus seems to be an indication *that a mother with a large family finds it more difficult to care for her home and children than a mother with a smaller family.*

(*f*) **The Relative Importance of Maternal Efficiency, Number of Living Children, Air-space per Person, and Income per Person.**

Since maternal efficiency, air-space per person, number of children in family, and income per person are to some extent interrelated, it is of importance to determine the relative value of these several factors in the nutrition of children. For the solution of this problem the partial correlation between weight and each of these variables for constant values of the remaining ones is required. Thus, for example, the partial correlation of weight and maternal efficiency for constant values of income per person and air-space per person

TABLE 184. *Correlations. Maternal Efficiency to Air-space.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	·4143 ±·054	·2229 ±·066	·3294 ±·068	·1381 ±·082	·2351 ±·062	·2704 ±·050	·1939 ±·061	·3078 ±·058	·4167 ±·053
	Edinburgh	·2792 ±·120	·3145 ±·103	·1925 ±·108	·2107 ±·103	·4667 ±·049	·4082 ±·051	·4432 ±·052	·2698 ±·063	·1633 ±·080
	Dundee	·1680 ±·069	·4856 ±·060	·4066 ±·066	·2716 ±·072	·3252 ±·046	·3153 ±·046	·2380 ±·052	·4758 ±·050	·1877 ±·062
Girls	Glasgow	·1647 ±·065	·3341 ±·066	·4629 ±·060	·4372 ±·078	·3989 ±·048	·3324 ±·049	·2889 ±·051	·2097 ±·064	·2538 ±·059
	Edinburgh	·6633 ±·066	−·3038 ±·096	·6306 ±·074	·7503 ±·051	·0136 ±·064	·2964 ±·061	·2390 ±·058	·4297 ±·055	·3173 ±·073
	Dundee	·3245 ±·063	·4622 ±·056	−·0667 ±·080	·4032 ±·064	·2493 ±·050	·4029 ±·042	·2383 ±·049	·3501 ±·053	·3808 ±·057

TABLE 185. *Correlations. Air-space to Maternal Efficiency for Children of 6 to 14 years. (Corrected for Age.)*

		Glasgow.	*Edinburgh.*	*Dundee.*
Boys	Air-space/Maternal Efficiency	·2814±·031	·4096±·043	·1223±·048
Girls	Air-space/Maternal Efficiency	·3116±·030	·1886±·047	·1811±·047

TABLE 186. *Correlations. Maternal Efficiency to Number of Living Children.*

	Age	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Boys	Glasgow	−·1096 ±·064	−·2551 ±·065	−·4727 ±·059	−·1586 ±·082	−·0442 ±·065	−·3171 ±·049	−·0812 ±·063	−·1752 ±·062	−·3165 ±·058
	Edinburgh	−·0307 ±·130	−·1524 ±·111	−·2342 ±·106	−·4412 ±·087	−·2080 ±·060	−·0572 ±·061	−·2273 ±·061	−·2419 ±·064	−·3074 ±·074
	Dundee	−·2372 ±·067	−·2636 ±·072	−·4520 ±·063	−·0498 ±·078	−·2024 ±·050	−·0951 ±·051	−·1808 ±·053	−·2268 ±·061	−·2159 ±·061
Girls	Glasgow	−·0426 ±·068	−·0728 ±·075	−·2779 ±·069	−·2003 ±·092	−·2002 ±·055	−·1535 ±·054	−·1800 ±·054	−·3238 ±·059	−·1355 ±·061
	Edinburgh	−·1049 ±·116	−·0218 ±·105	−·3031 ±·112	−·1817 ±·112	−·2539 ±·060	−·1715 ±·065	−·2240 ±·058	−·3595 ±·058	−·1105 ±·080
	Dundee	−·0329 ±·070	−·1016 ±·071	−·1853 ±·078	−·0322 ±·080	−·0881 ±·053	−·1718 ±·049	−·1392 ±·051	−·1816 ±·058	−·2038 ±·063

Table 187. *Partial Correlations.* (1) *Weight of Child.* (2) *Maternal Efficiency.* (3) *Air-space per Person.* (4) *Income per Person.*

Dundee Boys.

	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
$r_{12 \cdot 34}$	·3949	·4996	·5107	·0667	·1603	·2638	·0233	−·1667	−·0429
	±·060	±·059	±·058	±·078	±·050	±·047	±·055	±·062	±·064
$r_{13 \cdot 24}$	·1465	−·3867	·0341	−·0122	·0908	·1604	·1466	·1501	·0431
	±·069	±·067	±·079	±·078	±·051	±·050	±·054	±·062	±·064
$r_{14 \cdot 23}$	−·2163	·2895	−·0457	·0681	−·0220	·0480	−·0349	·2221	−·0404
	±·067	±·072	±·079	±·078	±·052	±·050	±·055	±·061	±·064

Dundee Girls.

	−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
$r_{12 \cdot 34}$	·2709	·7221	·0930	·3016	·2218	·2099	·0778	·0995	·1035
	±·065	±·034	±·080	±·073	±·051	±·048	±·052	±·059	±·065
$r_{13 \cdot 24}$	−·0072	−·2377	·0026	·0801	·0566	−·0451	·0881	·0554	·3004
	±·070	±·067	±·081	±·079	±·053	±·050	±·052	±·060	±·060
$r_{14 \cdot 23}$	−·1611	−·2681	·0337	·0866	·0009	−·0155	−·0170	·0408	−·2896
	±·068	±·066	±·081	±·079	±·053	±·051	±·052	±·060	±·061

TABLE 188. *Partial Correlations.* (1) *Weight of Child.* (2) *Maternal Efficiency.* (3) *Maternal Health.*

		−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Dundee Boys	$r_{12\cdot3}$	·2386	·4779	·5684	−·2354	·1580	·3277	·0589	−·0353	·0302
		±·067	±·061	±·053	±·074	±·050	±·046	±·055	±·064	±·064
Dundee Girls	$r_{12\cdot3}$	·3053	·1893	·2636	·4999	·3106	·2574	·1626	·1241	·2027
		±·064	±·069	±·076	±·060	±·048	±·047	±·051	±·059	±·063
Dundee Boys	$r_{13\cdot2}$	·0705	−·1296	·2136	·3166	−·0205	−·0994	−·0222	·0797	−·1187
		±·070	±·077	±·075	±·070	±·052	±·051	±·055	±·064	±·063
Dundee Girls	$r_{13\cdot2}$	−·1324	−·0240	·1768	−·2089	−·1982	−·1596	−·1464	−·0142	−·1031
		±·069	±·071	±·079	±·077	±·051	±·049	±·051	±·060	±·065

TABLE 189. *Partial Correlations.* (1) *Weight of Child.* (2) *Maternal Efficiency.* (3) *Number of Living Children.*

		−3 m.	3+ m.	6+ m.	9+ m.	1+ y.	2+ y.	3+ y.	4+ y.	5+ y.
Dundee Boys	$r_{12\cdot3}$	·3195	·4789	·7038	−·0976	·1486	·3171	·0738	−·0334	−·0644
		±·063	±·060	±·040	±·077	±·051	±·046	±·055	±·064	±·064
Dundee Girls	$r_{12\cdot3}$	·3567	·2139	·3389	·4714	·2475	·2049	·0915	·1350	·1792
		±·061	±·068	±·073	±·062	±·050	±·048	±·052	±·059	±·064
Dundee Boys	$r_{13\cdot2}$	·1497	·0560	·3285	−·0031	−·0551	−·1404	·1010	−·1160	−·1107
		±·069	±·078	±·070	±·078	±·052	±·050	±·055	±·063	±·064
Dundee Girls	$r_{13\cdot2}$	·0785	−·1679	·0062	·0102	·0430	·0124	−·0573	·0554	·0371
		±·070	±·069	±·081	±·080	±·053	±·051	±·052	±·060	±·066

will be a measure of the extent to which weight depends on the efficiency of the mother, wholly apart from any indirect association which is present due to the correlation between either weight and maternal efficiency, or air-space, or income per person. What would be the correlation between the nutrition of children and the efficiency of the mother if all the mothers considered had the same income and air-space per person? The desired result can be given in a rough way by the coefficients of partial correlation which are shown in Tables 187–9. These were worked out for Dundee only.

Table 187 gives the partial correlations of weight with maternal efficiency, air-space, and income per person. *Maternal efficiency still shows significant association with weight up to the end of the second year, wholly apart from differences in air-space or income.* The correlations after the end of the second year are quite insignificant. There is no apparent difference in the sexes in this relationship.

With regard to air-space, in boys there is no evidence of relationship under two years of age, all the correlations, except a negative one at 3 to 6 months, being quite insignificant. Over two years of age, in boys, the coefficients are barely significant up to the end of the fourth year, and at the fifth year there is no significant correlation. In girls, there is no evidence of association except the correlation at 3 to 6 months of age which is significantly negative, and that for 5 years of age which is significantly positive, while in both cases the correlation is of a low order of magnitude. It would appear that *air-space, within the limits studied, is of little importance with regard to its influence on nutrition when income per person and maternal efficiency are kept constant. Income per person also appears to have no relationship to nutrition similarly treated.* The few correlations which may be regarded as significant with regard to their probable errors are small, the majority of the correlations are absolutely insignificant, and there is no uniformity in the series.

Table 189 gives the results of the correlations of weight, maternal efficiency, and size of family. It will be seen from these results that the relationship between nutrition and efficiency of the mother still holds till the end of the second year, after allowing for variations in the size of the family. After two years there is no evidence of significant association.

The correlations of weight and size of family with efficiency of the mother constant are quite insignificant, except in a single instance—that of boys of 6 to 9 months.

The efficiency and health of the mother are also to some extent interdependent, *but with efficiency of the mother constant her health seems to have no significant relationship to the weight of the child.* The correlations between the efficiency of the mother and the weight of the child are little altered by keeping maternal health constant (Table 188).

It would appear, then, from the partial correlations in Dundee, that of the various factors studied maternal efficiency is the only one which plays a significant part in determining nutrition in the child, and this only seems to hold good till the end of the second year of life. Overcrowding, whether as measured by the size of the family, or air-space per person, and poverty, as indicated by income per person, do not seem to be factors influencing in any significant degree the nutrition of children.

(*g*) **Maternal Efficiency and the Nationality of the Mother.**

An attempt was made to ascertain if the nationality of the mother had any relationship to her efficiency.

It is generally supposed that there is at present a considerable immigration of Irish into Scotland and especially into Glasgow. It is therefore surprising to find that only 10 per cent. of the mothers of the families investigated were born in Ireland. The following table shows little or no difference between the condition in the houses and the care of the children of mothers born in Glasgow and those born in Ireland :

MOTHERS NOT IRISH.

Maternal care good	473 = 67·77	per cent.
,, ,, poor	225 = 32·23	,,
House clean	414 = 59·31	,,
,, dirty	284 = 40·69	,,

IRISH FAMILIES.

Maternal care good	57 = 72·15	per cent.
,, ,, poor	22 = 27·85	,,
House clean	46 = 58·23	,,
,, dirty	33 = 41·77	,,

There were 79 mothers who had been born in Ireland and it is interesting that 81 fathers had also been born there. This does not represent the total number of fathers and mothers of Irish stock. There is, undoubtedly, a considerable number of parents of Irish descent in Glasgow, but as the only means of detecting these on our returns was the character of the names, and as there is much similarity between the names in Scotland and in the north of Ireland, it was impossible to collect data which could be dealt with statistically. In the 777 families studied in Glasgow the father's name was typically Irish in 193, or 24·8 per cent. of the whole. This, of course, does not show that the mother was Irish, nor does it indicate that all fathers of Irish extraction are included, since among the 81 fathers born in Ireland a large proportion had names common to Scotland and to the north of Ireland alike.

The question of whether there is any difference in the efficiency of mothers born in Glasgow and those born outside of the city was considered, but it was found impossible to divide those born outside of Glasgow into town and country born because the birth-places range from industrial centres, such as Dundee, through all gradations of town and village to such strictly rural counties as Dumfries and Perth.

Of the 777 mothers a quite insignificant number were actually country bred. Mothers not born in Glasgow or in Ireland formed 21 per cent. of the whole, and between them and the Glasgow-born mothers there is no marked difference as regards the care of the children or the cleanliness of the home.

TABLE 190. *Percentage of good maternal efficiency and clean homes, according to birth-place of the mothers.*

Birthplace of mothers.	*Percentage of mothers with good efficiency.* *No. of cases.*	*Per cent.*	*Percentage of clean homes.* *No. of cases.*	*Per cent.*
Glasgow	535	66·17	535	59·07
Country and towns in England and Scotland (*not* Glasgow or Ireland)	163	73·00	163	60·1

(*h*) **Maternal Efficiency and Mental Capacity.**

There is no doubt that maternal inefficiency may be in some cases related to vice, as, for example, alcoholism, but it is also possible that want of intelligence is the more frequent underlying cause. It was found impossible to obtain reliable information regarding the alcoholic habits of the parents except in a limited number of cases, so that no extensive statistical inquiry was possible. An attempt, however, was made to gauge the mental capacity of the different types of mothers by submitting a series of ' good ' and ' bad ' mothers (25 in each class) to mental tests. This examination was carried out by the late Dr. H. J. Watt, Lecturer on Psychology in Glasgow University, who concluded that, on the whole, the ' good ' mothers were more intelligent than the ' bad ' mothers. Though the results show some overlapping and are thus not so conclusive as one would have desired, they are sufficiently suggestive to warrant a further investigation along these lines on a larger series with the efficiency of the mother graded into more than two classes : this it is hoped to do during the coming winter. For detailed report by Dr. Watt, see Appendix No. VI.

(5) RELATIONSHIP OF AGE OF MOTHER AND POSITION OF CHILD IN FAMILY TO THE HEIGHT AND WEIGHT OF THE CHILD

A further possible relationship of the size of the child to the condition of the mother is the age of the mother at the time of birth and the possible influence of the number of children previously born. Upon the subject Dr. P. L. MacKinlay has prepared the following report :

The previous work on this subject has mainly been concerned with the weights and heights of infants at birth. Duncan (1866) gives figures to show that the birth weights of infants increase with increasing age of the mother, to between the 25th and 29th year, after which there is a gradual fall till the end of reproductive life ; but he finds no relation of weight to the order of birth. Ingerslev (1876) gives the average weights of infants of primiparous women as 3,254 gm. and of those of multiparae 3,412 gm.—an excess of 158 gm. (about a third of a pound) in favour of the latter. Subdivided into groups according to the age of the mother and position in the family, the weights increase irregularly with the age of the mother till about 40 years, after which they fall. With the order of birth, the weights increase till the 5th pregnancy, after which there is an irregular decrease. Pearson (1914) finds that the offspring of first pregnancies are lighter and shorter than those of subsequent pregnancies, and that the later-born of large families are also on the average lighter than those of intermediate groups.

The returns from the Glasgow Welfare Centres afford information both as to age of mother and position of the infant in the family, so that something of interest may be gleaned from these returns relative to the weights and heights of the infants throughout the first year of life.

TABLE 191. *Correlations. Weight and Height of Child to Age of Mother.*[1]

	Age of Child .	1 m.	2 m.	3 m.	4 m.	5 m.	6 m.	10 m.	11 m.	12 m.
	Correlations of :									
Boys	Weight . .	·0723	·0060	−·0064	−·0682	−·0648	−·1568	−·1626	−·1431	−·2013
	and	±·030	±·035	±·040	±·043	±·044	±·040	±·042	±·049	±·055
	Age of mother	·0955	·1253	·1233	·0682	·1549	·1613	·1283	·1453	·1818
		±·030	±·034	±·040	±·043	±·043	±·040	±·042	±·049	±·055
	Height . .	·0184	·0531	·0193	·0316	−·0445	−·0719	−·0740	−·0672	−·1328
	and	±·031	±·035	±·040	±·043	±·044	±·041	±·043	±·050	±·056
	Age of mother	inde-	·2150	·0430	·0783	·1999	inde-	inde-	·0765	·0564
		terminate	±·033	±·040	±·043	±·042	terminate	terminate	±·050	±·057
Girls	Weight . .	·0917	−·0069	−·0235	−·0516	−·0241	−·0377	·0647	·0271	·0108
	and	±·032	±·040	±·039	±·044	±·045	±·042	±·044	±·049	±·050
	Age of mother	·1581	inde-	·1175	·1375	·0676	inde-	·0661	inde-	inde-
		±·032	terminate	±·039	±·043	±·045	terminate	±·044	terminate	terminate
	Height . .	·0308	−·0967	·0094	·0324	−·0525	−·0405	−·0052	−·0386	−·0233
	and	±·033	±·040	±·039	±·044	±·045	±·042	±·044	±·049	±·050
	Age of mother	·0907	·0321	·1797	·1399	·0934	·0856	inde-	inde-	·1252
		±·032	±·040	±·038	±·043	±·044	±·041	terminate	terminate	±·050

TABLE 192. *Correlations. Weight and Height of Child to Position in Family.*[1]

	Age of Child	1 m.	2 m.	3 m.	4 m.	5 m.	6 m.	10 m.	11 m.	12 m.
	Correlations of:									
Boys	Weight . .	·0857	·0480	—·0217	—·0363	—·1124	—·2214	—·1596	—·1662	—·2168
	and	±·030	±·035	±·040	±·043	±·043	±·039	±·042	±·049	±·055
	Position in	·2129	·1386	·1231	·2157	·2140	·3061	·2295	·1953	·2202
	family	±·029	±·034	±·040	±·041	±·042	±·037	±·041	±·048	±·054
	Height . .	·0447	·0671	—·0420	—·0074	—·0643	—·1387	—·1463	—·0841	—·1679
	and	±·030	±·035	±·040	±·043	±·044	±·040	±·042	±·050	±·055
	Position in	·1216	·2282	·1726	·1794	·1979	·2522	·1156	·0361	·1113
	family	±·030	±·033	±·039	±·042	±·042	±·038	±·042	±·050	±·056
Girls	Weight . .	·0665	·0305	·0684	·0367	·0468	·0579	·0453	·0581	—·1138
	and	±·032	±·040	±·039	±·044	±·045	±·042	±·044	±·049	±·050
	Position in	·1516	·0282	·2368	·1328	·1774	·1117	·1296	·1377	·1044
	family	±·032	±·040	±·037	±·043	±·043	±·041	±·043	±·048	±·050
	Height . .	·0103	—·0369	·0204	·0838	—·0369	—·0254	—·0729	—·0565	—·1519
	and	±·033	±·040	±·039	±·043	±·045	±·042	±·044	±·049	±·049
	Position in	·0765	inde-	·2151	·1307	·2168	·1360	·1762	·1630	·1138
	family	±·033	terminate	±·037	±·043	±·043	±·041	±·043	±·048	±·050

[1] The upper series in each case in Tables 191 and 192 is of coefficients of correlation; the lower, of correlation ratios.

TABLE 193. *Mean Weight of Child in Pounds and Age of Mother.*

	Age of Child	1 m.	2 m.	3 m.	4 m.	5 m.	6 m.	10 m.	11 m.	12 m.
	Boys.									
Age of Mother	15–21 years	8·1525	9·4375	10·5882	12·7619	13·6111	15·5526	17·4400	18·6875	20·2143
	21–27 ,,	8·5393	9·7731	11·2474	12·6351	14·0568	14·9687	18·3210	18·2955	18·7065
	27–33 ,,	8·7314	10·2149	11·4765	12·8963	14·2662	15·1823	17·8671	18·4434	19·0333
	33–39 ,,	8·6907	9·6136	11·1981	12·3393	13·6389	14·5937	17·1731	17·3108	18·1500
	39– ,,	8·5323	9·6000	10·4167	12·0000	12·1875	16·8182	16·2000	17·6667	17·5000
	Mean	8·5700	9·8298	11·1922	12·6373	13·9470	14·9241	17·7591	18·1401	18·7786
	Standard deviation	1·5320	1·9120	2·0712	2·2094	2·2961	2·4634	2·6393	2·5856	2·7806
	Girls.									
Age of Mother	15–21 years	7·6371	8·8415	10·1818	11·6667	12·2586	13·4231	16·1154	17·1667	17·1429
	21–27 ,,	7·9467	8·9897	10·5243	11·9762	12·8421	13·7826	15·9438	16·7273	17·2721
	27–33 ,,	8·2500	9·0000	10·6646	11·8939	12·9032	13·5423	16·4545	17·1129	17·1695
	33–39 ,,	8·3267	9·0902	10·6909	11·9048	12·3878	13·7131	16·2667	17·1618	17·5167
	39– ,,	7·5238	8·6667	9·5333	10·5000	12·5000	13·1364	16·6111	17·2778	16·8250
	Mean	8·0307	8·9789	10·4916	11·8117	12·6704	13·6379	16·1936	16·9735	17·2514
	Standard deviation	1·5010	1·7128	1·9333	2·0736	2·2083	2·0822	1·9959	2·2691	2·2766

Table 194. *Mean Weight of Child in Pounds and Position in Family.*

	Age of Child	1 m.	2 m.	3 m.	4 m.	5 m.	6 m.	10 m.	11 m.	12 m.
	Boys.									
Position in Family	1	8·0190	9·2772	10·7917	11·9500	13·5098	14·7308	17·9732	18·9844	20·0000
	2 and 3	8·6645	9·9118	11·2262	13·1270	14·4257	15·4375	18·4236	18·0492	18·7500
	4 and 5	8·8242	10·3280	11·7807	13·0254	14·1091	15·2500	17·5439	18·0714	18·7051
	6–8	8·9944	10·0208	11·7976	12·7065	14·0385	15·0714	17·4222	18·3056	19·7400
	Over 8	8·2717	9·3261	9·9231	11·7692	12·4412	12·8167	15·8529	19·2500	17·5385
	Mean	8·5700	9·8298	11·1922	12·6373	13·9470	14·9241	17·7591	18·1401	18·7786
	Standard deviation	1·5320	1·9120	2·0712	2·2094	2·2961	2·4634	2·6393	2·5856	2·7806
	Girls.									
Position in Family	1	7·5647	8·7324	10·1284	11·4000	12·4667	13·7674	16·5000	17·3095	17·8548
	2 and 3	8·0731	9·0111	10·2174	11·9203	12·6267	13·4235	15·8625	16·6137	17·0672
	4 and 5	8·2901	9·0741	11·1923	12·1923	12·3590	13·3559	16·0882	16·3800	17·3243
	6–8	8·1951	9·1569	11·1522	12·1548	13·5476	14·1373	16·6875	17·3375	17·2083
	Over 8	8·0217	9·0000	10·0312	11·3958	12·1800	13·8043	16·0588	17·5938	16·3125
	Mean	8·0307	8·9789	10·4916	11·8117	12·6704	13·6379	16·1936	16·9735	17·2514
	Standard deviation	1·5010	1·7128	1·9333	2·0736	2·2083	2·0822	1·9959	2·2691	2·2766

TABLE 195. *Mean Height of Child in Inches and Position in Family.*

	Age of Child	1 m.	2 m.	3 m.	4 m.	5 m.	6 m.	10 m.	11 m.	12 m.
	Boys.									
Position in Family	1	20·5572	21·3020	22·7014	23·3800	24·1373	25·0385	27·0179	27·5000	27·9259
	2 and 3	20·8194	21·8571	22·7798	23·8571	24·6284	25·2955	27·0764	27·3607	27·6667
	4 and 5	20·9615	22·0430	22·9912	23·9322	24·5455	25·2100	26·9123	27·3000	27·6026
	6–8	21·0562	21·9861	23·1548	23·9674	24·5769	25·3492	27·0333	27·3889	27·5400
	Over 8	20·5978	21·4348	22·0577	23·2885	23·7647	25·7167	26·3824	27·0000	27·2308
	Mean	20·8107	21·7530	22·7918	23·7377	24·4322	25·1426	26·9575	27·3434	27·6357
	Standard deviation	1·1760	1·3437	1·1944	1·2786	1·2113	1·2026	1·1497	1·1717	1·1268
	Girls.									
Position in Family	1	20·2235	21·2254	22·1959	23·1231	23·8111	24·6279	26·6170	27·0119	27·2581
	2 and 3	20·4846	21·2000	22·4891	23·2319	24·0267	24·5000	26·2750	26·7273	27·1642
	4 and 5	20·5926	21·3241	22·8173	23·3462	23·5385	24·3475	26·0588	27·7600	26·8919
	6–8	20·4451	21·1373	22·8913	23·6667	24·2500	24·8627	26·4625	26·8375	27·0278
	Over 8	20·3587	21·0833	22·0625	23·1667	23·3600	24·2391	26·0000	26·6875	26·4375
	Mean	20·4316	21·2113	22·4899	23·2908	23·8673	24·5345	26·3085	26·7460	27·0642
	Standard deviation	1·1962	1·2597	1·2712	1·1846	1·2269	1·2164	1·0570	1·1105	1·1814

TABLE 196. *Mean Height of Child in Inches and Age of Mother.*

BOYS.

