Department of Health and Social Security

Reports on Health and Social Subjects
No. 3

A Nutrition Survey of the Elderly

Report by the Panel on Nutrition of the Elderly

London
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LONDON
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PREFACE

The Committee on Medical Aspects of Food Policy has long been aware of the lack of information about the circumstances and conditions of life of ageing people, and its Panel on Nutrition of the Elderly has already stated that the "evidence is too patchy and unrepresentative to enable a comprehensive picture of the nutritional state of the elderly throughout Britain to be obtained". The first Report by the Panel, which was published in 1970, included a recommendation that field surveys should be undertaken which had then already been implemented. This Report presents the results of the study of the dietary habits, medical condition and socio-economic circumstances of men and women aged 65 years and over living in their own homes or with relatives in four areas of England and two areas of Scotland.

The field work of the survey was completed in one year from 1967 to 1968, but the processing and statistical interpretation of the information obtained has been a much more lengthy task. The time lag between investigation and publication is unfortunate but does not seriously detract from the value of the results. They include much that will help us to see our present situation more clearly and will facilitate future studies. It is to be hoped that the experience of handling this study will also make processing of future material more rapid and effective. This Panel has been feeling the way for others to follow.

It was reassuring to find that the dietary pattern of these elderly people was not very different from that of the general population; they ate much the same kind of food but in smaller quantities. There was also no evidence to suggest that those participants in the survey who ate a less good diet did so from any clear economic cause. The clinicians found some but not much overt malnutrition. The diagnosis is a difficult one, and the possible effect of differences between the clinicians in diagnostic criteria could not be excluded. The most important reason for malnutrition when it occurred was often an underlying medical condition rather than a poor diet.

Nevertheless the survey does show that some old people—even though they may have been only a very small proportion of a sample which included a high proportion of those at special risk—were demonstrably malnourished. There were others for whom more could have been done and others still whose margin of safety must have been narrow. We are certainly not justified in concluding that present services give all the assistance which is required.

Valuable as the findings of the survey are, the Panel feels that a greater significance could be attached to them if the surviving subjects were followed up, and the Panel recommends that the survey be repeated after a period of years. The Panel makes certain other recommendations. One of these draws attention to the necessity for identifying those in need by regular visits to elderly people, and this would be most effectively arranged by the community nursing services in collaboration with general practitioners. It is well known that many elderly people may often be unaware of the help that is available or of their need for it, or may be reluctant to seek it.

The Panel is to be congratulated on its achievement in gaining so much information of a kind and on a scale never before attempted in this country. The study described in this Report could not have been made without efficient organisation and co-ordination by all those taking part. The clinicians and dietary investigators did the main field work, but the survey would have been impossible without the assistance of the Clerks of the Executive Councils and the general practitioners in the areas: COMA is deeply grateful to them all. The Committee is most happy to acknowledge the co-operation of the members of the public who allowed themselves to become the subjects of this survey and submitted to what must often have been tedious interviews and rigorous examinations.

G. E. GODBER
Chairman, Committee on Medical Aspects of Food Policy

PANEL ON NUTRITION OF THE ELDERLY

The terms of reference of the Panel are:

"to evaluate the evidence on the nutritional state and diets of the elderly".

The members of the Panel on Nutrition of the Elderly are:

Chairman:

Dr. A. N. Exton-Smith	Geriatric Department, University College Hospital, London

Members:

Prof. W. Ferguson Anderson, O.B.E.	Professor of Geriatric Medicine, Glasgow University
Dr. J. D. B. Andrews	Geriatric Department, Isleworth Hospital, Middlesex
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Dr. J. A. Gillet	Medical Officer of Health, London Borough of Barking
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Secretaries:

Scientific:

Mrs. M. M. Disselduff	Departmet of Health and Social Security, London

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Mrs. J. M. Firth (until 1970)
Mr. L. G. Smith (from 1970)

The Panel wishes to acknowledge the expert help and advice of Dr. W. T. C. Berry, C.B.E., Principal Medical Officer, Department of Health and Social Security, and also that of Mrs. M. M. Disselduff, Senior Research Officer, who carried out a pilot survey, trained the dietary investigators and supervised their work.

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The survey was planned by members of the Panel on Nutrition of the Elderly listed on the preceding pages. The following members of the Panel organised and participated in the field work:

Professor W. Ferguson Anderson, Rutherglen
Dr. C. Cohen, Angus
Dr. D. E. Hyams, Cambridge
Dr. P. Millard, Camden
Dr. N. M. Plowright, Portsmouth
Dr. E. Woodford-Williams, Sunderland

In addition Dr. T. Judge and Dr. N. Cowan gave expert clinical assistance.

The Panel had the generous help of the clinical biochemists who added the laboratory investigations to the burden of their routine work, and is grateful to Professor D. Mollin and the staff of the Haematology Department, St. Bartholomew's Hospital, London, for haematological measurements; also to Mr. G. Thackray, Public Analyst's Department, Portsmouth, and Dr. I. Sharman, Dunn Nutritional Laboratory, Cambridge, for the riboflavine measurements.

Finally, acknowledgement must be made of the tireless efforts of all the dietary investigators who by their tact and patience elicited so much important information.

I PLAN OF THE SURVEY

CHAPTER 1

Introduction

1.1 Historical

1.1.1. The number of people in Britain aged 65 or over is rapidly increasing both absolutely and in proportion to the rest of the community. The percentages of the elderly in the total population for 1961, 1964 and 1967 were: men, 9·3%, 9·3%, 9·7%; women, 14·1%, 14·4%, 15% respectively. Even if there were no change in the willingness of relatives to care for and feed those who cannot manage for themselves, a growing burden would be imposed upon the community. We need much more up-to-date information about the circumstances of the elderly in order to devise ways and means of caring for those in need efficiently and economically.

1.1.2. The last major survey of the nutrition of the elderly in the U.K. was in Sheffield in 1952 (Bransby and Osborne, 1953). Its main emphasis was on old people living alone or with their spouses, and clinical as well as dietary information was collected. A smaller survey of 60 old women living alone in two London boroughs was made by the King Edward's Hospital Fund in 1962 (Exton-Smith and Stanton, 1965). No very clear-cut indication of malnutrition emerged and the popular idea that many old people who live alone exist almost entirely on bread, butter, jam, biscuits and cups of sweetened tea was not substantiated.

1.1.3. In 1967 a Panel on Nutrition of the Elderly, set up by the Committee on Medical Aspects of Food Policy, reported that although overt malnutrition rarely occurred there might be a wider incidence of sub-clinical malnutrition (Department of Health and Social Security, 1970). However, the Panel also stated that "evidence is too patchy and unrepresentative to enable a comprehensive picture to be obtained".

1.1.4. The survey described in this Report took place during the period 1967 to 1968 and was designed to fill in some of the gaps in this evidence. The subjects were elderly people living alone or with spouses, relatives or friends, but outside institutional accommodation, and all were included in the survey irrespective of their state of health. In this and certain other respects it differed from an interesting study made in two areas of Holland (de Wijn, van Staveren, de Groot-Polman, Postmus, Peeters and Wigbout, 1967) which appears to be the only other recent large survey of old people in the western world. The Dutch survey was restricted to healthy individuals, and certain differences, presumably national, limit the applicability of the findings to the U.K. elderly population. Dutch old people appear to be more heavily built than British and obesity seems more of a problem.

1.2 The Assessment of Nutritional Status

1.2.1. Though both this and other countries publish tables of recommended intakes or allowances of nutrients for all age groups (e.g. Department of Health and Social Security, 1969), the recommendations for the elderly are based on even less adequate evidence than are the allowances for other age groups (for whom, in any case, the requirements for any nutrient can frequently only be estimated with many assumptions). Whilst therefore a recommended intake is indicated on some of the histograms of nutrient intake which appear in Appendix A of the Report, the real issue is the extent to which correlations were revealed between disturbances of form or function of a sort likely to be due to malnutrition and intakes of a particular nutrient which were low relative to the majority of intakes of that nutrient.

1.2.2. Similar considerations apply to certain biochemical measurements. For example, some workers have spoken of "deficiencies" of ascorbic acid where the evidence merely showed values in leucocytes below those regarded as usual in younger people, but without referring to any disturbance of form or function which might result from such "deficiency" or to whether or not the subjects' intakes were adequate. Until the necessary groundwork has been done to establish levels which conduce to malnutrition, many biochemical findings require to be interpreted with reserve.

1.2.3. Comparable problems arise in clinical diagnosis. There is no disagreement where there is clear-cut malnutrition; however, if malnutrition is mild in degree there are wide differences not only in the proportions of any population diagnosed by different clinicians as malnourished, but also in the opinion given by a single observer examining the same individual on two occasions. In the elderly in particular a further complication is that non-nutritional disease may produce signs or symptoms similar to those arising from malnutrition, and the investigations needed to distinguish them cannot be made in the course of nutrition surveys.

1.2.4. How then is malnutrition revealed? In underdeveloped countries, when malnutrition is rife a diagnosis can often be made on clinical grounds alone; in Britain this is exceptional. But in certain instances malnutrition can be inferred from a summation of the evidence, for example where some indicative but non-specific clinical sign coincides with a low intake of the relevant nutrient and/or abnormal biochemical findings. Nevertheless, any statement as to how much malnutrition exists in a community is subject to the reservation that the amount diagnosed depends upon the delicacy of the tests used and upon the interpretation put on them. In the text, therefore, the basis for inferring or suspecting malnutrition is described in all instances.

1.2.5. The concepts of optimal and of marginal nutrition need here to be discussed. The term 'optimal' is often applied with a certain mystique to a state wherein an especially high intake of some nutrient is alleged to confer some special advantage to the consumer over "adequate" amounts. In our view what is adequate is optimal and what is not optimal is not adequate. Within the body, nutrients consumed are used for certain specific functions and if these are performed no added advantage accrues from the intake of greater quantities.

1.2.6. The only reservation relates to marginal nutrition, in which the supply of a nutrient or nutrients is only sufficient in the absence of disease or other stress. Some reserves are then desirable. What is less certain is the validity of some of the biochemical values which are interpreted to indicate marginal nutrition. For the elderly in particular such values might well be interpreted with more confidence if after a sufficient interval a second study of the same subjects were made. A comparison could then be made between the fortunes of those whose biochemistry indicated that in one or other respect their nutrition was marginal, and those whose biochemistry indicated a "better" nutritional state.

1.3 Follow-up Studies

1.3.1. From what has been said about marginal nutrition, the desirability of follow-up studies on the same subjects is obvious and indeed provision was made for this in the plans for the present study. In addition, uncertainty exists as to the extent to which a dietary survey made in a single week may be indicative of what happens in other weeks. In the hope of testing this in the present survey, some investigators were asked to resurvey a random sample of their subjects; 58 such records were completed and the results are discussed later (paragraph 4.7.1.).

1.3.2. When analysing the survey findings account could not be taken of any variations revealed by this resurvey. These, and the errors inherent in dietary surveys, have been ignored in reporting intakes of nutrients. The reader should therefore bear in mind that where consumption is stated to have been x grams, it should more properly read that the intake was *reported* as x grams.