	Age of Child	1 m.	2 m.	3 m.	4 m.	5 m.	6 m.	10 m.	11 m.	12 m.
Age of Mother	15–21 years	20·6610	21·1354	22·6618	23·4762	24·0926	25·1579	27·1000	27·0625	27·8214
	21–27 ,,	20·8371	21·8115	22·7577	23·7027	24·5455	25·2438	27·0185	27·4924	27·6739
	27–33 ,,	20·8270	22·0746	22·9059	23·9024	24·6104	25·1719	26·8861	27·3774	27·7111
	33–39 ,,	20·8041	21·5000	22·8396	23·7232	24·2639	24·9922	26·9615	27·1486	27·4667
	39– ,,	20·9032	21·8667	22·4167	23·3182	23·3750	25·0000	26·6500	27·3500	27·1000
	Mean	20·8107	21·7530	22·7918	23·7377	24·4322	25·1426	26·9575	27·3434	27·6357
	Standard deviation	1·1760	1·3437	1·1944	1·2786	1·2113	1·2026	1·1497	1·1717	1·1268

GIRLS.

	Age of Child	1 m.	2 m.	3 m.	4 m.	5 m.	6 m.	10 m.	11 m.	12 m.
Age of Mother	15–21 years	20·2419	21·2683	22·1705	22·8939	23·6897	24·4423	26·3654	27·0278	26·8214
	21–27 ,,	20·4333	21·2938	22·6165	23·4226	24·0066	24·5489	26·3034	26·8106	27·7647
	27–33 ,,	20·5345	21·2603	22·5443	23·3106	23·9516	24·6127	26·2955	26·6048	26·8729
	33–39 ,,	20·5400	21·0246	22·8571	23·4286	23·6224	24·5820	26·2778	26·7500	27·2500
	39– ,,	20·0238	21·0000	22·0667	22·9286	24·0000	23·8636	26·4444	26·6667	26·7500
	Mean	20·4316	21·2113	22·4899	23·2908	23·8673	24·5345	26·3085	26·7460	27·0642
	Standard deviation	1·1962	1·2597	1·2712	1·1846	1·2269	1·2164	1·0570	1·1105	1·1814

The correlations are given in Tables 191 and 192. The first two figures of each group are the coefficients of correlation worked out by the product moment method, the lower two are the correlation ratios corrected by the method described by Pearson (1909–10).

$$\text{Corrected } \eta^2 = \frac{\text{observed } \eta^2 - \frac{K-3}{N}}{1 - \frac{K-3}{N}},$$

where K is the number of arrays, and N the number of observations.

The mean weights and heights of infants for arrays of age of mother and order of birth are given in Tables 193 to 196. The small size of the correlations shows at once that neither of these variables has any great influence on the nutrition of infants; but *on the average the order of birth has more close association with weight and height than has the age of the mother.*

Infants of young and old mothers are inferior in weight to those of mothers of medium age throughout the first half of the first year of life; but by the last three months the inferiority of the offspring of young mothers has disappeared, and even a slight superiority is in evidence, while the infants of older mothers are still inferior to those of medium aged mothers. Height in both sexes shows the same relation as weight.

With order of birth, infants of the first and those over the eighth pregnancy are lighter and shorter than those of intervening pregnancies. The inferiority of the first born, however, is replaced at the end of the year by a definite superiority both in height and weight, while that manifested in the early months by the last born of families over eight is still apparent at the end of the year.

The age of the mother and order of birth might conceivably influence the physique of the offspring from the operation of causes which may be classified as (1) internal and (2) external. In the first group are included the suggestions of Ewart (1914), which are:

(*a*) that the germ-cells formed late in life partake of the senescence characterizing the somatic cells, or

(*b*) that the germ-cell up to fertilization is unaffected by senile somatic changes, but thereafter suffers from nutritive effects dependent on the soma, or

(*c*) that the parental populations are differentiated, persons procreating late in life being of a different type from others.

Apart from these factors there are some differences between first and subsequent pregnancies which might affect the weight of the offspring. Maternal morbidity in many of its forms is most frequent in first pregnancies, and parturition itself has its dangers magnified in a slum community from the high incidence of deformed pelves. These and possibly other dangers lead to a formidable proportion of the accidents of child-birth being from first pregnancies.

The difficulty and length of a first labour must of necessity be associated with even greater shock to the infant than usual. The weights of infants at birth have some relation to the duration of intra-uterine existence; but how far this is related to the age of the mother or order of birth is unknown. In later pregnancies the difficulties of parturition are lessened, the maternal soft parts are lax, the difficulties to be expected are better known, and can thus be prevented or minimized. The greater frequency of premature infants in multiparae might also be a factor in lowering the average weights of later born infants.

But apart from such intrinsic factors it is apparent that as the age of the mother increases and, with it, the number of pregnancies, the external environmental conditions under which the infant is born also change. The infant of a later pregnancy is born under circumstances in which overcrowding is great, the family income severely strained, the care of the infant less, and the possibility of disease, especially of the contagious type, greatest. It can scarcely be expected that the effects of poverty or overcrowding on nutrition would manifest themselves at the earliest periods of life, unless indirectly by their influence on the mother, who is the environmental influence of most importance to the infant in its early life. The young mother with one child only, ignorant possibly in some respects of the proper management of her first-born, is by no means lacking in interest for its welfare. The family income, although not at its maximum, is subjected to less strain, and overcrowding is not so intense as in the larger families. The small family allows the mother time to overtake her household duties and to attend to the needs of her infant in an efficient manner.

Whatever the reason for its low initial weight (exclusive of racial factors), the infant might reasonably be expected to make good the deficiency, if its future life were associated with the necessities for its new type of existence. Such is the case with those of the first-born who survive. At the end of their first year they show quite definite superiority over others, despite their greater trials and possibility of injury during parturition. Such is not the case with subsequently born children. Their lower weight is still manifest at the end of the year.

The position of the infant in the family is closely related to the size of the family, and as this increases, the care of the infant tends to diminish. Regard for infant life is then at a minimum. The lower income available per person, the greater degree of overcrowding as measured by the smaller air-space per person, and the larger family have already been shown to be factors determining in some degree the care which the mother bestows on her infant. The practice of breast-feeding is commoner, perhaps, in the slums than elsewhere; but, apart from our ignorance of the relation between both the quality and the quantity of the mother's milk and her state of health and nutrition, it is conceivable that the care of a large family and the time and trouble spent on breast-feeding an infant form an inducement either to supplement or completely replace this by artificial feeding often of a most unhygienic type. But the beneficial results of breast-feeding at that period of life are apparently lost soon after the infant is weaned (p. 200), so that it is doubtful whether we can consider this as a factor of importance in determining the association of the low weight and height of the later born of large families. It is quite probable that, wholly apart from the changes in the female reproductive system consequent on age (about which little definite is known of its effects on, at the end of the first year of life, the physique of the offspring), the relation of the weights of infants to the order of their birth or to the age of the mother is a secondary result of the efficiency with which the mother can supervise her infant. The connexion observed by previous workers between birth weights, and in the present study between weights and heights in the early months of life, with position in family and age of mother is most probably due to a variety of prenatal factors, on which we have here no information to attempt analysis. P. L. MacK.

B. *THE FATHER*

Apart from antenatal influence and the effects upon the home of drunkenness, laziness, and vice, the influence of the father upon the young child is manifestly much less important than that of the mother.

This is fortunate since it is practically impossible to collect reliable information as to the character and habits of the father.

(i) Previous Work

Karn and Pearson (1922) have arrived at some very interesting conclusions as to the influence of the father's health on the conditions of the home and the development of the child. They correlated the father's health with the father's wage and got the following results :

Father's wage.	*Father's health.* Strong and good.	Indifferent and poor.	*Totals.*
17*s.* and over	317	45	362
Under 17*s.*	63	31	94
Totals	380	76	456

leading to the value of tetrachoric $r = \cdot 4032 \pm \cdot 0590$. Thus even with returns which are recognized by the writers to be not the most accurately recorded data, there is a very sensible relation between the father's wage and his health. They also found a relationship, significant, but of no great intensity, between the father's health and the crowding of the home. The following tables give the means of the arrays of crowding :

Father's health.	*Persons per room.*
Good	1·498
Fair	1·547
Poor and Dead	1·718
All categories	1·517

As the father is away from home during the greater part of the day, it seems unlikely that the association of his health with the crowding of the home is caused by the conditions of the home, especially as Pearson shows that there is a much less association of the health of the mother, so constantly within doors, with the state of crowding. He says : ' Any bad health of the father means lessened and even total loss of wage ; this involves a reduction in the rent that can be paid and consequently a smaller or poorer type of home. It is not health (in the case of the father) following the home, but the home following the health.'

The writers also correlated the health of the father with that of the child and found the correlation rather greater than that of most of other environmental factors studied, with the exception of the health of the mother.

Correlation of father's health and that of	male	baby	=	·14434
,, ,, ,, ,, ,, ,,	female	,,	=	·1442
,, ,, mother's ,, ,, ,,	male	,,	=	·1961
,, ,, ,, ,, ,, ,,	female	,,	=	·2492

Elderton and Pearson (1910) give the results of a study of the influence of parental alcoholism on the physique and ability of the offspring. They used as their material a Report of the Edinburgh Charity Organization Society derived from a study of the families of children attending a school in one of the poorest parts of Edinburgh which yet had upon its roll 'an admixture of the substantially comfortable and thoroughly respectable working class'. Weights and heights of these children were recorded. They also used statistics collected in Manchester, where the health of the children was recorded, but not the height and weight. In the Edinburgh series the mean ages of the children lay between 9 and 10 years. They therefore did not touch the pre-school age with which we are specially concerned. Their conclusions are—(1) 'There is a higher death-rate among the offspring of alcoholic than among the offspring of sober parents. This appears to be more marked in the case of the mother than in the case of the father, and since it is sensibly higher in the case of the mother who has drinking bouts than of the mother who habitually drinks, it would appear to be due very considerably to accidents and gross carelessness and possibly in a minor degree to a toxic effect upon offspring. Owing to the greater fertility of alcoholic parents, the net family of the sober is hardly larger than the net family of the alcoholic. (2) The mean weight and height of the children of alcoholic parents are slightly greater than those of sober parents, but as the age of the former children is slightly greater, the correlations when corrected for age are slightly positive, i. e. there is slightly greater height and weight in the children of the sober. In the case of the father, the correlations are not significant having regard to their probable error; in the case of the mother they may be just significant, but they are so slight as to have no importance. . . . (4) The general health of the children of alcoholic parents appears on the whole slightly better than the health of sober parents. . . . The source of this relation may be sought in two directions; the physically strongest in the community have probably the greatest capacity and taste for alcohol. Further the higher death-rate of the children of alcoholic parents probably leaves the fitter to survive.'

(ii) Present Investigation

Habits of Parents.

We have not found it possible to investigate fully the influence of drinking habits of the parents on the condition of the child. But, apart from drunkenness, a moderate indulgence in alcohol makes a serious demand on such small incomes as those of the families which have been studied. Even a glass of whisky a day, costing 1*s.* 4*d.*, will make a material difference on an income of, say, 35*s.* per week.

In our investigation fathers were not generally seen and the information as to their habits derived from the wife was usually unreliable. It was also difficult, if not impossible, in most cases to ascertain if the wife was addicted to drink. In some cases, of course, this was obvious, but in others it was well concealed and was sometimes discovered only by chance.

For that reason, no extensive statistical investigation was possible. This is greatly to be regretted, for it leaves us in ignorance of the extent to which the condition of the home and the efficiency of the mother are influenced by this factor.

Miss Mabel Clark has made a very limited study in Dundee on the subject and she has obtained the following results:

In Dundee some definite information was collected regarding the habits of the parents, and as these details affect 122 boys and 136 girls between birth and six years of age a correlation between the weight of the child and the habits of the parents was attempted. The parents were divided into two categories: (1) Both parents temperate, and (2) Both parents intemperate. The children were classified into 2 lb. weight groups and one-year age groups with the following results:

TABLE 197. *Correlation of Factors: (1) Weight of Child. (2) Habits of Parents. (3) Age of Child.*

	r_{12}	r_{13}	r_{23}	$r_{12 \cdot 3}$
Boys . . .	·031	·9014	·0824	·3184 ± ·055
Girls . . .	·0451	·8687	·1953	·2654 ± ·054

M. L. C.

Although the partial correlations are consistent and in each case more than three times the size of the probable error, the raw correlations of weight of child and habits of parents are very small and subject to much larger probable error than coefficients computed by the product moment method. Hence it would be wrong to put much stress upon the final results, since the usual test of significance is inadequate. Further investigation upon this subject is required.

PART VII. AN INVESTIGATION OF THE RELATIONSHIP OF THE GROWTH AND NUTRITION OF CHILDREN OF RURAL COAL-MINERS IN SCOTLAND TO ENVIRONMENT

By Catherine A. S. Blair, M.B., Ch.B.

CONTENTS

(1) OBJECTS OF THE INVESTIGATION

It was considered desirable to undertake a study of a social class intermediate in position between the urban poor and the agricultural labourer.

The rural coal-miners in Scotland seemed to offer the required material. They resemble the town dwellers in being an industrial class and living in communities, while they correspond with the agricultural class in inhabiting separate houses, generally of one story, in villages situated in the open country.

A study of the Nutrition of Miners and their Families had been published in 1924 (M.R.C. Spec. Rep. Ser., No. 87) embracing the coal-mining communities, urban and rural, of Derbyshire, Northumberland, Durham, Lancashire, and Stirlingshire.

Since of the total 140 families only 17 were in Scotland, and since the dietary factor had alone been studied, the data were not sufficient for the present purpose, and it was decided to extend the inquiry to mining communities in other parts of Scotland. The counties of Ayrshire, Dumfriesshire, East Lothian, Stirlingshire, and Fifeshire were selected. (See map, p. 19.)

The studies were made between December 1923 and March 1924. The work was carried out in precisely the same manner as the intensive urban investigations and attention was directed to the condition of the children under six years. The total number of children dealt with was 3,101, consisting of 1,604 boys and 1,497 girls. The following investigators took part in the field work: Dr. Olive Somerville, Dr. Lilian Dickson, Dr. C. A. S. Blair, Miss J. Swanson, Miss Bryce Buchanan, and Miss E. M. Kerr.

The statistical analyses of the results were undertaken by Catherine A. S. Blair, who has submitted the following report:

(2) GENERAL AND LOCAL CONDITIONS OF COMMUNITIES STUDIED

South Ayrshire. Since the writer's part of the field work was carried out in this district, a somewhat full description of it may be given, and subsequently a briefer account of the other districts.

The villages visited lie within a radius of ten miles of the town of Ayr. Each village is typically rural in character, consisting usually of from 7 to 100 houses, and in a few cases 150–200 houses. In the vast majority of cases the houses are two-roomed cottages; in some villages a row of such cottages, generally white-washed, extends along either side of the road for some little distance; in others, the houses are arranged in ' rows ', each house being exactly of the same size and appearance as its neighbour. In the case of Tarbolton the houses are more of the tenement type, but most of these are in a state of disrepair and have been condemned.

The villages are all more or less easily accessible by motor charabancs, but this means of transport being quite new in the districts, the villages have not in any way become less rural since its institution. One ' store ' is usually to be found in each village, but sometimes not even that, the villagers having to depend entirely on vans from neighbouring towns.

The surrounding country is, for the most part, flat stretches of grass and ploughed fields, interrupted at infrequent intervals by the presence of a small coal-pit.

Almost without exception the people belong to Scotland, and generally to Ayrshire itself, many of them having been born and brought up within ten miles of their married home. One or two families occurred where either the father or the mother was a Pole. No Irish were met with.

The men in the villages are without exception miners, that term of course including all the different types of workmen—hewers, firemen, boiler-firemen, surface-men, drawers, brushers, pit-bottomers, horsekeepers, pit-head labourers, &c. In the vast majority of instances the fathers bring home their unopened pay-envelope to their wives. With the exception of Tarbolton, very few seemed to drink to excess—in most cases several miles have to be traversed to reach the nearest licensed premises. It was a striking fact, however, that if there happened to be a heavy drinker in a small village, the father's intemperance was without exception reflected in the condition of the house—the rooms were bare and dirty, the mother indifferent and lazy, and the children filthy and in rags. In Tarbolton, where there are no fewer than nine licensed premises, drinking to excess is common and the houses were the worst encountered.

With regard to the mothers, as a general rule the care of the house and of the children go hand in hand, and both are of a surprisingly high level. Despite the fact that each day, husbands, and in some cases sons also, come in dirty from the pits, most of the houses are spotlessly clean and in perfect order. Even in the smallest cottage, with eight or ten of a family, not a thing would be noticed out of place. In the somewhat rare instances in which the father drank (when doubtless the mother might indulge too, although it was rarely possible to elicit this) the condition of the house was startlingly different. No betting at all was detected among the mothers, and in every home practically all provisions are paid for at the time of delivery of goods. In some cases where the father had been off work for a long time with 'nystagmus' debt accumulated, but this did not usually go very far, as most of the people deal with the Co-operative Society, where accounts have to be paid regularly.

In the best type of house investigated, the mothers take an evident interest in the preparation of proper meals at regular hours, but in the majority of instances, although the house may be well kept and the children clean and well cared for, no attempt is made to have a midday meal. Children come in from school and cut for themselves slices from a loaf of bread standing on the table. On being questioned, the mothers generally stated that 'dinner' was prepared for 4 p.m., when the father came home from work, and the children also partook of it then. In the case of babies, feeding is somewhat irregular. Breast-feeding is in many cases continued for one and a half to two years, but the 'run of the house' is given in addition from an early age.

The children live a great deal out of doors, and it is the exception to find a household with well-regulated hours for rising and going to bed. The constant changing of the men each week between 'Day', 'Back', and 'Night' shifts is probably responsible for this, especially in the case of children under school age. Often the household is astir till 11.30 or 12 midnight preparing and clearing away a meal for the men coming off work at 10 p.m.; on the other hand, some households are disturbed at 6 a.m. by the miners' return from the night shift, and quite often the younger children return to bed with their father and remain there till 10 a.m., or even considerably later.

A very striking fact in the mining communities investigated is the frequency of illegitimacy. As a rule there is no promiscuous illegitimacy and in most cases the union is subsequently legalized by marriage, but it does not appear too high an estimate to state that fully 90 per cent. of the first children are at least conceived out of wedlock. Two glaring instances of promiscuous illegitimacy were encountered—in one case four illegitimate children being born, and in the other no fewer than six.

The houses generally are overcrowded, ten occupants of two rooms being quite common ; and frequently ' the room ' (so called in contradistinction to ' the kitchen ') is let either to a young married couple, or to a couple with a large family. It is characteristic of the miner's home that the sons of the family on growing up continue under the parental roof. As each automatically becomes a miner, there is no necessity for his going farther afield to earn a livelihood and hence it is no uncommon thing to find four or five adult men in one household. On marrying, of course, the sons leave the home, except in a few instances where it is impossible to obtain houses of their own.

Sanitation is by no means modern. Very few of the houses have water installed, consequently none have W.C.s or bathrooms. The villagers for the most part get their water-supply from the village pump, and in the tiniest villages from a well in the neighbourhood. In some cases there are outside W.C.s shared by two or more families, but in other instances only dry closets are provided, and often these are quite unfit for use. In some villages no sanitary arrangements of any description are provided.

In the more modern villages washing-houses fitted with boilers, &c., are built, but in most villages the women do all their washing in tubs in front of their own kitchen fire.

Despite many drawbacks consequent on the existing poor sanitary conditions, the S. Ayrshire mining district in many respects compares very favourably with the other districts studied. On the whole, the people are of a superior type, the houses are clean and well-kept, and the children healthy and well cared for.

Comparison of S. Ayrshire with other mining districts studied

Conditions are fairly similar in *N. Ayrshire*, but sanitation is even worse. Most of the villages have no sanitary arrangements at all, some have dry closets (each shared by six to ten families), while a very few have outside W.C.s. The miners, their wives and children do not vary much from those found in S. Ayrshire.

In the one village investigated in *Dumfriesshire* ideal conditions prevail. Housing and sanitation are modern, and children are thus brought up under the best possible conditions. Work is steady, wages are good, and drink and gambling are not prevalent.

The two villages visited in *East Lothian* are rather marked contrasts to each other. One is quite a model village with two-roomed houses, some with gardens in front, and all with good sanitation ; the other is squalid, the majority of the houses having no sanitary arrangements beyond outside dry closets (shared by four families) which drain into ashpits and are in a filthy condition. In a few houses W.C.s have been built recently, and in one 'row' there are baths, but these have no hot water and are placed awkwardly in a position just facing the outer door, and allow of no privacy. As a general rule the houses in this latter village are dirty and poorly furnished, and the children not very well cared for.