CHAPTER 2

Methods

2.1 **Dietary**

2.1.1. No method has ever been devised for collecting completely reliable and comprehensive dietary information from members of the general public. In other U.K. surveys reliance has usually been placed on 7-day records of the weight of every item eaten (except where food is eaten outside the home, when it has to be assessed). In some countries "recall" methods are used, whereby the food consumed in the previous 24 or 48 hours is described and the amounts assessed by the interviewer. In others, information on the previous week's food purchases is obtained. De Wijn *et al.* (1967) used a combination of these to study the diets of old people, reconciling as far as possible a 24-hour dietary recall with the weekly shopping bills. Presumably they recognised that a weighed record was unlikely to be within the capacity of some of their subjects.

2.1.2. In the study reported here an initial "recall-type" interview elicited the general dietary pattern (see Appendix B, p. 127), but the subject was also asked to keep a written diary of food eaten and times of eating during the succeeding week. The dietary investigator visited at frequent intervals in order to quantify this material and record it; food purchases were used as a cross check.

2.1.3. Recorded entries were coded, using a code list of approximately 800 foods for each of which a composition, in terms of energy and 12 nutrients, had been calculated. In the preparation of the food composition table no allowance was made for the seasonal variation of vitamin C content of foods; instead a weighted figure was used. The food composition table related to the edible portion of food ready for consumption and consequently allowance had been made for losses in preparation and nutrient loss or destruction in cooking.

2.2 **Medical and Radiological**

2.2.1. Every subject was asked to agree to a clinical examination at hospital or clinic, and a radiograph of the left hand (or right where there was a lesion of the left) was taken for measurement of cortical bone thickness of the 2nd metacarpal. Some subjects only agreed to a medical examination at home, when a visit was made by a physician. The form used in the medical examination (Appendix B, p. 133) included a search for the accepted signs of malnutrition, for signs probably or possibly due in part or whole to malnutrition, and for important non-nutritional disease, particularly where this was likely to affect the diet either through reduced ability to cope, diminution in activity (and hence energy requirement) or malabsorption.

2.2.2. No attempt was made to standardise the clinicians' methods (though they had the opportunity of discussion before the start of the survey), nor to test inter-observer error.

2.3 Biochemical

2.3.1. During the clinical examination, which routinely took place in the morning, a sample of about 30 ml blood was taken for biochemical investigation. The sample was divided into several portions (see Appendix B, p. 145). Some biochemical measurements were done in the individual areas, although not every area performed each test, and the methods used were not always the same (Appendix C, Table C3, p. 158). All the haematological measurements were made at St. Bartholomew's Hospital, London, on samples of blood packed in dry ice and sent by rail in insulated containers. The haematology results are described in detail in the Special Studies, p. 56, and the biochemistry is discussed on p. 62.

2.3.2. It was not possible at the time of the survey to arrange for all biochemical determinations to be made at a single centre. Therefore in order to have some idea of the degree of comparability to be expected in the results of the measurements made in the different areas, standard bloods and sera were sent from London to Portsmouth, Sunderland, Rutherglen and Angus throughout the year in which the survey took place. Biochemists in these areas were asked to include these samples amongst those taken from the elderly subjects in the survey and to measure haemoglobin, PCV, serum proteins, alkaline phosphatase, pseudocholinesterase, calcium and phosphorus on them. The results of this exercise are shown in Appendix C, Tables C4, 5, 6, pp. 160–2. Although some tests show the degree of variability between centres which is a familiar finding whenever trials for reproducibility are made, for haemoglobinometry agreement is better. Care has had to be taken to avoid distortion in correlations between biochemical and other findings, arising out of differences relating to individual centres.

2.3.3. In Portsmouth a 24-hour urine sample was collected on which riboflavine was measured in the Public Analyst's Department, and in Cambridge, measurements of riboflavine were also made in the Dunn Nutritional Laboratory on 4-hour specimens of urine taken after a 1 mg load dose.

2.4 Socio-economic Information

2.4.1. The dietary investigators were asked to make some enquiries concerning the socio-economic circumstances of each subject; Appendix B (p. 141) shows the questions asked. These were designed to indicate *inter alia* the extent to which the subject was socially isolated, whether he or she was wholly financially dependent on the State, and to assess dependence on others.

2.4.2. In addition, at the close of each study the dietary investigator wrote a "case report" containing anything likely to be of interest, and a general description of the individual and his environment was given. This was of value when dietary or other findings appeared out of harmony with the rest of the evidence.

2.5 Data Processing

2.5.1. The diet records were coded by fieldworkers according to a scheme prepared by the Department. The medical and social questionnaires were coded in the Department and all data recorded on punched cards, which were then used for the computer work carried out under contract by a commercial bureau. The information collected on each subject was extensive and in order to keep the tabulation programme within practical bounds and because little experience was available about the probable distribution and interrelationship of some of the factors, it was decided to deal with the production and analysis of results in two stages. A programme of tabulation was drawn up in advance which covered not only the basic requirements but a good deal of a more exploratory nature (even so, this totalled some 7,000 tables) which could be studied in detail for leads to other possible relationships. In the light of this study, a further programme of tabulations was specified and produced, which not only developed in greater detail certain aspects of the earlier analysis (in particular relating to socio-economic, haematological, and bone density information) but which filled in gaps revealed in the first material. These successive processes took a good deal of time and largely account for the lapse of time in reporting the results of the survey.

2.5.2. Statistical output was in the form of student's "t" tests and chi-squared tests. Student's "t" tests, which give the probability of a significant difference between two means, were used within each sex group to compare the mean calorie and nutrient intakes of the two age groups. Where an "F" test revealed significant differences between the variances of the two samples being tested, a modified version of the "t" test was used. No analysis was performed at this stage between means of subgroups within an age group. Chi-squared tests, which ascertain the probability of dependence between two variables, were produced by the computer on a specified number of distributions. It is a standard statistical criterion that no expected value of any one "cell" of a distribution should fall below 5; consequently it was necessary to specify acceptable combinations of subgroups of factors in order to prevent, on the one hand, hundreds of unusable tables, and on the other, random and probably unacceptable combinations of subgroups within a factor.