Similarly in *Stirlingshire* the good type of village and the bad type of village were visited; one with more or less modern housing and sanitation and the villagers as a rule well-behaved and industrious; and the other with poor housing conditions, lack of modern sanitary arrangements, and on the whole a more indifferent type of villager.

In *Fifeshire* three distinct rural mining districts were studied.

1. Two villages lying within easy access of Dunfermline are ideally situated overlooking the sea. The houses are modern, and consist of two or three rooms with inside scullery and boiler and outside W.C. for each house. There are no ashpits, the refuse being removed daily by carts, so that there is a freshness about the village atmosphere which is lacking in many of the districts studied. The houses are well kept and the children well cared for. There is a fair amount of gambling among the men, but not much drinking.

2. Three other villages are more isolated and therefore more completely rural—indeed some miners in this district live in cothouses on farms. Sanitation is by no means modern here, but the houses are for the most part well-kept and the children are very healthy.

3. Five villages in closer proximity to the towns of Leven, Buckhaven, and Kirkcaldy are distinctly less rural. They have the advantage of trams and buses running through or near them from Leven to Kirkcaldy; but, on the other hand, they have the disadvantage of being extremely close to the pits, making the atmosphere smoky and the general appearance of the houses dirty and uninteresting. The interior of the houses, however, is often surprisingly clean. Sanitation varies from the house with a dry closet outside to the one with installation of water and W.C. inside. As in the other districts both good and bad types of fathers and mothers are found. The general health of the children does not appear to be influenced much by the smokiness of the atmosphere or the sordidness of their surroundings.

These last-mentioned five villages in Fifeshire, along with one (Tarbolton) in Ayrshire, approach more closely the type of dwelling found in Glasgow slum areas than any of the other rural mining districts visited, but of course in the slum districts all the disadvantageous features of the mining villages are exaggerated, while the advantages are reduced to a minimum.

(3) COMPARISON BETWEEN SLUM AREAS OF GLASGOW AND RURAL MINING DISTRICTS

It may be of use to give a brief sketch of the contrasting conditions found in the mining villages and in the slum areas of Glasgow, so as to present some idea of the different environments in which the children are reared.

In the slum district of Anderston, Glasgow, the houses are entirely of the tenement type, and for the most part are one-roomed dwellings.

Blocks of tenements are built in such close proximity that streets in front and courts behind are extremely narrow, and sunlight is almost entirely occluded from the windows of the lower stories. Quite often a ' close ', i. e. a passage leading from a street to a back court beyond, is the only means of access to dwellings which can only be designated as hovels—dark and ill-ventilated.

Housing. Certainly the most striking point of contrast between the two districts lies in the housing. Practically no comparison can be drawn between the fresh, airy cottages of the rural miners, and the close, often foul-smelling rooms of the city slum-dwellers. In the one case practically all the houses are on the ground level—doors and windows constantly open to fresh air and sunlight, broad country roads in front and wide stretches of green fields behind ; in the other, many flights of dirty stone steps lead up to dark ' landings ', round which one has to ' grope ' to distinguish the four or five doors which each lead into one room in which a family has to exist. Here the ground floor, so advantageous to the country dweller, suffers most from lack of sunlight and abundance of street dust ; in some instances after entering the ' close ', a right-angled turning is met with, and then a long passage, inky black even at noonday, has to be traversed before the last door of the ground flat is reached.

In Tarbolton alone, which has been already mentioned as an exception to the general rule of the mining district, some comparison with the city slum-dwellings may be drawn, since the conditions in some of the houses are worse than any that prevail in Anderston. Several miserable hovels were visited in Tarbolton—' closes ' built below the general level of the narrow street, one-roomed houses with such uneven floors and such crumbling walls that pools of stagnant water had collected in the middle of the room. Daylight scarcely ever penetrated there, and no more loathsome sphere of existence can be imagined. In several villages in Fifeshire, as already stated, the atmosphere is smoky and the houses are dark.

Both in the mining area and in Anderston a common feature is overcrowding ; but whereas in the former this is partly due to the presence of perhaps four or five grown-up sons, in the latter overcrowding is more frequently due to the presence of a large family of young children, the older members of the family having gone to other districts and in some instances to other countries in search of work to gain a livelihood.

Sanitation. Sanitation in both districts is far from being modern. Conditions existing in the various mining districts have already been described. In the houses visited in the Glasgow slum area water is in some cases installed, but in others a common sink is found on each ' landing ' and is shared by the four or five families living on that ' floor '. In no cases are there W.C.s used by one family only—never more than one for each landing, and these are almost invariably in a most insanitary condition. The women are better off than the miners' wives, however, as regards laundry, since they can, if willing and energetic enough, take their turn in a municipal washing-house, where they can wash quickly and conveniently with a minimum of labour and expense.

Parental Responsibility. Conditions are so entirely different in the two districts that it is almost impossible to draw fair comparisons; on the one hand the miners have more or less steady work, with wages rarely below £2 per week, and in households with grown-up sons the total income is sometimes as much as £8 or £10 weekly; on the other hand, among the town slum-dwellers unemployment is at present rife, and households exist on the 'dole', supplemented in some cases by the meagre earnings of a wife who goes out 'charing'.

Despite the poverty of the Glasgow slums, drinking is much more prevalent than in the mining districts. In fact when one considers the exorbitant rents of some of these 'hovels' (averaging 7*s.* a week), and the amount of money spent on drink, it is difficult to know how the mothers make ends meet and manage to feed their children at all. There are of course many husbands who are steady and willing to work, but unable to obtain employment.

Maternal efficiency is generally of a lower level among the slum-dwellers than among the mining classes, but of course here again the question of poverty in the slums must not be lost sight of. In the vast majority of the houses visited in the mining area, scrupulous cleanliness of house and children was the rule; indeed it was difficult to understand how women could keep their houses so clean and tidy under such adverse conditions. As a matter of fact a woman's chief ambition seemed to be to keep her house in perfect order, rather than to prepare regular staple meals for her children. The irregularity of meal-times and bed-time referred to in connexion with the miners' homes is also found in Glasgow, but here in addition there is a poorer quality of food, resulting from poverty. A much greater percentage of the houses are dirty and untidy, and none at all come up to the shining perfection of the best type of a well-kept miner's home. The children of the slums are invariably more poorly clad, and in many instances the children's condition cannot be fully explained on the plea of poverty—some of the mothers apparently have no heart to struggle against the difficulties in their way, while others are shamelessly lazy and negligent.

Children. There can be no hesitation in deciding which is the better type of child—in those rural mining villages there are as healthy specimens of childhood as are found in any farm cothouse; while in the slums the typical picture is a pale, pinched, undersized little mortal growing up almost uncared for in a confined and sunless atmosphere. Rickets is, as would be expected, much more common in the slums, and some of those little ragged urchins present very pathetic sights as they attempt to run about on their misshapen limbs. Yet those slum children are surprisingly happy and contented, and they seem cleverer and more alert mentally than country miners' children of corresponding age.

(4) INFORMATION COLLECTED

A series of typical houses was visited in each village and a routine examination carried out, using the booklet given in Appendix II.

1. *Father.* Age, place of birth, occupation, wage, and general habits were ascertained as accurately as possible by questioning the mother.

2. *Mother.* Age, place of birth, health, general habits, and degree of maternal efficiency.

3. *Children.* Complete family history comprising sex and age of each child, number of still-births, miscarriages, &c.; accurate weight and height of each child under six years, with a statement as to child's general condition, age of cutting first tooth, age of walking, and feeding during first year of life.

4. *Housing.* General description of surroundings of house, accurate measurement of size of house, i.e. air-space; rent; condition of house as regards cleanliness, sanitation, ventilation.

(5) RESULTS

(i) General

After the field work was completed, those factors which were deemed most important were 'carded' by the writer in the following order:

CHILD.

Case Number.
Sex.
Age.
Weight in Pounds.
Height in Inches.
Stem Length.
General Health.
Position in Family.

HOUSE.

Cleanliness of House.
Air-space.
Ventilation.
Whether House is isolated or in Village.

MOTHER.

General Health.
Health during Pregnancy.
Maternal Efficiency.
Whether working during Pregnancy.
Weight of Mother.
Height of Mother.
Number of Pregnancies.
Deaths; Miscarriages; Still-births.
Number of Living Children.

GENERAL.

Income.
Income and Rent.
Price of Coal.

Finally five variables were selected for immediate consideration as being those most likely to be related to child life, and the correlations of these to the general condition and to the weight and height of the children were worked out statistically. They are:

Income per Person.
Air-space per Person.
Number of Living Children in Family.
Maternal Health.
Maternal Efficiency.

The correlation of weight to height was also determined and an attempt made to investigate the correlation of the estimate of the physical condition of the child made by the investigator with the height and weight.

1. (*a*) *Weight of Child.* This was estimated accurately by weighing on a spring balance children one to six years, without boots, but with ordinary indoor clothing; infants under one year were weighed with all clothing removed.

(*b*) *Height of Child.* Both total length and stem length were recorded, but only the total length was made use of statistically.

2. *General Condition of Child.* As a result of general inspection each child was classified as being either in good or bad condition

as regards health and nutrition. If a child appeared healthy, well nourished, and mentally alert, it was classed under 'General Condition Good', but if mentally or physically unfit, it was entered under 'General Condition Poor'.

3. *Income per Person.* The father's total income was arrived at by finding out his gross wage, his weekly deductions, and taking as the final figure his net wage. If there were any other wage-earners in the house, their incomes were added to give the total household wage, this total sum being then divided by the number of persons living in the house who were being fed and clothed out of that money. Thus if a lodger paid 30*s.* for board and lodgings, his money was added to household income as he was included as an inmate. But if a couple paid 2*s.* 6*d.* for rent of 'the room', that 2*s.* 6*d.* was added to household income, but the couple did not come under the category of inmates.

4. *Air-space per Person.* Each room was measured accurately, and the total cubic capacity of the house was divided by the number of persons resident in that house.

5. *Number of Living Children in Family.* By this is meant the total number of children living at the time of investigation, including grown-up married sons and daughters and those out 'at service', but since the studies were confined to families with young children, the number of older children included is negligible.

6. *Maternal Health.* This was classified as good or bad estimated from inspection and questioning the mother. If she looked healthy and stated that she felt quite well, she was classed under 'Maternal Health Good'. If, on the other hand, she looked anaemic, cachectic, or otherwise unfit, or if she admitted, on being questioned, that she had been in indifferent or poor health for some time, she was classed under 'Maternal Health Poor'.

7. *Maternal Efficiency.* This was classified as good or bad, as estimated from an inspection of the condition of the children as regards cleanliness, tidiness, and general evidence of care, and from consideration of the condition of the house (see p. 227).

Methods

Averages, with the relevant *standard deviations,* were calculated for factors 1 (*a* and *b*), 3, 4, 5, and subsequently *coefficients of variation* were estimated for these factors.

Then *correlation coefficients* and *correlation ratios* for each factor with all the others were calculated, the ratios being corrected by means of the formula

$$\text{Corrected } \eta^2 = \frac{\text{observed } \eta^2 - \frac{(K-1)}{n}}{\left(1 - \frac{K-2}{n}\right)}.$$

Subsequently *graphs* were drawn by plotting the means of the arrays of two factors at a time, and *calculated regression lines* were superimposed on these graphs, but as these reveal nothing of importance, they are not reproduced in this report.

TABLE 198. *Rural Miners' Families : Means and Standard Deviations.*

BOYS.

	Months.				*Years.*				
Age group	−3	3+	6+	9+	1+	2+	3+	4+	5+
Weight (lb.)	10·0925	15·0873	18·0646	20·5090	24·4072	29·0780	32·6866	35·2140	37·9662
Standard deviation (lb.)	2·2968	2·3920	2·3833	3·1017	3·2140	3·3426	2·5149	2·9939	3·6053
Height (in.)	21·2842	24·3404	26·4017	27·6295	30·4461	33·7789	36·5493	38·9780	40·9797
Standard deviation (in.)	1·6041	1·4661	1·5048	1·8696	2·0886	1·9960	1·8442	1·7818	1·7988
Air-space per person (c. ft.)	519·86	518·07	563·48	542·77	543·82	514·1479	527·11	523·80	496·62
Standard deviation (c. ft.)	264·65	216·24	243·33	262·21	278·55	244·33	275·11	255·30	236·89
No. of living children	3·8356	3·5904	3·7753	3·4699	3·8375	4·2926	4·2465	4·8560	5·0676
Standard deviation	2·9468	2·1820	2·4589	2·5596	2·3395	2·7055	2·4574	2·4216	2·5746
Income per person (shillings)	10·6849	9·8795	10·0562	10·6928	10·5300	9·7508	9·8592	9·5500	9·1892
Standard deviation (shillings)	4·3713	3·9874	4·1334	4·1158	4·4083	3·8881	4·2853	3·5163	3·5540

GIRLS.

	Months.				*Years.*				
Age group	−3	3+	6+	9+	1+	2+	3+	4+	5+
Weight (lb.)	10·0167	13·5246	16·8033	19·1048	22·9971	27·8452	31·8899	34·4297	37·3333
Standard deviation (lb.)	2·1281	2·0026	2·7198	2·7519	3·1243	3·2245	3·2911	3·2091	3·3323
Height (in.)	21·1500	23·7641	25·6567	27·1048	29·8679	33·4716	36·1971	38·6406	40·6181
Standard deviation (in.)	1·6653	1·4980	1·5720	1·6041	1·7857	1·9675	2·1264	1·9361	2·0095
Air-space per person (c. ft.)	515·00	527·465	524·67	587·09	579·66	528·75	544·88	512·109	504·17
Standard deviation (c. ft.)	236·87	246·804	263·80	289·41	321·41	241·02	260·01	227·324	242·06
No. of living children	3·7333	3·5211	3·9867	3·8871	4·0532	3·9853	4·4949	4·5859	5·5417
Standard deviation	2·4315	2·2698	2·5527	2·6732	2·5820	2·4324	2·7432	2·3740	2·5682
Income per person (shillings)	9·9167	10·2817	10·0000	10·1613	10·3707	10·2289	9·8464	9·4727	8·6285
Standard deviation (shillings)	4·0303	4·1794	3·8079	4·4117	4·3426	4·0479	3·5483	3·8631	3·4401

Owing to the fact that the numbers of examples of poor general condition of child, poor maternal health, and poor maternal efficiency, were very few compared with those where these factors were classed as 'good', factors 2, 6, and 7 could be correlated with the other factors only by means of *averages*.

Throughout the whole series of tables the age groups and the numbers included in each group were as given in Table 199.

TABLE 199. *Number of Cases in each Age Group.*

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys .	73	83	89	83	283	311	284	250	148
Girls .	60	71	75	62	263	273	293	256	144

making 328 boys and 268 girls in the first year.

The total number of children dealt with is 3,101, consisting of 1,604 boys and 1,497 girls.

Table 198 gives in tabular form the mean weight, height, air-space, number of living children, and income for all groups of children, with the relevant standard deviations.

There is nothing in the table requiring special comment. As would be expected the mean weights and heights for boys are slightly above the corresponding figures for girls. The mean air-space is remarkably constant, in every case but one lying between 500 and 600 c.ft. The average income per person lies between 9*s*. and 11*s*.

A comparison of these heights and weights with those of town children is given in Charts XXIV to XXVII (pp. 94 to 97).

(ii) CORRELATION OF HEIGHT AND WEIGHT

The correlation coefficients of height and weight are given in Table 200.

TABLE 200. *Correlations : Height with Weight.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
·7869 ±·0300	·4517 ±·0589	·3940 ±·0604	·6204 ±·0456	·7183 ±·0194	·6723 ±·0210	·6244 ±·0244	·4473 ±·0341	·4799 ±·0427
Girls								
·8164 ±·0291	·6584 ±·0454	·5937 ±·0504	·6876 ±·0451	·6565 ±·0236	·5400 ±·0289	·6382 ±·0234	·5627 ±·0288	·4989 ±·0422

As in the case of the town children and the children of agricultural labourers these correlations are consistently high.

(iii) RELATIONSHIP OF THE GENERAL CONDITION OF THE CHILD AS DETERMINED BY THE INVESTIGATOR WITH HEIGHT AND WITH WEIGHT OF THE CHILD

As already stated, the children were divided into two classes, those whose general condition was *good* and those whose general condition was *poor*. No less than 94·4 per cent. of the children were classed as of 'good' condition, only 5·6 per cent. being in bad condition.

TABLE 201. *Average Weights (in Pounds) of Children separately for those in Good and those in Poor General Condition.*

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Condition good .	10·26	15·13	18·09	20·66	24·41	29·22	32·78	35·41	37·99
Condition poor .	8·25	14·25	17·75	16·42	24·25	26·72	31·15	32·75	37·42
GIRLS									
Condition good .	10·14	13·58	16·84	19·30	23·15	28·00	32·01	34·51	37·56
Condition poor .	7·75	9·75	13·75	16·25	20·81	25·64	29·55	32·75	33·86

TABLE 202. *Average Heights (in Inches) of Children separately for those in Good and those in Poor General Condition.*

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Condition good .	21·33	24·32	26·45	27·66	30·44	33·87	36·61	39·03	40·92
Condition poor .	20·75	24·75	25·89	26·75	30·58	32·31	35·35	38·31	42·25
GIRLS									
Condition good .	21·15	23·81	25·67	27·20	29·91	33·56	38·44	38·67	40·68
Condition poor .	21·08	20·75	24·75	25·75	29·22	32·19	34·48	38·02	39·75

The 'condition' of the child determined by inspection is related to its weight for age and to a less extent to its height for age. It thus seems that the growth and nutrition of the child may be fairly assessed by an experienced observer from inspection. This bears out the observations made by Miss Tully (1924 *b*) on school children in Glasgow.

(iv) RELATIONSHIP OF ENVIRONMENTAL AND PARENTAL CONDITIONS WITH THE GROWTH AND NUTRITION OF THE CHILD

(*a*) **Environment.**

A. *Income per Person*

The average income per person per week is given in Table 198 on p. 262. For all the groups the general average is 9·95*s*.

(1) *Income per Person and Weight of Child.*

TABLE 203. *Correlations between Income and Weight of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
−·2076 ±·076	−·0178 ±·074	·1066 ±·071	·2821 ±·068	·1662 ±·039	·3452 ±·034	·1756 ±·039	·0626 ±·043	·0215 ±·055
Girls								
·1921 ±·084	·1338 ±·079	−·0064 ±·078	−·1376 ±·084	·1747 ±·040	·1485 ±·040	·1743 ±·038	·1581 ±·041	·0546 ±·056

Table 203 gives the correlation coefficients of income per person with the weight of the child. It will be seen that these are variable, the only significant ones being in the case of boys aged 9 + months and of boys of 2 + years of age. In none of the girls' groups was the correlation coefficient greater than 0·19, and as its probable error was 0·08 the coefficient became insignificant.

The correlation ratios given in Table 204 are variable, boys aged − 3 months giving 0·27 ± 0·07, and boys aged 2 + years giving 0·33 ± 0·03, while the others are either low or indeterminate.

TABLE 204. *Correlation Ratios. Income per Person and Weight of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
·2702 ±·073	Ind.	Ind.	·2040 ±·071	Ind.	·3304 ±·034	·1902 ±·039	·1413 ±·042	Ind.
Girls								
Ind.	·1854 ±·077	Ind.	·1618 ±·083	·0014 ±·042	·1601 ±·040	·1860 ±·038	·1544 ±·041	·1277 ±·055

(2) *Income per Person and Height.*

TABLE 205. *Correlations between Income and Height of Child.*

Age − 3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
−·1499 ±·077	·0740 ±·074	·0619 ±·071	·0891 ±·074	·0059 ±·040	·2501 ±·036	·1134 ±·040	·1520 ±·042	·0926 ±·055
Girls								
·0298 ±·087	·1568 ±·078	·1002 ±·077	−·1790 ±·083	·0814 ±·041	·1529 ±·040	·1245 ±·039	·2038 ±·040	·1195 ±·055

The correlation coefficients of income per person with height of the child are given in Table 205. This table shows that the correlation coefficients are variable, and most are very low; only in boys aged 2 + and 4 + years and in girls of 2 +, 3 +, and 4 + years are they at all significant.

The correlation ratios of income per person and height of the child are significant only in boys of −3 months and 2 + years, and in girls of 3 + months and 4 + years (Table 206).

TABLE 206. *Correlation Ratios. Income per Person and Height of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
·2615 ±·074	Ind.	Ind.	Ind.	Ind.	·2747 ±·035	·0828 ±·040	·0769 ±·042	Ind.
Girls								
Ind.	·2556 ±·075	Ind.	·2412 ±·081	·0141 ±·042	·1058 ±·040	·0879 ±·039	·1542 ±·041	·0192 ±·056

(3) *Income per Person and General Condition of the Child.*

TABLE 207. *Average Income per Person (in Shillings) of Families with Children in Good and Poor General Condition.*

Age	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Condition good	10·49	10·00	10·03	10·81	10·55	9·83	9·91	9·54	9·29
Condition poor	12·92	7·50	10·38	7·50	10·00	8·47	9·17	9·72	6·67
GIRLS									
Condition good	10·09	10·25	9·97	10·08	10·48	10·36	9·90	9·42	8·63
Condition poor	6·67	12·50	12·50	11·25	8·82	8·33	8·83	10·68	8·61

In Table 207 the average income associated with good and with poor general condition of the child is given. No marked association of the two factors is shown.

There is thus no evidence of a definite correlation between growth and nutrition with income.

(4) *Income per Person and Number of Living Children in the Family.*

TABLE 208. *Correlations between Income and Number of Living Children.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
−·5150 ±·058	−·5250 ±·054	−·6483 ±·042	−·5284 ±·053	−·4790 ±·031	−·4783 ±·030	−·3812 ±·034	−·2190 ±·041	−·2192 ±·053
Girls								
−·6741 ±·048	−·6502 ±·040	−·4321 ±·063	−·6173 ±·053	−·4172 ±·034	−·4517 ±·033	−·3902 ±·036	−·2687 ±·039	−·2696 ±·052

The correlation coefficients of income per person and number of living children in the family are given in Table 208. The figures there given show that the income per person is closely related to the number of living children in the family. The coefficients are invariably negative and high—−·65 to −·22—decreasing with age. This was of course what was to be expected—that with increasing size of family the income per person decreases. The correlations seem to fall with age, probably because the older children are then earning.

(5) *Income per Person and Air-space per Person.*

TABLE 209. *Correlations between Income and Air-space.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
·3287 ±·070	·2488 ±·069	·3875 ±·061	·3563 ±·065	·3390 ±·036	·4166 ±·032	·2795 ±·037	·3572 ±·037	·2576 ±·052
Girls								
·4683 ±·068	·5045 ±·060	·2787 ±·072	·5322 ±·061	·3034 ±·038	·3832 ±·035	·3534 ±·037	·3564 ±·037	·3269 ±·050

The correlation coefficients of income per person and air-space per person, which are given in Table 209, are as a rule high, ranging between 0·25 and 0·53. Since both depend on size of family they are necessarily closely correlated.

B. *Air-space per Person*

As indicated in the main report (p. 135) and as shown later (Table 215), air-space per person is simply a measure of overcrowding and is closely related with the number of living children in the family.

(1) *Air-space per Person and Weight of the Child.*

TABLE 210. *Correlations of Air-space per Person with Weight of Child.*

Age − 3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
·0192 ±·079	·1792 ±·072	−·0519 ±·071	·3119 ±·067	·1447 ±·039	·1758 ±·037	·0941 ±·040	·0894 ±·042	·1710 ±·054
Girls								
·0516 ±·087	−·0103 ±·080	·1598 ±·076	·1151 ±·085	·1320 ±·041	·1332 ±·040	·0818 ±·039	·1333 ±·041	·1347 ±·055

The correlation coefficients of air-space per person and the weight of the child given in Table 210 are practically always insignificant, revealing no definite relationship between the two factors.

The correlation ratios of air-space per person are given in Table 211. These ratios are significant only in boys of 3 + months, 9 + months, and 3 + years. In girls, seven out of nine groups are indeterminate.

TABLE 211. *Correlation Ratios. Air-space per Person and Weight of Child.*

Age − 3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
·1820 ±·076	·3825 ±·063	Ind.	·3255 ±·066	·1017 ±·040	·1451 ±·037	·2775 ±·037	·2113 ±·041	·1878 ±·054
Girls								
Ind.	Ind.	Ind.	Ind.	Ind.	·0858 ±·041	Ind.	·0728 ±·042	Ind.

(2) *Air-space per Person and Height of the Child.*

TABLE 212. *Correlations of Air-space with Height of Child.*

Age − 3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
·0057 ±·079	·2286 ±·070	·0282 ±·071	·0400 ±·074	·0542 ±·040	·1904 ±·037	·1193 ±·040	·2391 ±·040	·2175 ±·053
Girls								
−·0786 ±·087	·0390 ±·080	·2290 ±·074	−·0284 ±·086	−·0087 ±·042	·0949 ±·041	·1319 ±·039	·1912 ±·041	·2631 ±·052

The correlation coefficients of air-space per person and height of the child given in Table 212 are variable in sign and generally low, no coefficient being above 0·26. There is some tendency for the value of the correlations to increase with age.

Among the correlation ratios of air-space per person and height of child, most are indeterminate, the only significant one being boy aged 3 + months (Table 213).

TABLE 213. *Correlation Ratios. Air-space per Person and Height of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
·2042 ±·076	·3651 ±·072	Ind.	Ind.	Ind.	·2060 ±·037	·1140 ±·040	·2463 ±·040	·0755 ±·055
Girls								
Ind.	Ind.	Ind.	Ind.	Ind.	·1157 ±·040	·1297 ±·039	Ind.	·2736 ±·052

(3) *Air-space per Person and General Condition of the Child.*

TABLE 214. *Average Air-space per Person (in Cubic Feet) in Families with Children in Good and Poor General Condition.*

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Condition good .	527·61	518·99	551·22	548·75	535·06	521·16	534·01	522·19	498·59
Condition bad .	433·33	500·00	707·14	383·33	741·67	400·00	403·33	544·44	450·00
GIRLS									
Condition good .	509·65	505·00	521·62	591·38	570·73	534·31	541·01	505·91	505·56
Condition bad .	616·67	1,050·00	750·00	525·00	708·82	450·00	616·66	650·00	483·33

The foregoing table shows no relationship between the general condition of the child and the average air-space per person, possibly, in part, because there were so few examples of children in poor general condition.

There is thus no evidence of any correlation between air-space per person and the weight, height, and general condition of the child. Such a correlation was hardly to be expected as in practically every case the air-space was ample.

(4) *Air-space per Person and Number of Living Children in Family.*

TABLE 215. *Correlations of Air-space per Person with Number of Living Children in Family.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
−·5298 ±·057	−·3354 ±·066	−·4644 ±·056	−·4168 ±·061	−·4231 ±·033	−·4314 ±·031	−·3927 ±·034	−·4231 ±·035	−·4583 ±·044
Girls								
−·4966 ±·066	−·4291 ±·065	−·5054 ±·058	−·5325 ±·061	−·4592 ±·033	−·4401 ±·033	−·3984 ±·033	−·4004 ±·035	−·4672 ±·044

It will be seen that the correlation between the air-space per person and number of living children in the family is naturally negative and high, the larger families having the smaller air-space per person.

C. *Number of Living Children in the Family*

Since the size of the family determines the air-space per person, it might be expected to show the same absence of relationship with the weight and height of the child as is shown by air-space per person.

(1) *Number of Living Children in the Family and Weight of the Child.*

TABLE 216. *Correlations of Number of Living Children in Family with Weight of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
·0468 ±·079	−·1397 ±·073	·0600 ±·071	−·0813 ±·074	−·1895 ±·039	−·0839 ±·038	·0595 ±·040	·0191 ±·043	·0101 ±·055
Girls								
−·0539 ±·087	−·1105 ±·079	−·0498 ±·078	·1085 ±·085	−·0441 ±·042	·1151 ±·040	−·1298 ±·039	−·0584 ±·042	−·0321 ±·056

The correlation coefficients of the number of living children in the family and the weight of the child shown in Table 216 are insignificant throughout all the age groups, indicating no relationship between these two factors.

As regards the correlation ratios of number of living children in the family and weight of child, which are given in Table 216, these are rather more significant in boys than in girls. The ratios for boys aged −3 months, 9+ months, and 3+ years are significant. In the girls only one group—aged −3 months—is significant (Table 217).

TABLE 217. *Correlation Ratios. Number of Living Children in Family and Weight of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
·3319 ±·070	Ind.	·1908 ±·069	·3696 ±·064	·1279 ±·039	·0492 ±·038	·2068 ±·038	Ind.	Ind.
Girls								
·2839 ±·080	Ind.	Ind.	Ind.	·1407 ±·041	Ind.	·0395 ±·039	·0592 ±·042	·1027 ±·056

(2) *Number of Living Children in the Family and Height of the Child.*

TABLE 218. *Correlations of Number of Living Children in Family with Height of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
·0186 ±·079	−·2558 ±·069	·0457 ±·071	−·0108 ±·074	−·1511 ±·039	−·1117 ±·038	−·0202 ±·040	−·0193 ±·043	−·0296 ±·055
Girls								
−·0313 ±·087	−·0643 ±·080	−·0036 ±·078	·1899 ±·083	·0679 ±·041	−·0330 ±·041	−·1497 ±·039	−·1832 ±·041	−·1342 ±·055

The correlation coefficients of the number of living children and height of the child are given in Table 218. Practically all are negative and very low, the only significant one being for boys of 3+ months of age.

The correlation ratios of number of living children in the family and height of child are given in Table 219. Several of the ratios are indeterminate, the significant ones being boys aged −3 months, 9+ months, 1+ year, and 3+ years, and girls aged −3 months and 9+ months.

TABLE 219. *Correlation Ratios. Number of Living Children in Family and Height of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
·3502 ±·069	·1230 ±·073	Ind.	·2690 ±·069	·1736 ±·039	Ind.	·2301 ±·038	Ind.	Ind.
Girls								
·2724 ±·081	Ind.	Ind.	·3371 ±·076	·0802 ±·041	Ind.	·0231 ±·039	·0452 ±·042	·1604 ±·055

(3) *General Condition of the Child and Number of Living Children in Family.*

TABLE 220. *Average Number of Living Children in Families with Children in Good and Poor General Condition.*

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Condition good .	3·82	3·62	3·90	3·43	3·86	4·27	4·26	4·86	5·06
Condition bad .	4·00	3·00	2·29	4·67	3·17	4·61	4·00	4·83	5·33
GIRLS									
Condition good .	3·65	3·54	4·01	3·95	4·02	3·95	4·49	4·57	5·59
Condition bad .	5·33	2·00	2·00	3·00	4·53	4·44	4·53	5·00	4·78

The results shown in the table given above are negative in character. There is no striking variation in the size of family with healthy and with unhealthy children. *The number of living children in the family does not appear to have any relationship with the weight, height, or general condition of the children.*

D. *Diet*

The diets of this class (rural miners) have been considered in the main report on p. 186.

It is there shown that the average energy value is 2,917 calories per man per day by Lusk's standard, and that the amount of fresh milk consumed averages no more than 0·34 pint, expressed per man per day. The energy value is thus intermediate between that of the diets of agricultural labourers and of town slum-dwellers, and the average weight of the miner's child is intermediate between the other two classes (see Charts XXIV to XXVII).

Although we have no records of the height of adults of this class, apart from the general rural population, there is no doubt that they are taller than the average slum-dwellers. Their children are bigger, and the question arises, is this a hereditary character, or is it due to the more liberal diet or to the much greater time spent in the open air?

(*b*) **Parental Conditions.**

A. *Maternal Health*

The possible influence of the mother on the condition of the children is considered in the main report (p. 208).

The number of mothers in poor health was so small—only 9 per cent. —that it was not possible to work out satisfactorily correlation coefficients. The average weight and height of the children of mothers with 'good' health and with 'bad' health are given in Tables 221 and 222.

(1) *Maternal Health and Weight of Child.*

TABLE 221. *Average Weights (in Pounds) of Children of Mothers in Good and Poor Health.*

Age	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Maternal health good	10·14	15·16	18·22	20·63	24·39	29·21	32·72	35·26	37·89
Maternal health poor	9·25	13·75	16·50	18·55	24·61	27·55	32·23	34·71	38·63
GIRLS									
Maternal health good	10·16	13·51	16·81	19·29	22·99	27·76	31·95	34·37	37·45
Maternal health poor	8·00	13·75	16·75	16·95	23·08	28·44	31·42	35·01	36·75

The relationship between maternal health and the average weight of the child, as shown in the foregoing table, yields almost insignificant results. Boys between 3 + months and 1 + year who have unhealthy mothers are definitely lighter than those with healthy mothers, but in the case of the girls the difference is only marked in the groups of − 3 months of age and 9 + months of age.

(2) *Maternal Health and Height of Child.*

TABLE 222. *Average Heights (in Inches) of Children of Mothers in Good and Poor Health.*

Age	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Maternal health good	21·29	24·34	26·42	27·69	30·39	33·88	36·53	39·01	40·91
Maternal health poor	21·25	24·25	26·25	26·75	31·08	32·64	36·71	38·66	41·56
GIRLS									
Maternal health good	21·21	23·78	25·65	25·95	29·87	33·36	36·27	38·62	40·56
Maternal health poor	20·25	23·55	25·75	27·21	29·92	34·24	35·63	38·75	40·87

The average heights of the children as found associated with mothers of good and of poor maternal health are shown in the foregoing table. *The findings, both for boys and for girls, are quite insignificant and reveal no definite association between the size of the child and the health of the mother.*

(3) *Maternal Health and General Condition of the Child.*

TABLE 223. *Correlations between Maternal Health and General Condition of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
—	—	·161 ±·070	—	·373 ±·035	·233 ±·036	·056 ±·040	·204 ±·041	·139 ±·054
Girls								
·829 ±·027	—	—	—	·070 ±·041	·474 ±·032	·056 ±·039	·005 ±·042	·447 ±·045

Here, again, the small percentage of children with mothers not in good health prevented the working out of correlation coefficients except at certain ages. Where sufficient data allowed the calculation of the coefficients these were worked out and are given in Table 223, where it will be seen that the only definitely significant correlations between maternal health and the general condition of the child are for girls of 2+ years and of 5+ years. The other correlation coefficients are positive but insignificant.

(4) *Maternal Health and Income.*

To ascertain how far maternal health is related to income the following averages were worked out:

TABLE 224. *Average Income per Person (in Shillings) of Families of Mothers in Good and Poor Health.*

Age	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Maternal health good	10·51	9·94	10·06	10·64	10·66	9·88	9·88	9·56	9·18
Maternal health poor	13·75	8·75	10·00	11·50	8·93	8·20	9·78	9·46	9·22
GIRLS									
Maternal health good	10·13	10·23	10·04	10·00	10·35	10·23	9·83	9·45	8·46
Maternal health poor	6·88	11·00	9·58	12·00	10·83	10·21	9·92	9·67	9·40

From Table 224 it will be gathered that *there does not appear to be any definite relationship between maternal health and average income; in some cases income is low with poor maternal health, while in others the opposite holds good.*

(5) *Maternal Health and Air-space.*

TABLE 225. *Average Air-space per Person (in Cubic Feet) of Families of Mothers in Good and Poor Health.*

Age	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Maternal health good	506·52	520·25	559·88	537·18	550·00	525·70	523·56	520·26	491·29
Maternal health poor	750·00	475·00	600·00	630·00	466·67	382·00	567·39	558·70	540·63
GIRLS									
Maternal health good	512·50	505·30	534·06	590·35	574·70	519·33	545·19	513·94	503·78
Maternal health poor	550·00	610·00	416·67	550·00	683·33	592·86	542·42	493·48	506·00

Table 225 given above shows the average air-space associated with good and with poor maternal health. *As in the case of income, these averages do not permit of any definite conclusions;* but the few examples of poor maternal health show unusually large or unusually small air-space.

(6) *Maternal Health and Number of Living Children in Family.*

TABLE 226. *Average Number of Living Children in Families of Mothers in Good and Poor Health.*

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Maternal health good	3·96	3·57	3·79	3·49	3·81	4·20	4·25	4·83	5·05
Maternal health poor	1·75	4·00	3·63	3·20	4·09	5·32	4·17	5·13	5·19
GIRLS									
Maternal health good	3·66	3·56	3·83	3·80	4·04	3·92	4·41	4·50	5·63
Maternal health poor	4·75	3·00	5·83	4·40	4·25	4·43	5·18	5·43	5·12

Table 226 gives the average size of family, or, more accurately, the average number of living children in the family which was found associated with good and with poor maternal health. The results will be seen to be rather variable—if anything, there tends to be a slightly higher number of living children in the family where the maternal health is poor, that is, *where the families are large the health of the mother tends to be less good.*

B. *Maternal Efficiency*

The percentage of inefficient mothers was so small, only 7·2 per cent., that correlation coefficients could not be worked out and averages were calculated instead.

(1) *Maternal Efficiency and Weight of the Child.*

TABLE 227. *Average Weights of Children (in Pounds) of Mothers with Good and Poor Efficiency.*

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Efficiency good .	10·07	15·09	18·25	20·72	24·56	29·22	32·80	35·29	38·17
Efficiency poor .	10·35	14·75	16·42	17·75	22·71	26·50	31·64	34·32	35·84
GIRLS									
Efficiency good .	10·08	13·57	17·00	19·17	23·18	28·02	32·05	34·50	37·34
Efficiency poor .	8·25	12·95	12·08	17·75	20·75	25·43	29·80	32·92	37·25

In Table 227 the average weight of the child as found associated with good and with poor maternal efficiency is given. Here quite definite results are seen. In both boys and girls aged − 3 months and 3 + months maternal efficiency is not manifestly correlated with weight of the child, but in boys and girls aged 6 + months a very definite difference in weight is noticed between children associated with good maternal efficiency and those associated with poor maternal efficiency, the advantage being with the former. The marked advantage shown at 6 + months gradually becomes less as the age of the child becomes greater.

(2) *Maternal Efficiency and Height of the Child.*

TABLE 228. *Average Heights of Children (in Inches) of Mothers with Good and Poor Efficiency.*

Age	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Efficiency good	21·25	24·36	26·46	27·78	30·54	33·87	36·64	39·01	41·05
Efficiency poor	21·75	22·75	25·86	25·75	29·40	32·13	35·68	38·61	40·02
GIRLS									
Efficiency good	21·13	23·81	25·78	27·09	29·94	33·54	36·27	38·66	40·73
Efficiency poor	21·75	23·15	22·75	27·42	28·95	32·54	35·32	38·25	39·75

In Table 228 the average height of the child as it was found associated with good and with poor maternal efficiency is shown. As weight and height are so closely correlated, and as weight of child and maternal efficiency are definitely correlated, it is not surprising to find in these results a marked degree of correlation between height of child and maternal efficiency. Children with mothers classed as having poor efficiency are definitely (about one inch on the average) shorter than those children having mothers classed as efficient. As in the corresponding weight tables, it is noticed that the relationship with maternal care is not marked below 9 months, is definite from 9 months up to 4 years, but becomes less apparent again after that age.

(3) *Maternal Efficiency and General Condition of the Child.*

TABLE 229. *Correlations of Maternal Efficiency with General Condition of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
·303 ±·072	—	—	—	·218 ±·038	·021 ±·038	·111 ±·040	·233 ±·040	·647 ±·032
Girls								
—	—	—	—	·539 ±·030	·381 ±·035	·647 ±·023	·359 ±·037	·422 ±·046

An examination of Table 229 given above, which shows the correlations found between maternal efficiency and the general condition of the child, in such age groups as had sufficient data, reveals that among the girls very high correlations are found, varying from ·36±·04 to ·65±·02. Among the boys some are high, e. g. at 4 + years (·23±·04) and at 5 + years (·65±·03), but others are insignificant.

As a general rule, the weight, height, and general condition of the child are associated with maternal efficiency, and this is more evident in the case of girls of all age groups and in boys in the higher age groups.

These results correspond with those revealed by the examination of the data regarding slum families, where it was found that maternal efficiency is the factor most definitely correlated with the growth and nutrition of the child (p. 233). In Dundee the correlation was present at the earliest ages, but in Glasgow, as in these miners' families, it was better marked after 9 months of age and tended to decrease towards the sixth year.

The question of what factors modify maternal efficiency was examined. It appeared possible that the health of the mother, on the one hand, and, on the other, poverty and overcrowding, as indicated by the air-space per person, income per person, and the number of living children in the family, might each or all be related to her efficiency.

(4) *Maternal Efficiency and Maternal Health.*

The relationship between these two factors is shown in Table 230.

TABLE 230. *Correlations between Maternal Efficiency and Maternal Health.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
—	—	·078 ±·071	·598 ±·048	·454 ±·032	·454 ±·030	·309 ±·036	·156 ±·042	·351 ±·049
Girls								
·652 ±·050	·347 ±·070	·459 ±·061	—	·373 ±·036	·078 ±·041	·284 ±·036	·337 ±·037	·272 ±·052

The percentages of cases with maternal health poor and with maternal efficiency poor were so small that it was not possible to work out correlation coefficients at all ages. From the foregoing table it will be seen that *fairly high correlations are found between maternal efficiency and maternal health*, particularly in boys at 9 + months, 1 + year, and 2 + years, and in girls at − 3 months and at 6 + months. Other correlations are lower than these, but all are positive and nearly all are of significant value.

(5) *Maternal Efficiency and Income per Person.*

TABLE 231. *Average Income per Person (in Shillings) of Families of Mothers with Good and Poor Efficiency.*

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Efficiency good .	10·62	9·84	10·25	10·78	13·00	9·88	10·07	9·63	9·31
Efficiency poor .	11·50	12·50	9·38	9·58	8·59	7·34	7·96	8·69	7·73
GIRLS									
Efficiency good .	10·09	10·42	10·10	10·29	10·47	10 47	10·03	9·56	8·69
Efficiency poor .	5·00	8·50	7·50	7·50	9·13	6·97	7·50	7·71	8·13

Table 231 shows the average income associated with good and with poor maternal efficiency. *This table seems to indicate a relationship* *between maternal efficiency and income per person*; apparently more inefficient mothers are found in the poorer families. This contrasts in degree with the results found among the slum families in the towns (see p. 235).

(6) *Maternal Efficiency and Air-space per Person.*

TABLE 232. *Average Air-space per Person (in Cubic Feet) of Families of Mothers with Good and Poor Efficiency.*

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Efficiency good .	522·06	520·12	576·25	553·89	553·46	520·00	537·74	523·75	506·57
Efficiency poor .	490·00	350·00	450·00	400·00	434·78	406·25	425·93	426·19	372·73
GIRLS									
Efficiency good .	518·97	514·39	530·56	597·46	578·39	537·79	549·63	510·65	513·28
Efficiency poor .	400·00	490·00	383·33	383·33	683·33	407·89	483·33	541·67	431·25

In Table 232 is given the average air-space per person as found associated with good and with poor maternal efficiency. These averages are somewhat inconclusive, probably because there are so few examples of poor maternal efficiency. In many cases of good maternal efficiency the air-space was unusually high. In the case of boys the average air-space for those associated with poor maternal efficiency is definitely below the total average.

(7) *Maternal Efficiency and Number of Living Children in the Family.*

TABLE 233. *Average Number of Living Children in Families of Mothers with Good and Poor Efficiency.*

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Efficiency good .	3·90	3·60	3·66	3·43	3·75	4·27	4·17	4·83	5·06
Efficiency poor .	3·00	3·00	4·78	4·00	4·83	4·56	5·00	5·09	5·18
GIRLS									
Efficiency good .	3·60	3·40	3·98	3·75	4·00	3·89	4·43	4·56	5·49
Efficiency poor .	7·5	4·60	4·00	6·67	4·60	5·21	5·33	5·17	5·94

In Table 233 the average number of living children in the family as found associated with good and with poor maternal health is given. The table suggests that in boys from 6 months and in girls from under 3 months where maternal efficiency is poor there are more children in the family.

Maternal efficiency in this class seems to be related to the income and to overcrowding as indicated by the number of living children and the air-space per person. This seems to indicate that the small number of women classed as inefficient occur among the worst paid miners and those with overcrowded houses.

In the main report, it is shown by means of partial correlations, dealing with maternal efficiency, maternal health, air-space per person, income per person, and size of family, that the dominant factor related to the size and nutrition of the child is maternal efficiency. Unfortunately in this study of miners' families partial correlations were not worked out, but since it is shown that weight and height are closely related to the efficiency of the mother, and that they are only slightly related to the income and air-space per person and to the size of the family, *it seems clear that maternal efficiency is the important factor.*

(6) CONCLUSIONS

The results of the study of the relationship of these various environmental and parental factors in the miners' families correspond closely with those obtained in the slum families of the cities. Poverty and overcrowding do not reveal the expected association with the growth and nutrition of the child, while the health of the mother, unless in so far as it modifies her efficiency, is not obviously related. The efficiency of the mother shows the same correlation with growth and nutrition of the child as was found in the slum families.

This investigation seems to indicate that in Scotland the families of the rural coal-miners are reared under environmental conditions altogether superior to those under which the slum child of our great cities grows up. They spend more time in the open air, they are better fed, and, in the vast majority of cases, have the advantage of good maternal care.