CHAPTER 3

The Sample

3.1 The Areas Surveyed

3.1.1. Six areas were surveyed, their number and selection being governed by such practical considerations as the difficulties of co-ordinating a larger number centrally; in these particular areas a senior geriatric physician had displayed special interest in nutrition. Two areas were predominantly rural—the south of Cambridgeshire in England (excluding the city of Cambridge) and the county of Angus in Scotland (excluding the large borough of Arbroath). The remaining areas were different types of urban community—Rutherglen, a small town near Glasgow; the northern industrial seaport town of Sunderland; Camden, a part of London; and the southern seaport of Portsmouth. In Camden, the nutrition survey was done under the auspices of the King Edward's Hospital Fund and was an extension of an existing survey of a wider and different nature, on the unmet social and medical needs of the elderly, which was being conducted by Bedford College Social Research Unit and University College Hospital Medical School.

3.1.2. The aim was to obtain information in each area on approximately equal samples from four groups of the elderly population living at home—men aged 65 (70 in Camden) but under 75; men aged 75 or over; women aged 65 (70 in Camden) but under 75; women aged 75 or over. In Angus and Rutherglen the target was 100 records, i.e. 25 in each sex and age group. In each of the other four areas it was 200 records, i.e. 50 in each sex and age group. In the whole population there are considerably fewer people aged 75 or over than there are between 65 and 75, and since in both age ranges the women outnumber the men, the samples are weighted in the direction of the more elderly with a higher proportion of men than women. To allow for deaths, movement into welfare accommodation and so on, it was planned to draw samples of up to twice the required number of names.

3.1.3. Though the samples are relatively small and were not designed to produce in aggregate results which were necessarily representative of the U.K. as a whole, they constitute varied groups, with reasonably balanced proportions of the social, economic and environmental conditions obtaining throughout the country. The uniformity of results from the various areas suggests that some indication is given of the situation in the country as a whole; in certain instances therefore the data have been bulked. Where this is done, the reader should bear in mind that the sample is weighted as described in paragraph 3.1.2.

3.2 The Drawing of Samples

3.2.1. Except in Camden* the population was identified from the registers maintained by the local Executive Councils for the administration of the National Health Service. The procedure adopted, discussed beforehand with the British Medical Association and the Clerks of the Councils, ensured that no one outside the Councils had access to the registers. The population was stratified by the four age and sex groups from which samples were drawn by the Clerks. The selected subjects were then approached by the general practitioner or some other person on his behalf, made acquainted with the nature and purpose of the survey, and asked to participate. The Department of Health and Social Security and the Scottish Home and Health Department are much indebted to the Clerks of the Councils and to the doctors concerned for their help. Some subjects could not be traced despite enquiries of the local authorities and voluntary organisations, whilst others were found to be outside the scope of the survey because, for instance, they were away from home, or in hostels or hospitals. In a few instances doctors advised that, in the interest of the subjects, certain people should not be asked to participate in the survey.

Table 3.1.

Summary of the numbers drawn in the sample and the response

	Derivation of sample	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
A	Total sample drawn	1,568	441	279	363	124	146	215
B	Not traced	124	89	8	14	—	2	11
C	Reported dead[1]	61	26	4	22	—	—	9
D	Live sample A–(B + C)	1,383	326	267	327	124	144	195
E	Ineligible[2]	100	33	14	28	15	1	9
F	Eligible sample D–E	1,283	293	253	299	109	143	186
G	GP refused or advised against participation	32	17	1	9	—	5	—
H	Interviewed F–G	1,251	276	252	290	109	138	186
I	Refused to participate	372	134	52	91	9	37	49
J	Participated in study	879	142	200	199	100	101	137

NOTES: [1] People who died during the survey but for whom partial data were obtained e.g., someone medically examined who died before the dietary recording, are included in J and not in C.

[2] The ineligible cases at E include persons found to be under 65 years of age, in hospital or other institutions at the time of survey, prolonged absence from home, etc.

* In Camden a different method of stratification was used based on the number of visits made to a general practitioner. For this reason, Camden is excluded from some of the examinations of the participants and non-participants which follow.

3.2.2. Table 3.1 shows for each area the numbers drawn in the sample, those excluded for various reasons and those who provided information. The number of participants fell substantially short of the target of 200 in Portsmouth (142) because of the considerable numbers who could not be traced or who refused to take part, and also in Camden (137) where the original total sample was smaller than in other English areas. In Portsmouth only 51% of those interviewed (32% of the total sample drawn) participated, compared with 79% (72%) in Cambridgeshire, 69% (60%) in Sunderland, 92% (81%) in Rutherglen, 73% (69%) in Angus, and 74% (64%) in Camden.

3.2.3. The disparities between areas in sample loss from failure to trace, ineligibility or unwillingness are wide. The reasons for this are not entirely clear, but contributing factors may have been:

(a) unevenness in the quality of data recorded in the Register, affecting the extent to which names in the sample had to be discarded;

(b) variations in the sequence of dietary and medical investigations affecting the attitude and response of the subjects;

(c) the differing periods of time between drawing the sample and making contact, so affecting losses through death or change of circumstances;

(d) special local conditions, e.g. in Portsmouth, where there was a higher non-response rate, and in Rutherglen, where the high degree of co-operation may be partly attributed to the consultative clinic which has operated there for some 15–16 years.

Table 3.2.