PART VIII. AN INVESTIGATION OF THE RELATIONSHIP OF THE GROWTH AND NUTRITION OF THE CHILDREN OF AGRICULTURAL LABOURERS IN SCOTLAND TO ENVIRONMENT

By Olive M. Somerville, M.B., Ch.B.

CONTENTS

(1) OBJECTS OF THE INVESTIGATION

The main objects of this investigation were: (1) to determine what particular factor or factors have most influence on the growth and development of children in rural areas; (2) to compare the effects of rural and urban conditions on child life; and (3) to throw light upon the reputed agricultural poverty.

As environmental home conditions may be considered to have most influence on children during the earlier years of life before school age (see p. 28), only those under 6 years of age were considered. Data were collected for over 3,000 children in typical agricultural areas of Scotland, including Forfarshire, Fifeshire, Perthshire, East Lothian, Berwickshire, Ayrshire, Dumfriesshire, and the island of Lewis. The field work was done in part by the writer, and by Dr. C. A. S. Blair, Miss Crawford, Dr. L. M. Dickson, Miss

Kerr, Miss MacNae, Miss Swanson, Miss Urie, and the Drs. A. J. and C. B. Macleod (Lewis), to all of whom acknowledgements are due. The most scattered and isolated cottar-houses were visited by these workers and the conditions in each thoroughly investigated and recorded.

All children under 6 years were weighed, those under 1 year without clothes, above 1 year in ordinary indoor clothing without boots (see p. 35). The height and stem length were also taken. The schedule headings used in making the inquiry are given in Appendix II. Particular attention was paid to the maternal care of the children and home, total weekly income, air-space, housing and sanitation, and general condition of the children.

(2) GENERAL AND LOCAL CONDITION OF COMMUNITIES STUDIED

In the areas investigated conditions did not vary to any great extent. The housing and sanitation were better in some parts than others, and the wages and perquisites varied according to the prosperity or generosity of the farmers. With very few exceptions the people belonged to Scotland and the majority were living in their native county. In most cases the men were ploughmen, but a few cattlemen, dairymen, 'orra' men, shepherds, gamekeepers, rabbit-catchers, and foresters were encountered. The men lived open-air lives, rising early in the morning and spending the whole day from 6 a.m. to 6 p.m. in the fields. They were contented and industrious, and seemed to care for the home. No cases of heavy drinking were detected in any of the districts investigated by the writer.

Wages. The wages varied in each county according to the perquisites, the money value of which was calculated from data obtained from various sources; the average wage, including perquisites, was found to vary between 40*s.* and 45*s.* per week, i. e. 8*s.* and 9*s.* per person. The house was rent free in all cases, and meal, milk, and potatoes were allowed in varying amounts—some gamekeepers were also allowed coal and light. The men almost invariably handed over their entire pay to their wives for household uses, and the cost of their tobacco, which in many cases amounted to 2*s.* to 3*s.* weekly, was included in this.

Mothers. The mothers had mostly been field-workers or domestic servants before marriage. The majority were healthy and energetic, rising early in the morning, working hard all day, and going early to bed. Very little illness was to be found among them. Many helped at the farm and did the milking morning and evening, for which they received 5*s.* to 8*s.* weekly. On the whole the houses were kept clean and tidy, and the children were well cared for, though one met with isolated instances of neglect. Good wholesome food was cooked for the family at regular hours. Porridge and milk, soups and stews were prepared, and many mothers baked scones and oatcakes daily. As the towns were so far away, the shopping was done almost entirely from carts which came out from the towns once or twice weekly.

Housing. On the whole the housing was good. The houses stood singly or two together, seldom more, generally at some distance from the farm and surrounded by fields and open country. Many were in exposed positions and at high altitudes. The majority had a small garden in which vegetables were grown for home consumption. The houses had one, sometimes two rooms and a kitchen, all on the ground floor. The rooms were small, the ceiling seldom being more than 8 feet high, but the average air-space per person was 750 c. ft., being more than twice that of town dwellers of the same social standing. Through ventilation was possible in all cases and was used by the majority. The rooms were well lighted with good-sized windows. Many of the houses, however, were damp. There were almost invariably box-beds in the kitchen. In many cases the kitchen only was used and the sitting-room was unfurnished.

Sanitation. The sanitation, though varying in each district, was poor. Water-closets were the exception, and even dry closets were not provided in all districts. There was occasionally water in the house, but generally it was got from a pump outside, and in many cases had to be carried some distance.

In all the districts very little disease was found, the majority of the people being strong and healthy. There was practically no tuberculosis or venereal disease. The moral tone was moderately good. The children were sturdy, well clothed, and lived practically the whole day out of doors.

Comparison of the Districts investigated

Ayrshire. The farms in Ayrshire were small and many of them had only one cothouse, which was often some distance from the main road and approached by a muddy lane which led on to the farm-house. The usual house consisted of two rooms on the ground floor, but sometimes there were three or even four rooms. They were well lighted and ventilated but often damp. The sanitary arrangements were poor; no water-carriage system was found in any of the districts. The ploughman's wage varied from 26*s.* to 42*s.* weekly with, in most cases, 20 stones meal and one ton potatoes yearly, sometimes also one quart milk daily. Cattlemen got meal, milk, and potatoes *ad lib.*, and in some cases butter as well. Gamekeepers got coal and light. The children were well cared for, sturdy, and well developed, and practically no disease was to be found among them.

Dumfriesshire. The conditions here were very similar to those in Ayrshire. The people seemed to be fairly comfortable and did not have great difficulty in making ends meet. The cothouses were mostly single with two rooms on the ground floor. The majority of the houses had no sanitary arrangements whatever. Wages varied from 30*s.* to 38*s.* weekly with 20 stones meal and 10–20 cwt. potatoes yearly, and milk one quart daily or any amount at a cheap rate. Gamekeepers also got coal and light, rabbits and game.

Fifeshire and Forfarshire. The farms in these counties were small and had one or two cothouses at the most, and always a bothy attached for the unmarried ploughmen. The usual house was of one story with two rooms, some of them being very old and dilapidated. The sanitation was mostly by dry closets, but on several farms water-closets were provided. The farm labourer's wage ran from 23*s.* to 28*s.* weekly with valuable perquisites amounting to about 17*s.* weekly. In Fife the perquisites were five pecks (one peck = one-quarter bushel) meal and five pecks flour monthly, two loads (i. e. about three tons) potatoes yearly, two quarts milk daily, and a free house. In Forfar five stones meal monthly, one ton potatoes yearly, three pints milk daily, and a free house were provided.

East Lothian and Berwickshire. The farms here were much larger and often had a row of eight to ten cottar-houses attached. They were usually by the side of the road and seldom had any garden. The houses were as a rule two-storied with two rooms on the ground floor and two above, but the upstairs rooms had sloping beamed ceilings, and were seldom used except for lumber. Many were damp and poorly ventilated. The sanitation was very poor. In more than half the cases visited there were no sanitary arrangements at all. The wages averaged between 33*s.* and 38*s.* weekly, two loads (i. e. about three tons) potatoes yearly being the only perquisite. Milk was scarce ; in no cases was it given free. For this reason a large number of the children were brought up on Nestlé's Condensed Milk and other patent foods. The babies sometimes appeared small and the children not nearly so big and healthy as those in other parts, e. g. Ayrshire. The people did not appear to be so well off, and in many cases had great difficulty in providing adequately for the family. Porridge was not partaken of so freely as in the other districts mentioned, probably because of the scarcity of milk and the fact that oatmeal was not included among the perquisites. The houses were fairly well kept on the whole, though more cases of dirt and neglect were found than in the isolated cothouses of other parts. No more cases of rickets were found than in other districts.

Island of Lewis. The conditions in Lewis differed markedly from those in the districts already mentioned. The men were practically all crofter fishermen, and the income varied according to the weather and the season. The housing was very primitive, about one-third being the so-called ' black houses '. These were built of rough stones without mortar, and had a thatched roof. The walls were whitewashed inside and the floors were of earth and clay. A hole in the roof served the purpose of a chimney, and a fire of peat was in the middle of the kitchen floor. The cattle were often kept beyond the kitchen, separated from it by a wooden partition. Lately houses of two stories with corrugated iron roofs, chimneys, and grates have been constructed. In the black houses there were no sanitary arrangements. In spite of the poor housing conditions the children appeared to thrive. They were sturdy and well developed, and their average weights and heights closely approximated those of the other rural areas investigated. The maternal care of the children was good and they were suitably fed, though at certain times (e. g. in the winter of 1922) it was impossible to give them all they desired. The maternal health was good on the whole. The children lived practically the whole day out of doors and the infants were taken out regularly. (See Noël Paton (1922).)

(3) COMPARISON BETWEEN RURAL AND URBAN DISTRICTS

Great difficulties were encountered in comparing conditions in town and country. The slum areas of Glasgow, Edinburgh, and Dundee were investigated by various workers, and the writer spent some time in March 1924 in visiting the poorer parts of Edinburgh and Glasgow. So far as possible the families studied in the rural areas were selected as being of the same social class and in similar economic conditions to those investigated in the towns. Due allowance, of course, had to be made for perquisites customarily given to agricultural workers.

The majority of the population of these cities was housed in high tenement buildings of four stories, each family occupying one or two rooms, seldom more. The streets were narrow, situated in the heart of the city, and surrounded by rows and rows of similar houses, shops, and factories, so that the sun rarely penetrated. The air was smoky and contaminated. There was the continual noise of traffic.

Housing. The houses themselves were dark and cheerless. They were approached directly from the street by a dark 'close', steps and dark passages; often five or six doors opened on a common landing. The rooms were small and generally crowded with furniture, concealed beds always being found in the kitchen. The ceilings were rarely more than 8 ft. high. In these one or two rooms a family of ten or more would often be found. The average cubic space per person was 350 c. ft. as compared with 750 c. ft. in the country. The lighting was often very poor, especially in the lower stories of the buildings. The ventilation was fairly good in some cases. In Edinburgh many of the houses opened on to a wooden balcony, and the two rooms formed the whole width of the building—so that through ventilation could be procured. The rooms were also larger and the ceilings higher, but there were a great many single-roomed houses. On the whole the buildings were less lofty and the streets were wider in Edinburgh than in Glasgow.

Sanitation. In most cases there was one water-closet for each flat, i. e. three or four houses.

Parents. The parents in the towns were of a totally different type from those in the country. Many of the fathers of the city children were unemployed, and those who were employed worked short hours, did not rise till 8 or 9 a.m., and were correspondingly late at night. Among them there was a good deal of drinking and betting, and nearly all were heavy smokers. The ploughman invariably started the day at 6 a.m. or sooner, and he seemed to take more interest in his home and children.

In the towns the mothers were generally small and anaemic-looking, and not as a rule energetic; many kept their houses clean and looked after their children well, but the majority appeared to have given up the attempt as useless.

Diet. The feeding in town was quite different from that in the country. Meals were at irregular hours, and frequently there was no properly cooked midday meal. Very little milk was purchased, so few had porridge and milk in the mornings.

Income. In the city the fathers were of various occupations, including factory workers, vanmen, railway-men, porters, tram conductors, shop assistants, and labourers of all kinds. The weekly wage varied between 40*s.* and 60*s.* The unemployed married man got 27*s.* 6*d.* and 1*s.* for each child ; in many cases they also got parish relief. From this a rent of 5*s.* to 10*s.* per week was paid and the rest went for food and clothing, though in many cases the father kept back a large part for his own use. In the country, though the wages were lower, the houses were free, so that the whole income was available for food and clothing, and the father, in most cases, handed the whole wage to the mother for household use.

Children. The town children appeared to be poorly developed, often pale, and, in Glasgow, frequently rachitic, thus forming a striking contrast to the country children, who were sturdy, well developed, and rosy cheeked, and in whom rickets was almost non-existent. The clothing of the urban child was often scanty and ragged ; the infants were not taken out regularly owing, in many cases, to the height of the buildings.

(4) RESULTS

(i) General

With the data collected by the various workers the results were worked out by statistical methods. The factors to be dealt with were carded, the weights being taken to the nearest half-pound and the heights to the nearest quarter-inch, and age arranged in groups of three months below one year and of twelve months above one year, i. e. group 0 to 3 months contained all children up to, but not including, 3 months ; group 1 to 2 years contained all children of 1 year up to, but not including, 2 years. The variables selected were the same as those dealt with in the urban studies : (1) Weight, (2) Height, (3) Income per person, (4) Air-space per person, (5) Number of Living Children, (6) Maternal Health, (7) Maternal Efficiency, (8) General Condition of Child.

The weights and heights were taken in groups of 2 lb. and 2 in. respectively, air-space in groups of 100 c. ft., income in groups of 5*s.* The maternal health, efficiency, and condition of child were only grouped in two classes, 'good' and 'bad'. As the houses were free, only the income available for household purposes was used, and the total income was arrived at by an inclusion of the value of the perquisites estimated from data obtained from various sources. To arrive at the income per person the total income thus obtained was divided by the number of people in the house.

Of the cases recorded 2,783 were found to have the full data necessary for statistical treatment. They are distributed in age groups as follows :

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys .	69	57	58	60	321	246	286	188	128
Girls .	55	72	74	60	246	263	276	167	157

The means and standard deviations of the several variables are given in Tables 234 and 235.

TABLE 234. *Means and Standard Deviations.*

Boys and Girls 0–12 months.

	Age.	*Mean weight.*	*Standard deviation.*	*Mean height.*	*Standard deviation.*	*Mean air-space.*	*Standard deviation.*	*Mean No. of living children.*	*Standard deviation.*	*Mean income per person.*	*Standard deviation.*
	Months.	lb.	lb.	in.	in.	c. ft.	c. ft.			Shillings.	Shillings.
BOYS	−3	10·45	2·13	21·71	1·91	697·83	235·74	3·75	1·97	8·62	2·90
	3+	14·38	2·38	24·50	1·44	728·95	455·90	3·25	2·02	8·77	2·97
	6+	18·16	2·17	26·72	1·61	751·72	394·83	3·36	2·71	8·84	3·51
	9+	20·18	2·67	27·70	1·78	785·00	468·80	3·67	2·69	9·54	3·62
GIRLS	−3	8·87	1·86	20·95	1·34	715·45	328·59	3·6	2·57	8·72	3·28
	3+	14·00	2·96	24·10	1·65	805·56	424·88	3·5	2·37	9·37	3·53
	6+	17·07	2·60	26·20	1·69	758·11	373·69	3·38	2·25	9·29	3·38
	9+	19·25	2·09	27·52	1·62	735·00	369·38	3·2	2·33	9·17	3·05

TABLE 235. *Means and Standard Deviations.*

Boys and Girls 1–5 years.

	Age.	*Mean weight.*	*Standard deviation.*	*Mean height.*	*Standard deviation.*	*Mean air-space.*	*Standard deviation.*	*Mean No. of living children.*	*Standard deviation.*	*Mean income per person.*	*Standard deviation.*
	Years.	lb.	lb.	in.	in.	c. ft.	c. ft.			Shillings.	Shillings.
BOYS	1+	25·24	2·94	31·44	1·87	788·01	364·16	3·36	2·28	9·55	3·32
	2+	29·47	3·24	34·84	1·86	760·57	375·99	3·63	2·17	8·97	3·20
	3+	33·60	3·38	37·91	1·83	722·73	356·36	3·92	2·24	8·60	2·81
	4+	36·73	3·84	40·35	1·86	681·91	350·62	4·47	2·29	8·32	2·53
	5+	40·36	4·67	42·42	1·80	662·89	283·63	4·57	2·31	8·12	2·63
GIRLS	1+	23·94	3·13	30·74	1·99	749·59	357·01	3·16	2·00	9·31	3·26
	2+	28·23	3·15	34·42	1·86	793·92	374·26	3·66	2·38	9·23	3·09
	3+	32·23	3·60	36·13	1·96	684·06	339·01	4·18	2·53	8·71	2·82
	4+	35·34	3·53	39·74	1·80	697·60	326·45	4·10	2·12	8·40	3·25
	5+	38·52	4·10	41·82	2·03	662·10	320·79	5·06	2·76	8·23	2·97

In Tables 236 and 237 a comparison is shown of the heights and weights of these agricultural labourers' children with the average heights and weights of the children of the three towns studied in the main report and with the heights and weights of the children of the Island of Lewis. It will be seen that the average weight and height of the town children, with the exception of girls under 3 months of age, are lower than either the country or the Lewis figures. The Lewis children are slightly shorter but heavier than the country children in the mainland of Scotland.

TABLE 236. *Weights of Rural, Urban, and Lewis Children (in Pounds).*

	Boys.			Girls.		
Age.	*Rural.*	*Urban.*	*Lewis.*	*Rural.*	*Urban.*	*Lewis.*
−3 months	10·45	9·88	—	8·87	9·38	—
3+ ,,	14·38	13·46	—	14·0	12·32	—
6+ ,,	18·16	16·11	—	17·07	15·63	—
9+ ,,	20·18	18·54	—	19·25	17·20	—
1+ years	25·24	21·32	26·73	23·94	20·42	22·58
2+ ,,	29·47	26·14	29·71	28·23	25·09	26·89
3+ ,,	33·60	30·07	34·04	32·23	28·05	32·38
4+ ,,	36·73	33·01	37·19	35·34	31·98	36·70
5+ ,,	40·36	37·13	37·00	38·52	35·58	38·50

TABLE 237. *Heights of Rural, Urban, and Lewis Children (in Inches).*

	Boys.			Girls.		
Age.	*Rural.*	*Urban.*	*Lewis.*	*Rural.*	*Urban.*	*Lewis.*
−3 months	21·71	21·42	—	20·95	21·17	—
3+ ,,	24·50	23·85	—	24·10	23·27	—
6+ ,,	26·72	25·40	—	26·20	25·10	—
9+ ,,	27·70	26·86	—	27·52	26·45	—
1+ years	31·44	29·47	31·01	30·74	29·47	29·30
2+ ,,	34·84	32·87	34·25	34·42	32·96	33·20
3+ ,,	37·91	35·80	37·52	36·13	35·28	36·04
4+ ,,	40·35	38·16	40·13	39·74	37·92	38·64
5+ ,,	42·42	39·84	40·68	41·82	39·03	40·96

(ii) CORRELATIONS OF WEIGHT WITH HEIGHT

The correlations of weight with height are given in Table 238.

TABLE 238. *Correlations of Weight with Height.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
·7395 ±·037	·5275 ±·065	·5567 ±·061	·4918 ±·066	·6491 ±·022	·5930 ±·028	·6042 ±·025	·5349 ±·035	·5662 ±·041
Girls								
·7121 ±·045	·7396 ±·036	·5486 ±·055	·6774 ±·047	·7444 ±·019	·6426 ±·024	·6480 ±·024	·5909 ±·034	·6769 ±·029

These correlation coefficients are uniformly high and agree with the similar correlation coefficients for height and weight as found in the main report.

(iii) Correlation of the General Condition of the Child, as determined by the Investigator, with the Height and Weight of the Child

An attempt was made to test the relationship of the general condition of the child, as determined by inspection, with its height and with its weight. The condition of the child was regarded by the investigator as good if he was well nourished, well developed, and showed no signs of chronic disease or serious acute disease. If the child was suffering from an acute infectious disease but was otherwise well developed he was classed as in good condition. Since between 96 and 97 per cent. of these children were assessed as in good condition, the resultant group assessed as in poor condition (3–4 per cent.) was so small that the ordinary methods of working out correlations could not be adopted, and tables showing the relationship of the average height and average weight of the child with its general condition were constructed.

Table 239. *Average Weights (in Pounds) of Children in Good and Poor General Condition.*

Age	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys									
Condition good	10·67	14·48	18·28	20·39	25·29	29·52	33·70	36·82	40·50
Condition poor	6·75	11·75	16·08	17·25	23·04	27·61	30·93	33·55	37·89
Girls									
Condition good	9·09	14·13	17·25	19·25	24·02	28·25	32·47	35·33	38·64
Condition poor	6·75	11·08	10·75	No data	21·04	26·75	27·95	35·75	35·42

Table 240. *Average Heights (in Inches) of Children in Good and Poor General Condition.*

Age	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys									
Condition good	21·80	24·53	26·84	27·80	31·47	34·87	37·96	40·36	42·39
Condition poor	20·25	23·75	24·42	26·25	30·18	33·75	36·75	39·95	43·04
Girls									
Condition good	21·03	24·21	26·26	27·52	30·80	34·46	37·49	39·74	41·86
Condition poor	20·15	21·42	23·75	No data	28·46	31·42	35·42	39·75	40·75

From Tables 239 and 240 it will be seen that the children judged by the investigators to be in poor condition were found on the average to be below the height and weight of the children judged to be in good condition.

From these tables, it is obvious that the *assessment of the condition of the child by inspection by a trained observer is in agreement with the assessment of growth and nutrition by height and weight.*

(iv) The Relationship of Environmental and Parental Conditions with the Growth and Nutrition of the Child

(a) Environment.

A. *Income per Person*

(1) *Income per Person and Weight of Child.*

Table 241. *Correlations of Income per Person with Weight of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
·0008 ±·081	·0116 ±·089	−·0330 ±·088	·4637 ±·068	·0065 ±·038	·0218 ±·043	·0675 ±·040	·0392 ±·049	−·1027 ±·059
Girls								
·1234 ±·090	·1777 ±·077	·3063 ±·071	·3667 ±·075	·1064 ±·043	·1465 ±·041	·0712 ±·040	·0401 ±·052	·1105 ±·053

In Table 241 the correlation coefficients of income per person and the weight of the child are practically of no significance except in boys and girls aged 9 + months and in girls aged 6 + months. In all but two groups the correlation is positive, but in many cases smaller than the probable error.

The correlation ratios given in Table 242 confirm the results of the correlation coefficients.

Table 242. *Correlation Ratios. Income per Person and Weight of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
Ind.	Ind.	Ind.	·4470 ±·070	Ind.	Ind.	Ind.	Ind.	·1626 ±·058
Girls								
·3351 ±·081	·2256 ±·075	·2698 ±·073	·2810 ±·080	Ind.	·1019 ±·041	·0867 ±·040	Ind.	Ind.

(2) *Income per Person and Height of Child.*

Table 243. *Correlations of Income per Person with Height of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
·0219 ±·081	·0156 ±·089	−·2283 ±·084	·1581 ±·085	·0362 ±·038	·0634 ±·043	·0770 ±·040	·1433 ±·048	·2331 ±·056
Girls								
·0166 ±·091	·1867 ±·077	·0791 ·078	·2479 ±·082	·1259 ±·042	·1643 ±·040	·0729 ±·040	·1591 ±·051	·2129 ±·051

An examination of Table 243 giving *the correlation of income per person with height of child reveals little relationship between these two factors.* Very few of the coefficients are significant; all are low and, in most cases, less than the probable error. The ratios are also small, but show a definite correlation in several age groups, specially marked in boys aged 6 + months and 9 + months.

The correlation ratios shown in Table 244 are very small, but show a definite correlation in several age groups specially marked in boys aged 6 + and 9 + months.

TABLE 244. *Correlation Ratios : Income per Person and Height of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
Ind.	·1397 ±·088	·3679 ±·077	·3495 ±·076	Ind.	·1216 ±·042	Ind.	·1078 ±·049	·2197 ±·057
Girls								
·2329 ±·086	Ind.	Ind.	·1176 ±·086	·0206 ±·043	·1638 ±·040	·1479 ±·040	·0748 ±·052	·1411 ±·053

(3) *Income per Person and General Condition of the Child.*

TABLE 245. *Average Income per Person (in Shillings) of Families with Children in Good and Poor General Condition.*

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Condition good .	8·58	8·82	8·77	9·69	9·58	8·98	8·63	8·27	8·10
Condition poor .	9·37	7·50	10·00	7·50	8·21	8·93	7·95	10·50	8·21
GIRLS									
Condition good .	8·95	9·53	9·34	9·17	9·34	9·25	8·69	8·41	8·19
Condition poor .	6·50	5·83	7·50	No data	8·21	7·50	9·17	7·50	9·17

Since the proportion of children classed as in poor condition was so small—some 3–4 per cent.—correlation coefficients were not worked out, and the average incomes associated with 'good' and 'poor' condition of the child are given in Table 245. *They show a want of relationship between income and the condition of the child.*

(4) *Income per Person and Number of Living Children in Family.*

TABLE 246. *Correlations of Income per Person with Number of Living Children in Family.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
−·7100 ±·040	−·6608 ±·050	−·6417 ±·052	−·5201 ±·064	−·5940 ±·024	−·5820 ±·028	−·5154 ±·029	−·5531 ±·034	−·5996 ±·038
Girls								
−·5145 ±·067	−·5634 ±·054	−·6275 ±·047	−·7047 ±·044	−·3833 ±·037	−·6151 ±·026	−·4582 ±·032	−·5838 ±·034	−·3504 ±·047

From Table 246 it will be seen that high negative correlations are found between the income per person and the number of living children in the family. This result, indicating that the larger the family the smaller the income per person, might be expected when it is remembered that the income of the ploughman does not vary to any great extent.

(5) *Income per Person and Air-space per Person.*

TABLE 247. *Correlations of Income per Person with Air-space per Person.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
·4297 ±·066	·2598 ±·083	·5681 ±·060	·5762 ±·058	·4816 ±·029	·5584 ±·030	·5216 ±·029	·4556 ±·039	·5292 ±·043
Girls								
·5293 ±·065	·5650 ±·054	·7184 ±·038	·4881 ±·066	·5418 ±·030	·5282 ±·030	·4572 ±·032	·5363 ±·037	·4681 ±·042

The correlation coefficients of income per person and air-space per person are given in the foregoing table. Since the income per person and the air-space per person are both dependent on the size of the family, a close relation between these two factors may be expected. The correlations, which are uniformly significantly high, show this expected relationship.

B. *Air-space per Person*

Air-space per person is simply a measure of overcrowding. In these families of agricultural labourers the air-space was generously ample, averaging 750 c. ft. per person, and the children spent a large part of their time in the open air.

(1) *Air-space per Person and Weight of the Child.*

TABLE 248. *Correlations of Air-space per Person with Weight of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
−·0894 ±·081	·1027 ±·088	·0757 ±·088	·4308 ±·071	·0264 ±·038	·0095 ±·043	·0528 ±·040	·0159 ±·049	·2121 ±·057
Girls								
−·0701 ±·091	·0773 ±·079	·0765 ±·078	·2131 ±·083	·0095 ±·043	·0999 ±·041	·0638 ±·040	·1373 ±·051	·0937 ±·053

Table 248 gives the correlations of air-space per person with the weight of the child at different ages. From these results there appears to be no association between the air-space per person and the weight of the child. The correlation coefficients are all positive but low, and in most cases smaller than the probable error. The only significant correlations are in boys and in girls of 9 + months.

Correlation ratios for these two factors were also calculated and are given in Table 249.

TABLE 249. *Correlation Ratios. Air-space per Person and Weight of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
Ind.	Ind.	Ind.	·1110 ±·086	Ind.	Ind.	·0783 ±·040	Ind.	·0446 ±·059
Girls								
Ind.	Ind.	Ind.	·3491 ±·076	·0013 ±·043	·1988 ±·040	Ind.	·0191 ±·052	Ind.

The correlation coefficient results are confirmed by the ratios, which were found to be either indeterminate or insignificant except in girls of 9 + months of age.

Graphs were constructed by plotting the means of the arrays in order to see whether the weight varied in any definite manner for each 100 c. ft. increase of air-space per person, but no definite trend could be made out. Regression lines were also calculated and drawn in the graphs. The slope of these regression lines gives a means of measuring the degree of correlation or association of variation between the variables. In the groups of both boys and girls aged under 3 months the line sloped gradually downwards, showing only a slight correlation which was negative. In the groups above 9 months of age the line sloped upwards more or less rapidly. These graphs have not been reproduced.

It was thus found that air-space per person, i. e. the degree of overcrowding in this community, has no definite relationship to the weight of the children.

(2) *Air-space per Person and Height of Child.*

TABLE 250. *Correlations of Air-space per Person with Height of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
−·1050 ±·080	−·0025 ±·089	·0678 ±·088	·1980 ±·084	·1304 ±·037	·0924 ±·043	·1349 ±·039	·0391 ±·049	·3691 ±·052
Girls								
−·1124 ±·090	·0796 ±·079	−·1365 ±·077	·2538 ±·081	·0633 ±·043	·1041 ±·041	·1491 ±·040	·1215 ±·051	·1971 ±·052

The correlation coefficients of air-space per person and height of the child shown in Table 250 are nearly all positive but low, and the majority are not significant.

Correlation ratios for the same two factors are given in Table 251.

TABLE 251. *Correlation Ratios. Air-space per Person and Height of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
Ind.	Ind.	·1269 ±·087	Ind.	Ind.	Ind.	·2404 ±·038	Ind.	·3834 ±·051
Girls								
·2691 ±·084	Ind.	Ind.	·2460 ±·082	·1078 ±·042	Ind.	·1516 ±·040	Ind.	·0430 ±·054

Of these ratios only two are over 0·2, more than half are indeterminate, the rest are low.

The graphs (not reproduced here) formed by plotting the averages of each array show nothing constant.

Like weight of the child, height of the child shows no definite relationship with the air-space per person in the families of the agricultural labourers.

(3) *Air-space per Person and General Condition of Child.*

TABLE 252. *Average Air-space per Person (in Cubic Feet) of Families with Children in Good and Poor General Condition.*

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Condition good .	685·38	730·00	759·09	816·07	790·45	762·13	722·00	674·59	667·36
Condition poor .	900·00	700·00	616·67	350·00	678·57	707·14	740·91	950·00	585·71
GIRLS									
Condition good .	726·00	816·67	768·06	735·00	754·68	799·23	677·39	698·79	662·58
Condition poor .	610·00	583·33	400·00	No data	578·57	333·33	800·00	600·00	650·00

In Table 252 the average air-space per person is shown as found associated with children of 'good' and of 'poor' general condition, respectively. A want of relationship between these two factors is shown by the table; in some instances the children of poor general condition have a greater average air-space per person than children of the same age with good general condition.

(4) *Air-space per Person and Number of Living Children in the Family.*

TABLE 253. *Correlations of Air-space per Person with Number of Living Children in Family.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
−·5600 ±·056	−·3951 ±·075	−·4686 ±·069	−·5470 ±·061	−·5215 ±·027	−·5297 ±·031	−·4848 ±·030	−·5382 ±·035	−·5122 ±·044
Girls								
−·4625 ±·072	−·3373 ±·070	−·6606 ±·044	−·5106 ±·064	−·4777 ±·033	−·5781 ±·028	−·5324 ±·029	−·4789 ±·040	−·5800 ±·036

From Table 253 it will be seen that—as might be expected—there is a high correlation between the air-space per person and the size of the family—as the size of the cothouse does not vary to any great extent. All the correlation coefficients in the table are negative and significant, showing that with increase in size of family there is decrease of the amount of air-space per person.

C. *Number of Living Children in Family*

(1) *Number of Living Children in Family and Weight of Child.*

TABLE 254. *Correlations of Number of Living Children in Family with Weight of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
−·1144 ±·080	−·1967 ±·086	·1273 ±·087	−·3368 ±·077	−·0258 ±·038	·0654 ±·043	·0946 ±·040	·0241 ±·049	−·0359 ±·060
Girls								
·0373 ±·091	·1007 ±·079	−·1042 ±·078	−·3573 ±·076	−·1552 ±·042	−·0984 ±·041	−·0891 ±·040	−·2142 ±·050	−·0080 ±·054

The correlation coefficients of the number of living children in the family with the weight of the child are given in Table 254. It will be seen from these results that there is no constant correlation between these two factors, but the correlation is definitely significant in both boys and girls aged 9 + months. Most of the other coefficients are not significant and the signs are variable, though the majority are negative.

TABLE 255. *Correlation Ratios. Number of Living Children in Family and Weight of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
·2064 ±·078	Ind.	·2210 ±·084	·2794 ±·080	·1233 ±·037	Ind.	Ind.	Ind.	·0711 ±·059
Girls								
·5475 ±·064	·1033 ±·079	Ind.	·2403 ±·082	Ind.	·1266 ±·041	·1196 ±·040	·1514 ±·051	·1625 ±·052

The correlation ratios given in Table 255 confirm the results shown by the correlation coefficients, many being indeterminate, whilst others are only slightly significant.

When graphs (not reproduced) were plotted of the means of the arrays no constant trend could be made out.

There is thus shown no definite relationship between the number of children in the family and the weight of the child.

(2) *Number of Living Children in Family and Height of the Child.*

TABLE 256. *Correlations of Number of Living Children in Family with Height of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
−·0837 ±·081	·0451 ±·089	·1729 ±·086	−·1323 ±·086	−·0837 ±·037	−·0392 ±·043	·0219 ·040	−·0706 ±·049	−·2348 ±·056
Girls								
−·0085 ±·091	·0728 ±·079	·0696 ±·078	−·2270 ±·083	−·1669 ±·042	−·0790 ±·041	−·1362 ±·041	−·2283 ±·049	−·1142 ±·053

The correlation coefficients of number of living children in the family with height of child are shown in Table 256. They are low, the majority of no significance, and the signs variable, though most of them are negative.

TABLE 257. *Correlation Ratios. Number of Living Children in Family and Height of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
Ind.	Ind.	Ind.	·4798 ±·067	·1033 ±·037	Ind.	Ind.	Ind.	·2728 ±·055
Girls								
·4941 ±·069	·1631 ±·077	·0871 ±·078	·2968 ±·079	·2232 ±·041	·1626 ±·040	·1910 ±·039	·2169 ±·050	·2380 ±·051

The correlation ratios given in the foregoing Table 257 show a slight but definite correlation between the number of living children in the family and the height of the child in all the girls over 9 months and in the boys aged 9 + months and 5 + years.

When graphs (not reproduced) were plotted of the means of the arrays, no definite trend was observed.

There is thus no indication of a definite relationship between the number of children in the family and the height of the child.

(3) *Number of Living Children in Family and General Condition of Child.*

TABLE 258. *Average Number of Living Children in Families with Children in Good and Poor General Condition.*

Age	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Condition good	3·80	3·27	3·42	2·18	3·35	3·62	3·97	4·52	4·57
Condition poor	3·00	2·50	2·33	6·75	3·71	4·34	2·64	2·80	4·57
GIRLS									
Condition good	3·60	3·51	3·36	3·20	3·13	3·66	4·24	4·11	5·13
Condition poor	3·60	3·33	4·00	—	4·43	4·00	3·13	3·50	3·33

In Table 258 the average number of living children in the family as found associated with varying general condition of the child is shown. *From these results there would seem to be no relationship between the number of living children and the general condition of the child.*

D. *Diet*

An investigation of the diets of some typical families of this class is given in the main report on pp. 180 et seq. The results of this investigation show, on the average, a liberal supply of 3,220 calories of energy per man per day and, on the average, the use of 0·87 pint of milk per man per day. This contrasts with the average intake of 2,564 calories and 0·39 pint of milk in the slum families and 2,917 calories and 0·34 pint of milk in the miners' families.

While the diet of these country families is thus more generous than that of the urban dwellers of the class studied, the larger size of adults and children, the more active life, and the greater exposure to cold and wet on the part of the rural families may explain this difference. It is impossible to say whether it is for these reasons that the diet is more liberal or whether the people are bigger because of the more liberal diet (p. 190).

(*b*) **Parental Conditions.**

A. *Maternal Health*

As indicated in the main report, the child, both before and after birth, is so closely related to its mother that some correlation of the condition of the child with the condition and character of the mother might be expected (p. 207).

The health of the mother may influence the development of the child both during pregnancy and after birth. Only the general maternal health at the time of the investigation was considered in this study. In estimating this, the health was regarded as good if the mother was physically and mentally well developed and there was no history or obvious evidence of organic disease. Only 4·95 per cent. of the children investigated had mothers with poor health.

TABLE 259. *Percentages of Unhealthy and of Inefficient Mothers.*

Age . .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Mother unhealthy .	5·8	1·8	0	11·7	2·2	5·3	7·3	5·3	7·0
Mother inefficient .	5·8	7·0	3·4	13·3	10·8	8·5	11·5	9·6	16·4
GIRLS									
Mother unhealthy .	3·6	2·8	1·4	1·7	4·1	4·6	5·4	4·2	10·2
Mother inefficient .	9·1	6·9	1·4	6·7	8·5	6·8	9·1	9·6	12·7

On account of the small number of children with unhealthy mothers there was not much material to work with, especially in the groups below one year. In three groups, i. e. in boys of 3+ months, and in girls of 6+ and 9+ months, there was only one child having a mother with poor health, so that these figures do not represent true averages (Table 259).

(1) *Health of the Mother and Weight of the Child.*

TABLE 260. *Average Weights (in Pounds) of Children of Mothers in Good and Poor Health.*

Age	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Mother's health good	10·58	14·41	18·16	20·15	25·23	29·45	33·71	36·79	40·36
Mother's health poor	8·25	12·75	No data	20·46	25·32	29·67	32·18	35·55	40·31
GIRLS									
Mother's health good	8·88	14·06	17·09	19·24	23·99	28·24	32·29	35·34	38·58
Mother's health poor	8·75	11·75	15·75	19·75	22·75	28·03	31·15	35·32	38·00

Table 260 gives the average weight of the child as found associated with the condition of the mother's health. From these results it is manifest that *there is little association between the health of the mother and the weight of the child.* There is a slight tendency, however, for the children of mothers in poor health to be lighter, this being especially evident below one year of age.

(2) *Health of the Mother and Height of the Child.*

TABLE 261. *Average Heights (in Inches) of Children of Mothers in Good and Poor Health.*

Age	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Mother's health good	21·77	24·50	26·72	27·69	31·45	34·83	37·95	40·41	42·48
Mother's health poor	20·75	24·75	No data	27·75	30·89	35·06	37·51	39·35	41·64
GIRLS									
Mother's health good	20·92	24·14	26·22	27·53	30·75	34·47	37·44	39·76	41·90
Mother's health poor	21·75	22·75	24·75	26·75	30·55	33·42	36·22	39·32	41·12

In Table 261, given above, the association of the average height of the child with the 'good' and 'poor' health of the mother is shown. The results lack co-ordination, and the relationship of the height of the child with the maternal health is, like the weight of the child, uncertain.

(3) *Health of the Mother and General Condition of the Child.*

TABLE 262. *Correlations of the Health of the Mother with General Condition of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
—	—	—	·290 ±·080	—	—	·603 ±·025	—	·213 ±·057
Girls								
—	·696 ±·041	—	—	·492 ±·033	·779 ±·016	·252 ±·038	·642 ±·031	·413 ±·045

In Table 262 the correlation coefficients of the health of the mother and the general condition of the child are given in those age groups in which sufficient data were available. From the results given it would appear that since the correlation coefficients are all significantly high there is a considerable relationship between the health of the mother and the general condition of the child. It is possible that the better efficiency of the mother of better health plays a large part in this.

(4) *Health of the Mother and Income per Person.*

TABLE 263. *Average Income per Person (in Shillings) of Families of Mothers in Good and Poor Health.*

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Mother's health good	8·62	8·79	8·84	9·72	9·73	9·00	8·61	8·39	9·01
Mother's health poor	8·75	7·50	No data	8·21	8·07	8·46	8·45	7·00	7·50
GIRLS									
Mother's health good	8·77	9·36	9·30	9·19	9·34	9·25	8·73	8·40	8·28
Mother's health poor	7·50	10·00	7·50	7·50	8·50	8·75	8·50	7·50	7·81

In Table 263 the average income found associated with good and with poor health of the mother is shown. From these results it would appear that *there is some slight relationship between the two factors, at least after the age of* 6 *months, the good health of the mother being associated with rather larger average incomes per person.*

(5) *Health of the Mother and Air-space per Person.*

TABLE 264. *Average Air-space per Person (in Cubic Feet) of Families of Mothers in Good and Poor Health.*

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Mother's health good	702·31	733·93	751·72	819·81	795·22	765·45	727·36	691·57	666·81
Mother's health poor	625·00	450·00	No data	521·43	464·29	673·08	664·29	510·00	611·11
GIRLS									
Mother's health good	721·70	801·43	759·59	738·14	755·17	800·00	689·85	698·75	667·38
Mother's health poor	550·00	1000·00	650·00	550·00	620·00	666·67	583·33	671·43	615·62

The average air-space per person which was found associated with good and with poor maternal health is shown in Table 264. It would appear from these results to have *some possible slight relation with the health of the mother, those in poor health being associated with an air-space of* 100 *to* 200 *c. ft. less than those mothers in good health.*

The relation of air-space to income and to size of family has already been emphasized.

(6) *Health of Mother and Number of Living Children in the Family.*

TABLE 265. *Average Number of Living Children in Families of Mothers in Good and Poor Health.*

Age	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Mother's health good	3·78	3·18	3·36	3·42	3·33	3·60	3·93	4·43	4·62
Mother's health poor	3·25	7·00	No data	5·57	4·71	4·31	3·81	5·30	3·89
GIRLS									
Mother's health good	3·43	3·56	3·30	3·19	3·11	3·63	4·15	4·12	5·04
Mother's health poor	8·00	1·50	4·00	4·00	4·40	4·25	4·67	3·57	5·25

In Table 265 the average sizes of the families found associated with mothers in good health and with poor health respectively are given. From these results there would seem to be little or no association between the health of the mother and the size of the family.

From the foregoing results it may be concluded that maternal health (i) is not a factor of importance in determining the growth, nutrition, or general condition of the child, (ii) has some slight possible relationship with the average income per person, (iii) has possibly some slight relationship to the air-space per person, and (iv) has little or no relationship with the number of living children in the family.

B. *Maternal Efficiency*

The efficiency of the mother (p. 227) was regarded as good when the house was kept clean and tidy and a reasonable amount of care expended on the feeding, clothing, and supervision of the children. The percentage of inefficient mothers found among the wives of agricultural labourers was not high, being only 9·4 per cent. Since the percentage of inefficient mothers was so low, tables of averages were constructed instead of attempting to calculate correlation coefficients.

(1) *Maternal Efficiency and Weight of Child.*

TABLE 266. *Average Weights (in Pounds) of Children of Mothers with Good and Poor Efficiency.*

Age	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Efficiency good	10·52	14·23	18·21	20·52	25·40	29·40	33·74	36·84	40·73
Efficiency poor	9·25	16·25	16·75	18·00	23·87	30·18	32·51	35·64	38·46
GIRLS									
Efficiency good	8·93	14·14	17·09	19·39	24·20	28·32	32·37	35·40	38·81
Efficiency poor	8·35	12·15	15·75	17·25	21·13	27·08	30·83	34·75	36·55

Table 266 shows the average weights of the children found associated with mothers of good and of poor efficiency. In only two instances—that of boys of 3 + months and also of 2 + years of age—does the weight of the child associated with poor efficiency of the mother exceed the weight associated with good efficiency. In all other cases the weight of the child associated with mothers classed as efficient is greater, thus showing the direct association of the weight of the child with the efficiency of the mother which was indicated earlier in the main report.

(2) *Maternal Efficiency and Height of Child.*

TABLE 267. *Average Heights (in Inches) of Children of Mothers with Good and Poor Efficiency.*

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
BOYS									
Efficiency good .	21·73	24·41	26·79	27·88	31·60	34·83	38·05	40·41	42·70
Efficiency poor .	21·25	25·75	24·75	26·50	30·04	34·89	36·87	39·75	40·99
GIRLS									
Efficiency good .	20·99	24·11	26·22	27·64	30·92	34·49	37·49	39·76	41·95
Efficiency poor .	20·55	23·95	24·75	25·75	28·75	33·53	36·19	39·62	40

Table 267 gives the average height of the child as found associated with the relative efficiency of the mother. Like weight, height shows a definite relation with the efficiency of the mother, all the heights, with one exception—that of boys 3 + months—being greater where the efficiency of the mother is classed as ' good '.

(3) *Maternal Efficiency and General Condition of the Child.*

TABLE 268. *Correlations of Maternal Efficiency with General Condition of Child.*

Age −3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys								
—	—	·691 ±·046	·833 ±·027	·492 ±·029	—	·422 ±·033	·223 ±·047	·056 ±·059
Girls								
·608 ±·057	·492 ±·060	—	—	·676 ±·023	·756 ±·018	·263 ±·038	·568 ±·035	·558 ±·037

In Table 268 the correlation coefficients of maternal efficiency and the general condition of the child are given in those age groups for which sufficient data were available. All these correlations, except in boys of 5 + years, are positive and significant, ranging between 0·2 and 0·8, and more than half are over 0·5. *From this it would appear that there is a definite relationship between the efficiency of the mother and the nutrition, growth, and general condition of the child,* and the results suggest that the influence of the efficiency of the mother is most strongly felt during the earlier years of childhood, becoming, in the case of boys, insignificant in the fifth year of life.

In order to elucidate the factors determining efficiency in the mothers, correlations of maternal efficiency with maternal health, income per person, air-space per person, and number of living children in the family were calculated, and are given in the subjoined tables.