Reasons for refusal to participate in the survey

Reason given	All areas	Portsmouth	Cambridgeshire	Sunderland	Rutherglen	Angus	Camden
Objected in principle	24	11	3	5	—	1	4
At work or too busy	44	24	1	8	1	9	1
"Did not need" because all right	25	10	1	5	1	6	2
Ill, unable to cope with survey, or too old to be bothered	31	21	2	4	—	2	2
Did not want to see doctor	40	1	7	23	1	7	1
Relatives unwilling	12	4	1	1	1	1	4
Subject unwilling, no reason given	196	63	37	45	5	11	35
Totals	372	134	52	91	9	37	49

3.2.4. Where a patient was contacted but did not participate, the reason for not wanting to take part was recorded; the results are summarised in Table 3.2.

The commonest specific reason given by non-responders was that they were too busy at work or elsewhere. Health was sometimes mentioned, particularly in Portsmouth, where 21 of the 134 non-responders said they felt too ill or old to be bothered with the survey and 10 others that they felt all right and "did not need" to take part. In Sunderland 23 of the 91 non-responders (and a few in other areas) gave unwillingness to see a doctor as their reason.

3.2.5. Information was obtained on 879 people—425 men and 454 women. Their age distribution in 5-year bands is shown in Table A1 (p. 76). In Camden, subjects under 70 years of age were not deliberately drawn in the sample, although in fact one woman under 70 was included. The numbers of men and women in the two Scottish areas were almost exactly equal, but in Camden the women aged 75 and over outnumbered those below that age. In the other nine area/sex groups there were as many or more in the younger range. Figure 3.1 compares the age/sex distribution of the overall sample with that of the total population of England, Wales and Scotland.

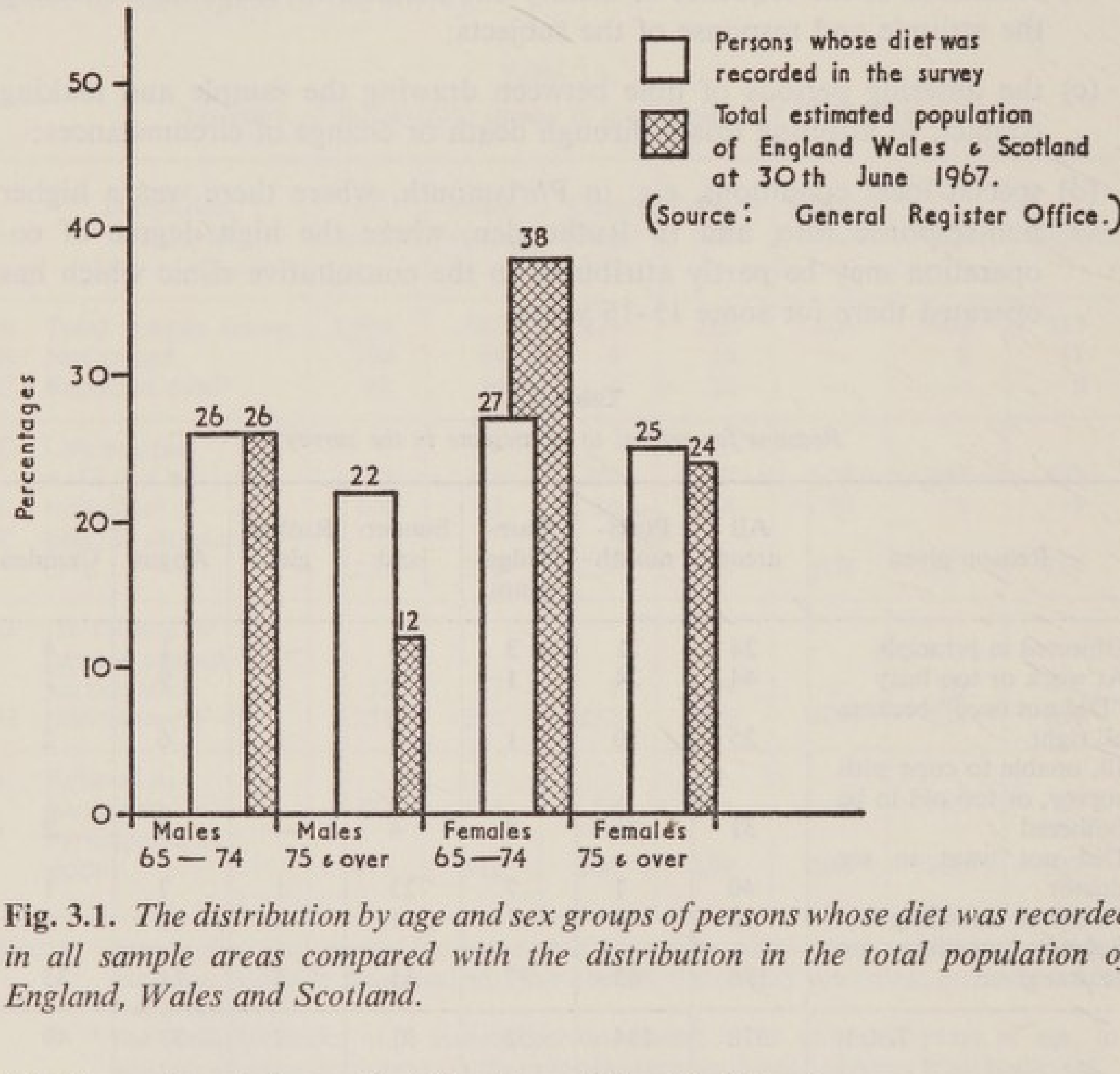

Fig. 3.1. *The distribution by age and sex groups of persons whose diet was recorded in all sample areas compared with the distribution in the total population of England, Wales and Scotland.*

3.3 Comparison between Participants and Non-Participants

3.3.1. The sex, and in most cases the age, of people who did not take part in the survey is known and in Table A2 (p. 77) their age/sex distribution is compared with that of the participants. Non-response was higher among women (34% of those interviewed in the five areas excluding Camden) than among men (27%). The highest refusal rate was in Portsmouth (45% of the men and 52% of the women interviewed); the lowest was in Rutherglen (6% of the men and 11% of the women). Among those aged 75 or over the proportion who refused (27% of men and 34% of women) was not significantly higher than among those aged 65–74 (24% of men and 30% of women). Information was frequently obtained on the mode of living of non-participants, together with an assessment of their degree of physical and mental competence and an indication of whether they were dependent on others to carry on. Table A3 (pp. 78, 79) sets out for both participants and non-participants the distribution by these factors in each area except Camden (for which this information is not available).