Table 269. *Correlations of Maternal Efficiency to Health of the Mother.*

Age	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys	·447 ±·065	—	—	·063 ±·087	·323 ±·034	·187 ±·041	·544 ±·028	·633 ±·029	·725 ±·028
Girls	—	·632 ±·048	—	—	·263 ±·040	·257 ±·039	·369 ±·035	·124 ±·051	·161 ±·052

Table 270. *Average Income per Person (in Shillings) of Families of Mothers with Good and Poor Efficiency.*

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys									
Efficiency good .	8·69	8·77	8·93	10·05	9·59	9·11	8·73	8·46	8·29
Efficiency poor .	7·50	8·75	6·25	6·25	7·50	7·50	7·65	7·08	7·26
Girls									
Efficiency good .	8·80	9·51	9·30	9·37	9·41	9·24	8·86	8·52	8·38
Efficiency poor .	8·00	7·50	7·50	6·25	8·21	9·03	7·20	7·19	7·25

Table 271. *Average Air-space per Person (in Cubic Feet) of Families of Mothers with Good and Poor Efficiency.*

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys									
Efficiency good .	713·08	750·00	753·57	840·38	801·92	779·33	740·51	697·65	695·79
Efficiency poor .	450·00	450·00	700·00	425·00	670·59	559·52	586·36	533·33	495·24
Girls									
Efficiency good .	714·00	829·10	759·59	764·29	772·31	809·39	703·39	711·59	678·47
Efficiency poor .	730·00	510·00	650·00	325·00	507·14	583·33	490·00	565·63	550·00

Table 272. *Average Number of Living Children in Families of Mothers with Good and Poor Efficiency.*

Age .	−3 months	3+ months	6+ months	9+ months	1+ years	2+ years	3+ years	4+ years	5+ years
Boys									
Efficiency good .	3·63	3·17	3·35	3·29	3·19	3·50	3·85	4·35	4·36
Efficiency poor .	5·75	4·25	3·50	6·12	4·74	5·05	4·48	5·67	5·67
Girls									
Efficiency good .	3·64	3·52	3·3	2·87	3·05	3·62	3·97	4·03	4·93
Efficiency poor .	3·20	3·20	4·00	7·75	4·38	4·28	6·29	4·75	5·95

Apparently among the children of agricultural labourers efficiency of the mother is related to good maternal health, to larger incomes, to greater air-space, and to smaller families.

In this investigation partial correlations which were used in the main report to determine the relative part played by each of these factors in modifying the growth and nutrition of the child were not worked out, but from the earlier part of this report it will be seen that income, air-space, number of living children in family, and health of the mother are *not* directly related to the size of the child, and it is there seen manifest that maternal efficiency is the important factor (pp. 129, 134, 138, and 214).

(5) CONCLUSIONS

The general result of the study of the families of agricultural labourers is to confirm the evidence obtained from the investigation of slum families and to indicate that the factor most directly correlated with the growth and nutrition of the child is maternal care—the efficiency of the mother. The study further reveals a pleasing picture of family life, contrasting with the squalor of life in the slums of the great cities. It presents a condition of comfort, good health, vigour, and efficiency.

GENERAL CONCLUSIONS

This investigation has been confined to the poorer classes of the three largest Scottish cities and to labourers and miners in the rural districts of Scotland, and the conclusions drawn must be restricted to these, although they may be accepted as indicating a probable similarity of conditions elsewhere in the same social class. It is greatly to be regretted that no similar series of studies was carried out simultaneously in England.

The evidence collected gives little support to many of the prevalent ideas as to the causes of the low weight and height of the slum child.

1. In the first place, the figures do not afford the striking evidence we expected of a marked delay in growth. Unfortunately we have no statistics of the relative weights and heights of town and country children of the poorer classes at birth. Information upon this is urgently required, and an attempt should be made to secure it. There is some evidence of a retardation in the gain of weight, and less as regards gain in height in town infants below eighteen months as compared with country infants, but after that age the town child seems to grow, if anything, more rapidly than the country child, so that after eighteen months the curves of growth for the two run fairly parallel. If the early retardation is due to some environmental factor or factors they must be chiefly operative before the middle of the second year of life (pp. 100 to 104).

2. The correlation of the size of the offspring with the size of the parents has already been indicated in the study of adults by Pearson, and the figures yielded by the study of the population of Dundee (p. 107) certainly confirm this and show that small parents tend to beget small children.

Previous investigators have shown that town dwellers are on an average shorter and lighter than the inhabitants of country districts, and the work of Beddoe (1870) shows that this applies to Scotland. Evidence has been adduced from the work of others (pp. 80 and 110) that the towns are more and more breeding their own population and being less and less recruited from the country. There is thus some indication that the small size of the town child is in part at least an inborn characteristic.

While the growth of the population studied shows no retardation after eighteen months, the possibility that environmental factors do influence the condition of the children, especially during the early months of life, is, of course, not excluded.

3. No clear indication has been found that the nutrition of the child is directly associated with the income of the family, expressed as per person. We, like others, had anticipated that a much closer correlation would have been discovered, and that proof would have been afforded of the truth of the adage that 'the poor man's curse is his poverty'. The contention that a mere increase of wages would, *per se*, lead to better growth of the children is thus not supported by these results. Of course, the want of a more direct correla-

tion of income with nutrition does not necessarily mean that income is without effect ; it may merely indicate that any effect is masked by the prepotent influence of some more dominant factors.

The income per person is closely related to the size of the family, and this again to the space in the house available per person.

4. The overcrowding due to the large families with the concomitant decreased supply of air have been suggested as potent factors in modifying the nutrition of the child. The air-space per person in the house is not a measure of the fresh air which the members of the family enjoy, since it only expresses the cubic capacity of the house in relationship to the inmates and does not indicate the condition of ventilation or the extent to which the children are taken into the open air. It is really another expression of the size of the family and an index of overcrowding. Overcrowding might well be expected to exercise a prejudicial effect in so far as it greatly increases the risk of infection. It is curious, therefore, to find that the correlations of weight and height to size of family and to air-space per person are all small and many of them insignificant (pp. 134 and 138). But it must be recognized that here again the failure to establish a correlation does not exclude a connexion and may only mean that some other factors are dominant.

5. Perhaps the most prevalent belief is that the small size of the town child is due to a defective supply of suitable food, but the satisfactory rate of growth after eighteen months does not support this view.

The comparatively limited series of dietary studies in which it has been possible to correlate the weight of the children with the energy value of the diet when analysed does seem to indicate that when the diet falls much below a level of 2,600 calories per man per day there is some suggestion of a correlation of weight in the children with the energy value of the food.

But, on the other hand, the long series of dietary studies which have now been carried out in Glasgow seem to show that a family diet with an energy yield of between 2,500 and 2,700 calories per man per day is the average for these classes, and that on this allowance the growth of the children shows no retardation when it is compared with the growth of the country children on a diet of over 3,000 calories.

No statistical method can answer the fundamental question of whether the difference in size of town and country children depends on the diet or whether the difference in the intake of food is dependent upon the different demands of the two types of children, the probability of which is indicated on p. 148.

That the difference in size of the town and country child is not determined by the amount of fresh milk consumed is indicated by the small consumption by the well-grown children of rural miners whose family consumption of milk is as small as that of the slum families (pp. 190 and 294).

6. The prejudicial influence of artificial feeding of the infant has been emphasized by many writers. Our examination of the correlation of breast and artificial feeding with the weight of the child shows that such a correlation is manifest in infants below eight or nine months, but that after this it is absent (p. 201). By the tenth month

the child that has not been breast-fed was found to be as heavy as that which has been. The possible influence of a selective mortality and other factors among the artificially fed infants in explaining this is discussed (p. 203). Further work upon the subject is urgently required.

The intimate relation of both mother and child during the intra- and extra-uterine life of the latter suggests that the mother's condition may react upon the nutrition and growth of the child.

7. The most obvious possibility is that the health of the mother—either her general health or her health during pregnancy—may be correlated with the condition of the child.

A. For the study of the correlation of health during pregnancy with the nutrition of the child the results from Child Welfare Centres were used. For all ages of the infant to thirteen months the correlations fail to reveal any connexion between maternal health during pregnancy and the condition of the child. This confirms the previous findings of Pearson.

B. The general health of the mother shows a small correlation with the weight and height of the children at different ages, but when the factor maternal efficiency is kept constant this disappears. Maternal health is, therefore, not revealed as a factor of prime importance.

8. It seemed that in yet another way the mother might influence the condition of the child. There are admittedly good mothers and indifferent mothers ; mothers who devote themselves to the care of their children and house and mothers who pay little attention to either. At the beginning of the inquiry chief attention was paid to the care of the child, but it soon became evident that when the care of the child was good the condition of the house was also satisfactory (p. 228). It thus became manifest that the mothers might be classified into those taking good care of children and house—efficient mothers, as we have called them—and mothers more or less indifferent—inefficient mothers. The difficulties of classifying the women in these two categories, and the precautions taken to secure a uniform system of division, are considered on p. 228.

When the correlations between maternal efficiency and weight and height of the child are studied they are found to be the only really significant ones in the series. From one to four years they are significant in all three towns : below this age in Glasgow and in Edinburgh the correlations are insignificant, while in Dundee they are still significant. Correlations of the same character as those found in Dundee were found in the families of agricultural labourers and rural miners. It has been indicated that such a correlation would not be expected till after the effects of maternal neglect had made themselves apparent, and that this may explain the absence of a significant correlation at the earlier ages in Glasgow and Edinburgh (p. 231). As already indicated, it would seem from the analysis of the rate of increase in weight and height that the critical period is before the end of the second year, at an age when the child is obviously most dependent upon its mother's care.

Of all the factors studied the character of the mother is the most directly associated with the nutrition of the child, but, as already indicated, the correlation between maternal efficiency and height and weight are not sufficiently high to justify the conclusion that maternal care is the only factor modifying the physique of the children. The probability of the influence of heredity has already been discussed.

If it be admitted that maternal efficiency is a factor playing a part in determining the condition of the child, it becomes of importance to attempt to ascertain to what the efficiency is due. Is it an inborn character, or is it dependent on the environmental conditions under which the mother lives ?

To some extent it is correlated with the air-space per person and the size of the family, i. e. with overcrowding (p. 235). The less the air-space per person and the larger the family, the worse on the average is the efficiency of the mother. In other words, overcrowded dwellings and an inferior type of mother tend to go hand in hand. Which is cause and which effect is, however, another matter. The results of various statistical studies on fertility show that the population is being recruited mainly from the improvident type of parents, who contribute more than their share to the birth-rate. It is thus a question whether the larger families are the product primarily of inefficient parents, or whether the greater number of children leads to a less degree of care being shown for the well-being of the offspring.

Maternal efficiency is also associated with the health of the mother, and this is most strikingly shown in the families of agricultural labourers and rural miners, where overcrowding does not occur to the same extent and where the proportion of inefficient mothers is very small. In these communities the condition of health appears to be a, if not the, determining factor.

To summarize—this study must be considered as pioneer work, as the first extensive attempt to estimate the influence of various environmental conditions on the growth and nutrition of the slum child. Such work cannot be expected to yield results of definite finality, and like most other scientific investigations it raises more questions than it answers, points out lines for further work, and indicates the difficulties of such attempts to elucidate social conditions. It does, however, seem to show that heredity and the inherited growth impulse play no small part in determining the growth of the child, and that in spite of environmental factors, which may appear prejudicial, the slum child tends to develop on the lines of its parents.

The apparent lag in the growth of the town child as compared with the country child, before the middle of the second year of life, indicates that future investigations must concentrate upon this period.

Of the environmental characters studied, ' maternal efficiency ' seems more closely associated with variations in the condition of the child than our measures of ' poverty ', ' underfeeding ', or ' overcrowding '. We cannot, indeed, on the present evidence, determine the precise nature of the relationship and, hence, determine what hindering circumstances are to be overcome or what good is to be encouraged out of the complex of good and bad qualities which lead to an assessment of ' maternal efficiency '. But our studies suggest that ' maternal efficiency ' is not directly and immediately associated with ' poverty ' but is, at least to some extent, associated with size of family, cubic capacity of the house per person, i. e. with overcrowding, and with maternal health.

The provision of improved housing accommodation by permitting a larger proportion of mothers to care more efficiently for their children and homes might prove to be a beneficial measure. What is not demonstrated is that simple increase of income would be followed by improvement in the condition of the children. Bad parents, irrespective of their incomes, tend to select bad houses, as the money is often spent on other things. The saying that ' what is the matter with the poor is poverty ' is not substantiated by these investigations, which show that the problem of a slum population is far more complex than such a statement would indicate. The results of our investigations, indecisive as many of them appear, indicate that a position must be taken up removed from that of the sociological or political theorist, on the one hand, who believes that a simple increase of income would remedy all evils, and from that of the thoroughgoing eugenist on the other. The evidence supports neither extreme, but seems to indicate that the current teaching gives too much rather than too little weight to the environmental factors which, theoretically at least, it might be possible to remedy by economic adjustments.

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APPENDIX I

FORM USED AT CHILD WELFARE CENTRES

Fill up fully Items marked by star.

CHILD LIFE INVESTIGATION.

Form M.R.C. 141.
(Revised April, 1921.)

Name
Address
No. First Attendance Age at

CHILD. Date of Birth Sex Leg. ? Illeg. ?
Attendance at Birth, *Doctor or Midwife ?*
Full time ? If premature, state duration of Pregnancy (in months).

* ENTIRELY BREAST-FED.	* MIXED FEEDING.	* ENTIRELY ARTIFICIALLY-FED.
How long (in weeks)	How long (in weeks) Why On what	How long (in weeks) Why On what

Vaccination Date

MOTHER. Maiden Name Age *Height *Weight
*Suckling during Pregnancy How long ?
Health during Pregnancy
Habits
*Occupation (if any) *Before Marriage* / *During Pregnancy* If so, till when ?
*Place of Birth : Town Country

***FAMILY HISTORY.** No. of Pregnancies

No.	Age.	Sex.		Alive.	Dead.		Still-born.	Mis-carriage.	Dur. of Preg.	Duration of Feeding.		
		M.	F.		Age at Death.	Cause of				Breast.	Mixed.	Artificial.
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												

FATHER. Surname Christian Name Age
Occupation *Height
Regularly employed during wife's Pregnancy *Weight
Reported Health
Habits
*Place of Birth : Town Country

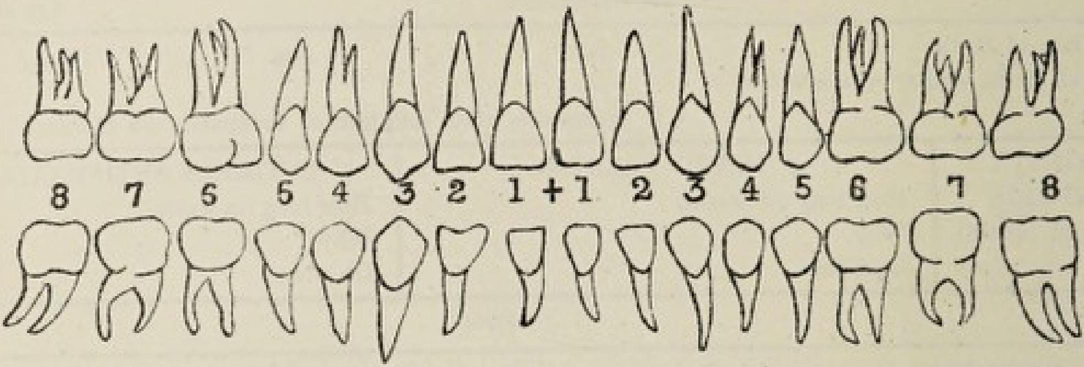
***HOUSE.** Position in House or Tenement Rent : week
No of Apartments No. of Inmates
Damp Ventilation Defective Light
General Sanitation

* If exact measurements are not available, state as "Short" "Medium," or "Tall," and as "Light," "Medium," or "Heavy" in proportion to height:

(1049). Wt.P1481—369. 1000. 11/22. Gp 147. M.R.Co.Ltd.

* TEETH OF MOTHER.

Signify diseased conditions by the following letters:—A = Absence; D = Deformity; P = Pyorrhœa; C = Caries; H = Hypoplasia.



SUMMARY OF REPORTS ON CHILD.

Indicate in Summary:—B = Boiled Milk. U = Unboiled Milk.

* NATURE OF FOOD.	WEEKS.				MONTHS.										
	1	2	3	4	—2	—3	—4	—5	—6	—7	—8	—9	—10	—11	—12
Breast only															
Breast and—															
(*a*) Cow's Milk (*Boiled or not*)															
(*b*) Other artificial Food ..															
Artificial Food only—															
(*a*) Cow's Milk (*Boiled or not*)															
(*b*) Other artificial Food															
Type of Bottle used															
CONDITIONS REGARDING—															
Health. (*a*) Thriving															
Health. (*b*) Not Thriving															
Health. (*c*) Fair															
Feeding. (*a*) Well															
Feeding. (*b*) Ill															
Sleeping. (*a*) Well															
Sleeping. (*b*) Ill															

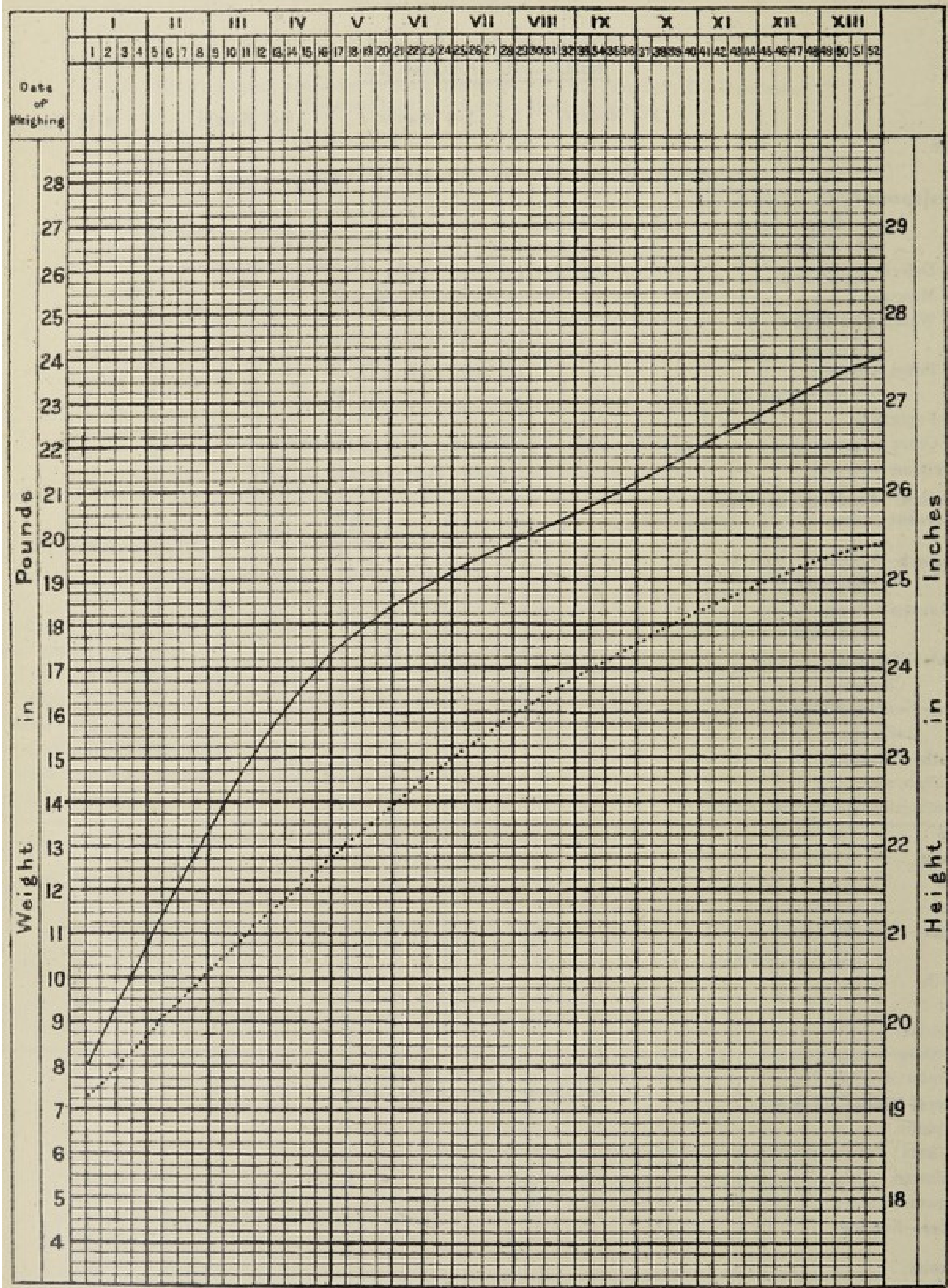
REPORT BY NURSE.

Date of Death

Cause

MEDICAL RECORDS.

	1-3 Months.	3-6 Months.	6-9 Months.	9-12 Months.
Date				
Age				
* **Development**—Height (*total*) ..				
Height (*stem*) ..				
Weight ..				
Defects (congenital) ..				
Muscular				
Walking (a) Began ..				
(b) Alone ..				
Bones (enlarged epiphyses, etc.)				
Fontanelle				
Other measurements ..				
* **Nutrition**—General				
Detailed Feeding at the Present Time				
Stomach—Vomiting				
Flatulence				
Abdomen—Hernia				
Distension ..				
Stools—Number				
Character				
Skin—Healthy or Pale				
Rash, etc.				
Mouth—Condition				
Thrush, etc.				
Teeth (stating eruption of 1st)				
Nose				
Throat				
Eyes				
Ears				
Habits—Sleep (1) Cot ?				
(2) With Mother?				
Bath				
Air				
Exercise				
Clothing				
Comforter				
* **General Notes**—Illnesses ..				
Syphilis				
Rickets				
Phimosis				
Treatment				
Advice—Feeding				
Habits				
Medical				



Height ———— Weight ....

P.272 M.S. 17994 471. 1832, 1250, 5.2.6.

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APPENDIX II

FORM USED IN HOUSE-TO-HOUSE INVESTIGATION

No...........................

Medical Research Council.

CHILD-LIFE INVESTIGATION.

Name of Observer..

Name of Family..

Address of Family...

Dates of Visits...

CHILD-LIFE INVESTIGATION

Name of Child ....

Name of Father ....

Name of Mother ....

Address ....

....

Date of Birth ....

Weight at Birth ....

Height at Birth ....

Condition at Birth ....

Full time ? .... Premature ? ....

Any abnormality at Birth ? ....

Is Child a Twin ? ....

FATHER.

Place of Birth (*a*) Name of Town ....

(*b*) ,, County ....

Age ....

General Condition ....

Previous health ....

Weight ....

Height ....

Habits—Drink, &c. ....

Occupation ....

Weekly Income—

(1) of Father—

(*a*) Present ....

(*b*) During last pregnancy ....

(2) of Family from all sources ....

MOTHER.

Place of Birth (*a*) Name of Town ....

(*b*) ,, County ....

Age ....

General Condition ....

Health before and during pregnancy ....

Health during lactation ....

If suckling previous child during last pregnancy—how long? ....

Weight ....

Height ....

Habits—Drink, &c. ....

Occupation (if any) (*a*) before marriage ....

(*b*) during pregnancy ....

(*c*) till when? ....

Care of Children ....

FAMILY RECORD

No. of Pregnancies..............................

No.	Miscarriage (and month of).	Dead-Birth.	Alive.								
			Age.	Weight.		Height.		Stem Length.		Condition and Defects. Adenoids,
				lb.	oz.	ft.	in.	ft.	in.	
......	....	....	......	......	......	......	......	......	......	....
......	....	....	......	......	......	......	......	......	......	....
......	....	....	......	......	......	......	......	......	......	....
......	....	....	......	......	......	......	......	......	......	....
......	....	....	......	......	......	......	......	......	......	....
......	....	....	......	......	......	......	......	......	......	....
......	....	....	......	......	......	......	......	......	......	....
......	....	....	......	......	......	......	......	......	......	....
......	....	....	......	......	......	......	......	......	......	....
......	....	....	......	......	......	......	......	......	......	....

FAMILY RECORD (*continued*)

Feeding during Infancy.					
			Mixed—Breast and Artificial.		
No.	Entirely Breast-fed. How long ?	Alleged reason for any Artificial Feeding.	Breast + Cow's Milk. (What strength ?)	Breast + other Artificial Feeding ; Nature of Artificial Feeding, and how often given ?	How long continued ?
......	....	....	....	....	....
......	....	....	....	....	....
......	....	....	....	....	....
......	....	....	....	....	....
......	....	....	....	....	....
......	....	....	....	....	....
......	....	....	....	....	....
......	....	....	....	....	....
......	....	....	....	....	....
......	....	....	....	....	....

FAMILY RECORD (*continued*)

Illnesses (within past year)—Rickets, Teeth, &c.	Dead.		Age at First Tooth.	Age of learning to walk.	Taken out during infancy.
	Age at Death.	Cause.			How often ?

FAMILY RECORD (*continued*)

Feeding during Infancy (*continued*).				
	Artificial Food only.			
Frequency of Feeding.	Cow's Milk. (What strength ?)	Nature of other Artificial Foods.	How long continued ?	Frequency of Feeding.

HOUSING.

Position on map ....

Surroundings ....

Approaches ....

Has house through ventilation ? ....

No. of stairs up ....

No. of rooms ....

Size of rooms ....

Height of ceiling ....

Windows, area of ....

Exposure of rooms ....

No. of inmates ....

No. of lodgers, if kept ....

How much of house is used by family ? ....

Air-space per person ....

Condition of house—

(1) Cleanliness ....

(2) Sanitary arrangements ....

(3) Ventilation ....

(4) Humidity (Leonard Hill) ....

Rent (monthly) ....

APPENDIX III

NOTES ON GLASGOW FAMILIES IN MISS MACNAE'S DIETARY STUDIES

1. The family consists of nine children, the eldest being 15½ years and the youngest 6 months. In spite of the fact that most of the time, even before the war, the husband had worked only very spasmodically as a dock labourer, and had bouts of drinking, this mother has brought up all the children to be strong and healthy. They were all breast-fed, taken out regularly, not one of them showing the slightest signs of rickets, and even, although the accommodation was so limited, the house always looked clean and tidy. As shown in Table 113, this mother also gets the highest energy value in food per penny, and also the highest percentage of carbohydrates, and, as is natural, the highest percentage of this and of the fat was of vegetable origin. It would appear that, almost invariably, the lower the income, the higher the carbohydrates, due to the purchase of large quantities of bread and potatoes. The rent was 7*s.* weekly ; coal 3*s.* ; gas 2*s.* ; insurance 1*s.* 9*d.* ; washing 1*s.* 6*d.* The total income was 58*s.* weekly and the children always appeared well clad and well cared for.

2. The conditions in this family of 2 adults and 2 children were very good ; house well situated and plenty of air-space. Both children had just had whooping-cough, which possibly partly accounts for the fact that they were under weight. This mother was the most interesting marketer, bought a good variety of food, baked bread and scones at home, and, after paying rent—5*s.* 9*d.* weekly—was

able to save a little. Of course this is a small family and the father—a labourer—earned 52*s.* weekly.

3. Conditions in this family had been very bad; the father had been a great deal out of work and there were 7 children. The mother, however, was a good manager and always contrived to make ends meet. In spite of such bad times, the children all looked well, although under weight; the mother is a very small woman but healthy. Total income 45*s.* weekly; rent 4*s.* 7½*d.*; coal 2*s.* 6*d.*; gas 2*s.*; insurance 1*s.* 6*d.*; the father has always been steady and helped in the house. He is a labourer.

4. This was, physically, a particularly good family, all being above the average height and weight. Both father and mother are very tall and broad. One of the children was operated upon for tubercular glands of the neck, but seems to be in good health again. Most of the income was spent on food and the mother was a very good buyer. The house—one apartment—was a sublet room and only cost 3*s.* 3*d.* weekly. Ventilation was very bad; air-space was small. Father was a labourer; total income of family 45*s.*

5. This family had probably the best circumstances in the group of nine. In spite of this, the mother gets the lowest energy value per penny (see Table 113), and also the lowest total number of calories per man per day. Here, where the income is higher, the percentage of carbohydrates is low. The week in which the study was carried out the mother was not very well and made a goodly number of 'tea-dinners', but probably this was a common occurrence. No margarine was ever used, but a great deal of butter, which would account in part for the high percentage of fat and certainly for the high percentage of it being of animal origin. The house was exceptionally good and a fair amount was spent on clothes. Father—a barman—earns 55*s.* weekly; rent 9*s.* 3½*d.*

6. This was a typical working-class family. The father had always worked as a lamplighter, and never been unemployed. The children were very small and thin, but both parents were below average height. The mother had had five children in four years, three of whom were living. One child of two years showed marked evidence of rickets, but, on the whole, the children were in good health. The home was in a basement, badly ventilated and dark, and the mother said the children were seldom taken out. Total income 40*s.*; rent 6*s.* 8*d.*; coal 2*s.* 6*d.*; gas 2*s.*; superannuation fund 2*s.*

7. This was the poorest family. They had had a great deal of unemployment and were behind with the rent. Nevertheless the children were very healthy looking and well cared for. The mother was a good cook and tried to make the food as appetizing as possible. In this respect she resembled the mother in family 2, and in both cases the percentage of protein is higher than in any of the other dietaries of the group. The house was of one apartment, but bright and well ventilated. Total income 37*s.* weekly; rent 7*s.*

8. This was, physically, a particularly good family, all being above the average in height and weight except one child, the only male member of the family, who was very ill at the time of the study. This mother purchased the highest total number of calories, but had spent more than her weekly income on food during the week of the study. As a rule she managed to pay everything weekly, and was not in debt. The house was of one apartment, badly ventilated and very dingy. Total income 45*s.* weekly; rent 4*s.* 2*d.*

9. Conditions here were not very good. The father—a coal labourer—worked only about four days a week and the mother was a bad manager. The children, however, although not very clean, looked fairly healthy and took their food well. Tea was made very frequently; soup was made very seldom. Most of the income was spent on food. The house was very untidy, presented no air of comfort, and was dark and badly ventilated. Total income 45*s.* weekly; rent 5*s.* 10*d.* weekly.

APPENDIX IV

NOTES ON FAMILIES IN MISS CLARK'S DIETARY STUDIES

1. Father carter, regularly employed, but drinks. Usual wage £2 15*s.* : gives £2 8*s.* to wife, out of which she has to pay rent (6*s.* 7*d.*), societies (3*s.* 2*d.*), clothes, &c. Mother does occasional sewing; very careful. House and children beautifully clean. Second child has abdominal tuberculosis: the others are healthy.

2. Father employed only one or two weeks since January: keeps house: mother working in jute mill. Income of father 18*s.*, wife about 30*s.* House very clean and children well kept and well nourished, except baby. Income overspent by about 6*s.* 3*d.* Rent arrears 24*s.*

3. Father jute weigher, with pension. Mother also working at present, to make up for lock-out. Mother's father and brother also working. Total income £6 13*s.* 4*d.* All household well cared for and well nourished. Surplus money banked.

4. Father cripple, hawks occasionally. House bare and untidy, surviving child fair health. Mother very badly nourished. Income 29*s.*, of which 8*s.* could not be accounted for. Arrears of rent 54*s.* 10*d.*

5. Father ropeworker, income £2. Arrears of rent 17*s.*, owing to lock-out. 7 children well cared for but not very healthy in appearance. Mother very thin and anaemic. Father also thin. Usual dinner ½ lb. mince for 9 people, with potatoes or bread.

6. Father jute machineman, wages £2 1*s.* 9*d.* House rather bare, belongings pawned during lock-out. Arrears of rent 33*s.* 4*d.* Mother doing her best with food. Two elder children only fair in condition and not very intelligent, speech not clear.

7. Father jute batcher. Both parents careful and steady, undernourished. Income 36*s.*, rent arrears 62*s.* Eldest girl fair condition, others good. House clean.

8. Father dyeworker. Wages £2 10*s.* : 4 children got school dinners. Mother careful and good shopper. Rent 20*s.* arrears. Baby and child of 4 not recovered from illness contracted while mother in hospital with pneumonia. House clean and well furnished.

9. Father foundry machineman, not very healthy. Ill during week of study, income 9*s.* 6*d.* instead of usual £2 10*s.* House and children badly kept but children well nourished (3,481 calories per man per day for week of study). Youngest two albinos and rachitic, frequently in Infant Hospital. Food to usual extent bought on credit. Rent arrears 36*s.*

10. Father jute preparer, unemployed 14 months. Mother 9/12 pregnant. Income 23*s.* free milk, 2 children got free school dinners. Rent 25*s.* arrears. House filthy and unventilated. Mother never good housekeeper. Two elder children been rachitic. Youngest girl (2½ years) good condition.

11. Father unemployed 4/12—juteworker. Income 18*s.* father, 12*s.* wife. Mother in very poor condition, badly treated by husband. Children all in poor condition. Income overspent, arrears to pay at shops. Rent only 8*s.* 6*d.* in arrears. House fair.

12. Father juteworker, unemployed 2 years. Income 25*s.* and free dinners. Free milk usually, but not applied for in time during week of study. Girl of 15 died in March from tuberculosis. Funeral being paid for in instalments. Mother slightly paralysed. Eldest girl also tubercular and oldest boy suspected to be suffering from same disease. Three youngest children in good health. House fair, but almost bare. Children very few clothes.

FOUR TYPICAL BUDGETS.

Budget I.

	£	s.	d.	
Societies	0	3	5	
Rent	0	6	7	
Coal	0	1	10	
Gas	0	1	9	
Cigarettes and paper	0	1	2	
Cleaning materials	0	1	2	
Boots	0	2	0	
Retained by husband	0	7	0	
Arrears at grocer's	0	2	0	
Food	1	5	3	
	£2	12	2	Income £2 17*s.* 6*d.*

Budget II.

	£	s.	d.	
Societies	0	2	11	
Rent	0	6	0	
Coal	0	3	8	
Gas	0	2	4	
Cigarettes	0	1	0	
Cleaning material	0	2	5½	
Clothes	0	4	0	
'Minding baby'	0	2	0	
Food	1	9	0	
	£2	13	4½	Income £2 7*s.* 8*d.*

Budget VI.

	£	s.	d.	
Societies (with arrears)	0	7	0	(usual 4*s.* 6*d.*)
Rent	0	3	8	
Coal	0	1	10	
Gas	0	1	0	
Coke	0	1	0	
Pans	0	1	0	
Clothman	0	2	6	
Bootman	0	1	6	
Food	0	19	8	
	£1	19	2	Income £2 1*s.* 9*d.*

Budget XII.

	£	s.	d.	
Funeral Society	0	2	0	
Rent	0	3	6	
Coal	0	3	8	
Gas	0	1	7	
Tobacco	0	1	8	
Firewood	0	0	2	
Borrowed money repaid	0	4	0	
Food	0	13	1	
	£1	9	8	Income £1 5*s.* 0*d.*

APPENDIX V

COST OF CLOTHING OF ADULTS AND CHILDREN AMONG THE WORKING-CLASS FAMILIES IN GLASGOW

The subjoined table gives the estimated cost of an outfit for adult females and for boys and girls from infancy to 12 years, and the relative cost when compared with the cost of an adult male's outfit. The cost of an adult male's outfit is estimated to be £6 5*s.*, and is taken as unity.

TABLE 1. *Cost of Outfit for Boys and Girls from Infancy to 12 Years and Adult Female and relative cost as compared with Adult Male* (=1).

Age and sex.	*Estimated cost of clothing.* *s.*	*d.*	*Clothing scale compared with adult male=* 1·0	*Diet scale (Lusk).*
Adult female	87	1	0·68	0·83
Infants:				
First outfit (2)	30	0	0·23 } 0·49 [1]	0·5
Shortcoated (2)	33	0	0·26 }	0·5
Boys— 2 years	44	7	0·35	0·5
,, 4 ,,	45	8	0·36	0·5
,, 6 ,,	51	1	0·40	0·6
,, 8 ,,	55	4	0·43	0·6
,, 10 ,,	63	2	0·49	0·83
,, 12 ,,	66	7	0·52	0·83
Girls— 2 years	33	3	0·26	0·5
,, 4 ,,	36	5	0·28	0·5
,, 6 ,,	38	2	0·30	0·6
,, 8 ,,	42	0	0·33	0·6
,, 10 ,,	46	5	0·36	0·83
,, 12 ,,	50	3	0·39	0·83

[1] This figure for infants is reached by allowing two complete sets of 'long' clothes and two complete sets of 'shortened' clothes.

The data on which the estimate is based were obtained from the Glasgow Co-operative Society. An attempt has been made to include all garments considered necessities in the class under consideration. Three pairs of stockings were allowed for in each outfit as being the probable number of pairs worn out with each outfit, but this is possibly too low an estimate of the stockings worn out by active boys and girls while wearing out the other garments. Stockings for both boys and girls seem to be the article of clothing which is dearer than those worn by adults. In the case of all other garments there is a definite increase in the cost on the approach of adult life.

The customers who deal with the co-operative shops are of a class rather superior to those studied in the present inquiry.

J. A.

APPENDIX VI

MATERNAL EFFICIENCY AND MENTAL CAPACITY

Tests were applied to fifty-seven women, only three of whom 'struck' soon after the preliminary information had been obtained from them. Several had to be excluded from the final list because of retardations obviously due to defective eyesight. There were left for most of the statistical determinations two groups of 20 and 26 mothers, the former being described as 'good', the latter as 'bad'. These descriptions were prepared by the various field workers (Miss Tully, Miss MacNae, Miss Urie, and Miss Gribbon) who visited the houses.

The tests were applied individually as follows. After a preliminary period for shock-absorption, in which the birthdays of all the children and their general welfare, &c., were noted, and some indication of the purpose and benefit of the inquiry was made, the time was taken for the reading aloud of the test passage set out on p. 351 of C. Burt's *Mental and Scholastic Tests*, London, 1921, the number of errors being noted as well. Then the first three tests (Opposites, Analogies, and Mixed Sentences) contained in 'Group Tests, Series 33' of the National Institute of Industrial Psychology (to which we hereby renew our thanks for permission to use them) were applied. The instructions for these tests were presented orally, the booklet being opened at Test 1, for example, with the actual test matter covered from sight. The examiner pointed with his pencil at the printed instruction and read it over clearly and also the examples, making sure that the latter were, at least apparently, understood. With the dullest an effort was made to bring them up to 'scratch' on these examples by means of reiteration. Then the covering paper was removed and the work begun, the first underlining being encouraged with 'That's right. Now go ahead, as fast as you can.' The set time of three minutes was allowed. Once or twice, when comprehension obviously failed, a further effort was made to reach comprehension by questions such as: 'Dry and wet: are they the same or opposite?' before the test was abandoned as hopeless.

This oral method proved satisfactory and encouraging, helping to carry the subjects into work and establishing good feeling. Apart from the three who struck the embarrassment felt by the subjects in the work was negligible. All of them seemed eager to do their best and to keep up the effort till the time was up, in spite of the distraction provided by the occasional presence of a child that could not be left at home. In this respect the conditions were not always ideal, but they were the best possible under the circumstances; and on the whole the procedure seems to have justified itself.

After the booklet test the Porteous Maze tests for ages XII and XIV were given, the doing of the test for age VII being used as an instruction. It was thought that this practical work might offer scope to some of the more defective minds likely to be involved in the inquiry.

The invitation to attend for this work at the Royal Hospital for Sick Children, Yorkhill, Glasgow, included the promise of a payment of half a crown.

Results. Correlations (products-moment) were determined between the three booklet tests: (1) for the total number of items rightly underlined in each test ('Totals'); (2) for the total number rightly underlined in the *first half* of each test ('Halves'); and (3) for the total number rightly underlined minus the number wrongly underlined in each test ('R–W'). The amount of the tests done was usually about a half, and beyond that guessing was obviously prevalent. The correlations for the first halves are accordingly rather higher. The correlations for R–W show it is too drastic a method of scoring for such relatively poor performances as these subjects made.

TABLE 1. *Correlations (r) between Opposites Test (I), Analogies Test (II), and Mixed Sentences Test (III).*

	Tests I to II ($n=48$).	*Tests II to III* ($n=47$).	*Tests III to I* ($n=47$).
Totals	0·602±0·06	0·439±0·082	0·635±0·058
Halves	0·612±0·06	0·651±0·057	0·888±0·019
R−W	0·43 ±0·08	0·32 ±0·09	0·55 ±0·07

Totals = Total number of items done in each test.
Halves = Number of items correctly done in the first half of each test.
R−W = Number of items correct minus the number wrong in each test.

These three booklet tests may, therefore, be taken as internally consistent. And for the purpose of correlation with the other tests they may be properly represented by proportionate summation, when the following results appear.

TABLE 2. *Correlations (r) between the Proportionate Sum of the three Tests of Table 1 and the other Tests (Halves).*

	Reading times ($n=47$).	*Maze XII* ($n=44$).	*Maze XIV* ($n=44$).	*Sum of XII and XIV* ($n=44$).
First halves of three booklet tests .	−0·675±0·054	−0·369±0·09	−0·283±0·09	−0·356±0·09

From this it appears that the reading times are well correlated negatively with the booklet tests as a whole, and might be taken alone as representative of the whole test-work done. Although the times of performance of the mazes are well correlated with one another (+0·65±·06, n=44) they show a much lower correlation with the booklet tests. Evidently the aspect of speed does not emerge so naturally and inevitably in them as in the reading work. A variable amount of time is spent in surveying the maze before starting, while the speediest method is undoubtedly to begin tracing the maze at once and to look only to the next coming choice of pathways.

We may, therefore, proceed to consider the relation of performance in these tests to the good-bad classification of the subjects.

TABLE 3. *Quantitative Difference between the Test-work of the 'Good' and 'Bad' Subjects and its Reliability.*

	Average good.	*Average bad.*	*Difference.*	*Difference.*	*Probable integral.*
First halves of each booklet test *	56·25	45·77	10·48	6·632	7·8 to 1 agst.
R−W	60·43	43·65	16·78	10·46	8·96 to 1 agst.
Reading times (in seconds) .	85·36	102·04	16·67	12·20	4·8 to 1 agst.

* Average proportion correct in the first halves of the three tests.

From this it appears that the two classes—good and bad—are not so distinct from one another for these representative tests that their differences might not be due to the chances of sampling. Still the probability lies against mere sampling error, and suggests that with gradation in the classification and possibly improved classification a more distinctive difference might be obtained. The probabilities for the maze tests are slightly in favour of the same results being obtained another time.

The biserial correlations for these three indices are:

Halves . . .	+0·279±0·183 (=2×P.E.)
R−W . . .	+0·356±0·172 ,,
Reading . .	+0·238±0·183 ,,

H. J. W.

APPENDIX VII

INCIDENCE OF RICKETS IN GLASGOW AND DUNDEE

During the time I was working in Dundee I visited about 250 families, and my impression on comparing Dundee and Glasgow with regard to rickets is that the disease is not only much more prevalent in Glasgow, but also much more severe. While I believe that a great number of the babies in Dundee would show a positive X-ray plate for rickets, the disease would appear to be of a mild degree and not sufficient to cause delayed walking or to produce any deformities, slight epiphyseal enlargement at the wrists being often the only clinical sign. I seldom found a case where a child had gone off his feet after commencing to walk, which, in Glasgow, is a common occurrence. Only in one instance did I find a family obviously rachitic, and this was where the mother had had 4 children and 1 miscarriage during a period of 5 years. The eldest, a boy of 5 years, was at school; the second died at $2\frac{11}{12}$ years from broncho-pneumonia and convulsions; the third child, aged $1\frac{9}{12}$ years, was unable to walk; while the baby, aged 7 months, showed active rickets.

Thinking that perhaps I had not seen a sufficient number of cases, I asked one of the Health Visitors what her district was like (I had not worked there) and she kindly took me round. In the whole of her district, comprising about 1,000 families, she could only show me 6 families where there were marked rachitic deformities, but she remarked (just as I had noticed) that a great number of the babies showed slight signs of rickets, legs being a little bent when they started walking (not late), but soon becoming quite straight. She also said it was the exception to find a child ' going off its feet ' with rickets.

I may say that in nearly all the families with the deformities the children had been breast-fed but had seldom been taken out. In one case the eldest child spent the first ten months of his life in the Highlands and walked at that age, when the parents came to Dundee and the mother went out to work: three children born since then are markedly rachitic.

Speaking generally, and especially when the mother goes out to work, the diet consists largely of tea, sausages, &c., probably because such food is quickly prepared. The babies also are taken off the breast, at least during the day, and handed to a neighbour with a bottle. I believe, however, they are kept on the breast at night for a considerable time, and sometimes, if the mother's place of employment is near at hand, they get a breast-feed at the dinner hour.

The houses, although often small, cramped, and very dilapidated, frequently have an outside stair and balcony where the children play and the babies sometimes sleep. The use which is made of the public parks in Dundee by the working classes is also a noticeable feature; indeed they seem to be used almost entirely by them, and during the summer months large numbers of mothers and children can be seen sitting there every evening.

I have not seen any slums in Dundee to compare with those in the worst districts of Glasgow, and even in the worst places in Dundee a short walk takes one into comparatively good air, which is in marked contrast to the conditions in Glasgow.

I need hardly say that when working in Glasgow I could go into house after house and find two, sometimes three children, not walking or having gone off their feet on account of rickets. I admit, of course, that I probably saw the worst cases, but then I have also seen the worst in Dundee, according to the people who work continually among them.

I may say, in conclusion, that it came as a great surprise to me to find Dundee so much better so far as rickets is concerned than Glasgow, with so many mothers working in the factories and such indifferent feeding, but I have consistently found that the Dundee mothers attach a great deal of importance to getting the children out into the open air.

H. W. MacNae.

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