3.3.2. Taking the areas together, 17% of the male non-participants whose mode of living was ascertained lived alone, compared with 13% of the participants. The equivalent figures for the women were 39% and 37% respectively. Of the participating men 71% had wives living with them and 16% lived with other relatives, but only 35% of the participating women had husbands living with them and 24% lived with other relatives. The corresponding percentages for non-participants were 67% and 15% respectively for men and 31% and 27% respectively for women.

3.3.3. Similar proportions were considered to be independent (in the sense of not being dependent on others for shopping, preparation of meals and so on) amongst participants and amongst those non-participants for whom it was possible to make an assessment—79% of male and 76% of female participants; 75% of male and 79% of female non-participants in the five areas shown in Table A3 (pp. 78, 79). The figures for particular areas were fairly constant, except that in Portsmouth a smaller proportion of male non-participants were classified as independent (62%) than in other areas, and in Sunderland higher proportions of non-participants of both sexes were so classified (88% of men and 84% of women).

3.3.4. The information from the doctors was invaluable in assessing directions in which the sample of participants might be biased. For example, it is particularly important to assess the extent to which "bad cases", i.e. those who are mentally or physically incompetent, failed to participate in the survey. Among the 600 participants in the areas excluding Camden, and also Portsmouth where this information was not available, 3% were judged to be mentally confused, compared with 2·5% among the non-participants; 22% of participants were judged as of limited physical competence and 1·5% were helpless, compared with 19% and none respectively among the non-participants. It is of course possible that those of the non-participants who were confused were more confused than the corresponding participants. It is also possible that among those with whom no contact could be made (though known to be at home) a few very bad cases existed. But out of this unusually extensive information about the non-participants there is no positive indication that the sample surveyed is biased in the direction of missing the "worst" cases. Though this is also true about Portsmouth, the relatively larger proportion of non-participants and the larger numbers among those whose mental or physical competence is unknown reduce the assurance with which conclusions may be drawn.

3.3.5. There were 879 subjects who agreed to either a medical, a dietary or a socio-economic investigation; and 789 had all three. Fifty-two had a medical examination only and 38 a dietary-cum-socio-economic investigation only. Table A4 (p. 80) shows the age/sex distribution of those from whom records were obtained.

3.4 Social and Economic Make-up of the Sample

3.4.1. The interviewers also asked a number of general questions about the subject's way of life. Some of these questions, such as the reasons for not eating particular foods, the giving and receiving of gifts of food, and the interest in preparing and cooking meals, were included to help in the verification and interpretation of the diet record. Others were designed to establish facts about the subject's social conditions and economic situation which might have a bearing on the dietary and clinical findings, and from which the applicability of the findings to definable sections of the population might be inferred. The principal items on which information was sought were marital status, including, for those who were widowed or divorced, the length of time since they had lost their partner; the mode of living; the sources and amount of their income. The subjects were also asked who prepared the majority of their meals, whether they received meals on wheels, and if not, whether they would like to do so.

3.4.2. *Social class.* Information on the occupation (current or past) or, for women who were or had been married, the occupation of the husband, was obtained as a basis for determining a social class in accordance with the Registrar-General's classification of occupations. Changes in living conditions and the effects of increasing infirmity may make this an unreliable guide to the current way of life of those who have retired or whose husbands have died or retired many years earlier. Nevertheless, the social classification probably serves to group together people who have lived their lives in broadly similar environments which can be expected to have influenced their diet and nutritional condition in characteristic ways. The distribution by social class of those who provided diet records is shown by area and sex in Table A5 (p. 81).

3.4.3. As might be expected, there were wide differences between the areas. In the more rural areas (Cambridgeshire and Angus) and in Camden there were higher percentages of Class I and II (22%, 29% and 22% respectively) than in the other areas, which had 11% or less. The proportion of non-manual Class III occupations was highest in Rutherglen (21% as compared with 5–13% in the other five areas). If this class is combined with Classes I and II the area differences are less pronounced, viz:

	%
Portsmouth	20
Cambridgeshire	27
Sunderland	19
Rutherglen	29
Angus	36
Camden	35

3.4.4. Class III manual occupations predominated in Sunderland and Rutherglen (44% and 46% respectively), and were lowest in Cambridgeshire (24%). But Classes IV and V were well represented in Cambridgeshire (47%), as against 35% in Sunderland and 25–29% in the other four areas. Farmers and agricultural workers were well represented in Cambridgeshire—24 in Classes I and II (12% of the total sample for the area) and 27 in Classes IV and V (13% of the total sample). Persons classified as "others" included former members, and wives or widows of former members, of the armed forces; only in Portsmouth was there a considerable number (16%), mainly from the Royal Navy.

3.4.5. Since little information is available on which to determine the social class of non-participants, it is not possible to say whether there was a social class bias among those who participated or whether the distributions found in the survey correspond to that of the elderly populations in the respective areas. However, a comparison can be made between the social class distribution of the total survey sample and that of the total elderly population as revealed by the 1966 Census. Table A6 (p. 82) shows that the survey included a larger share of Class III at the expense of other classes, particularly of I and II, but even so the distributions conform quite well.

3.4.6. *Marital status.* The distribution by marital status of the 396 men and 431 women from whom diet records were obtained is shown in Table A7 (p. 82). Fifteen per cent of the women were single, three times as many as the men. As was to be expected, there were more men with wives alive than there were women with husbands (72% against 33%). Fifty-one per cent of the women were widowed or divorced, compared with 23% of the men—a total of 300 in all areas. All but 21 of these had been widowed or divorced for at least one year, so that no clear conclusions could be drawn about the effects on nutrition of recent bereavement.

3.4.7. Because small numbers are involved, it would be unwise to place too much significance on the differences between the figures for particular areas, but it is interesting to note—though not easy to explain—that 13% of the men and 32% of the women in the Angus sample whose marital status was known were single as were 27% of the women in Camden, compared with 5% or less of men and 6–16% of women in the other areas. The areas which produced most widowed and divorced were Sunderland and Rutherglen (29% of men and 60% of women in each area).

3.4.8. *Mode of living*. Figures are given (paragraph 3.3.2. and Table A3, pp. 78, 79) for the distribution by mode of living of the participants and non-participants in all areas but Camden. A similar distribution for those who presented diet records is given in Table A8 (p. 83). Thirteen per cent of the men and 40% of the women lived alone, the highest proportion being in Camden (18% and 57% respectively) and the lowest in Portsmouth (11% and 32%). The sex difference reflects again the fact already noted—that more than twice as many men as women had living spouses.

3.4.9. *Meals-on-wheels.* Twenty-one people—12 men and 9 women, 2·5% of those whose diets were recorded—were receiving some meals-on-wheels; all but two were over 74 years of age. At the time of the survey 1·7% of all persons aged 65 and over in England and Wales were receiving meals-on-wheels. The largest number of recipients were in the Cambridgeshire sample (6, including 2 who had them 5 days per week), Sunderland (5, once or twice a week) and Camden (4, all 5 times a week). Table A9 (p. 84) shows the distribution in each area by the number of meals served. The 800 who were not receiving meals-on-wheels were asked whether they would like to have them, and 35 (4·4%) said they would, the proportion being similar in all areas (see Table A10, p. 85).

3.4.10. *Preparation of meals*. The proportion of people of both sexes whose meals were prepared for them by relatives other than husband or wife, or by other helpers, increased with age (7·4% of men and 8·8% of women under 75; 28% of men and 21% of women over 75), but it is noteworthy that even in the higher age group 3 out of 4 people still prepared their own meals or had them prepared by their spouses. The figures are given in Table A11 (p. 85).

3.4.11. *Income and expenditure*. To obtain a full picture of income and expenses* it would have been necessary to ask detailed personal questions inappropriate to this kind of survey. It was, therefore, decided to concentrate on three pieces of information—the sources of income, the total income less expenditure on housing (i.e. rent, rates and mortgage payments) and the amount per head usually spent on food—and to respect any reluctance to disclose figures. In fact, information on the amount of income was not forthcoming from 29% of the subjects. The weekly income after deduction of housing costs of the 587 people who gave figures was distributed as follows:

Total weekly income less expenditure on housing	*Number of persons*	%
Less than £4	26	4·5
£4 but less than £5	85	14·5
£5 but less than £7	125	21
£7 and over	351	60

* Throughout this section it should be remembered that these expenditures relate to pension levels and prices operative in 1967.

3.4.12. Variations between households in needs and conditions, and in the expenses to be met apart from housing costs, limit the inferences that can be drawn from these figures. Nor was it possible to check their accuracy. Of the 26 who had less than £4 per week, 15 were in Sunderland and there were none in Angus or Camden (but the information was not available for the majority in the other areas).

3.4.13. The information about the amount per head spent on food was obtained more easily—only 12% did not give it. The 729 responders were distributed as follows:

*Weekly amount per head spent on food**	*Number of persons*	%
Less than £1·50	113	15·5
£1·50 but less than £2	204	28
£2 and over	412	56·5

Area distributions varied considerably—from 4–6% in the lowest and 73–75% in the highest spending groups in Portsmouth, Rutherglen and Camden, to 20–27% in the lowest and 39–46% in the highest groups in Cambridgeshire and Sunderland.

3.4.14. *Sources of income*. The subjects were asked whether they or their spouses received a Social Security retirement pension, Supplementary Benefit, or employer's pension and regular income from any other source. They were not asked to say how much they received from each source or what the "other sources" were, and it was not possible to verify their answers: 116 (14%) said they received only a Social Security pension; 2 Supplementary Benefit only; 167 (20%) Social Security pension and Supplementary Benefit but no other income; and 537 (65%) income from other sources only or in addition to Social Security pension and/or Supplementary Benefit. In all, 247 (30%) received Supplementary Benefit. The figures are given in more detail by area in Table A12 (p. 86) and by age and sex in Table A13 (p. 87).

3.4.15. A person living alone with no income but a Social Security retirement pension would normally qualify for Supplementary Benefit. In fact, of the 225 people in the survey who were found to be living alone, including boarders, 29 (6 men and 23 women) declared Social Security pension to be their only source of income. The numbers of those living alone who gave information on income and expenditure on food were distributed as given on the next page. The income figures are not comparable to those given in paragraph 3.4.11. for all respondents because the latter were often the joint incomes of husband and wife. As might be expected, a larger proportion of those living alone than of the total sample spent £2 or more a week on food, but the proportion spending less than £1·50 was also slightly higher amongst those living alone.

* See footnote on p. 14.

Total weekly income less expenditure on housing	*Number of persons*	%
Less than £4	16	10
£4 but less than £5	54	33
£5 but less than £7	51	32
£7 and over	40	25

Weekly amount spent on food	*Number of persons*	%
Less than £1·50	35	18
£1·50 but less than £2	39	19
£2 and over	126	63

II RESULTS

CHAPTER 4

The Food and Food Habits of the Elderly

4.1 General

4.1.1. The state of nutrition depends mainly on the content of nutrients and energy in the diet which in its turn depends on the food consumed. Therefore in considering the nutritional state of old people a logical approach is first to describe the foods that are consumed and their nutritional contribution.

Table 4.1.

Average daily intakes of energy and nutrients by men and women in each age group

Nutrient	All persons	Men		Women	
		65–74	75 and over	65–74	75 and over
Energy (kcal)	1,962	2,344	2,103	1,787	1,628
(MJ)	8·2	9·8	8·8	7·5	6·8
Protein (g)	63·7	74·6	67·6	59·2	53·6
Fat (g)	93	110	98	87	78
Carbohydrate (g)	224	266	244	200	187
Calcium (mg)	830	910	880	800	730
Iron (mg)	10·2	12·2	10·9	9·4	8·5
Vitamin A (i.u.)	3,450	3,790	3,650	3,420	2,960
(µg)	1,035	1,140	1,100	1,030	890
Thiamine (mg)	0·9	1·1	0·9	0·8	0·7
Riboflavine (mg)	1·3	1·6	1·4	1·3	1·1
Nicotinic acid (mg)	13·0	16·8	13·6	11·5	10·2
Pyridoxine (mg)	1·1	1·4	1·2	1·0	0·9
Vitamin C (mg)	39	43	38	40	34
Vitamin D (i.u.)	104	133	107	92	84
(µg)	2·6	3·3	2·7	2·3	2·1

4.1.2. As already stated (paragraph 3.1.2), there is in the sample an over-representation of older people and men compared with the proportions in the population as a whole. Appropriate weighting would therefore be required to relate the amounts and proportions of foods and nutrients to the national average for all elderly. However, since the sample as originally drawn was not intended necessarily to be nationally representative and since the aim at this stage is merely to provide a general picture of what is consumed, no weighting has been attempted. The differences with age and sex are not so great as to affect the conclusions drawn below.

4.1.3. The average daily intakes of energy and all the nutrients is shown in Table 4.1 for the different sex and age groups. The overall average shown for the survey as a whole is affected of course by the artificial constitution of the sample with respect to age and sex.

4.2 Local Differences in Intakes

4.2.1. Differences in intakes in the different areas can be seen in Table A14 (pp. 88, 89).

4.2.2. The energy intakes of men exceeded those of women and for both sexes decreased with age in all areas, with the exception of men in Camden where the numbers were small. However, there were differences between areas which are illustrated by the percentage distributions across the range of energy intakes given in Table A15 (pp. 90, 91). These differences were not significant for the women, but were substantial for the men. For the men aged 65–74 the average for the areas with the lowest and highest intakes differed by 279 kcal (1·2 MJ) and for those aged 75 and over by as much as 585 kcal (2·4 MJ). In all four sex/age groups, Sunderland produced the lowest average intakes; the highest were in Angus (men aged 65–74), Camden (men and women aged 75 and over) and Cambridgeshire (women aged 65–74).

4.2.3. The difference in energy consumption between the areas was reflected in differences in most of the other nutrients. With the exception of vitamin D and nicotinic acid the lowest intakes of all nutrients were recorded in Sunderland. The intake of vitamin C was lower in the three northern areas than in the other areas.

4.2.4. The percentage distribution of the average daily intakes of protein in the different areas is shown in Table A16 (p. 92); similar information about the intakes of riboflavine, vitamin C and vitamin D is shown in Tables A17, A18 and A19 (pp. 93–96).

4.3 **The Daily Pattern**

4.3.1. As well as measuring the total daily consumption, food intakes were examined in periods of the day:

(a) before 11.30 a.m.;
(b) from 11.30 a.m. to 2.30 p.m.;
(c) after 2.30 p.m.

4.3.2. Energy intakes showed the same pattern in all areas. Average intakes for the three periods of the day were 497, 589 and 876 kcal (2·1, 2·5 and 3·7 MJ) respectively. Corresponding figures for the intake of animal protein were 8·6 g, 18·2 g, and 16·9 g.

4.3.3. Many old people take a series of snacks during the day making it impossible to define breakfast, lunch or supper in a uniform manner. However, if "lunch" is equated with the period (b), the contribution of 589 kcal is seen to be about one-third of the day's total, but the contribution of animal protein is appreciably more than one-third. The point is particularly relevant wherever meal services are provided for old people.

4.3.4. Although the data could not be analysed in terms of the number of separate occasions on which food or liquid was taken, it could be assumed that where reasonable amounts of fish, meat or eggs were eaten during a given period this represented a cooked meal. Cheese and milk intakes were more difficult to interpret as they could have been taken as part of a cooked meal or as snacks.

4.3.5. An examination of the consumption of eggs, meat and fish by periods of the day showed that the average sum of the weights of these foods eaten at midday was 2·3 oz. and the corresponding figure for the evening period 1·8 oz. An average serving of one of these foods for the populace as a whole, eaten as part of a cooked meal, may be taken as 3 oz. and the average figures for midday and evening are lower than this mainly because some people did not eat cooked lunch and others did not eat a cooked supper, but most ate one or the other and some both.

4.4 **Average Consumption of some Individual Foods**

4.4.1. *Meat.* The average consumption was 2·8 oz. per day of which on average 0·2 oz. was eaten at breakfast, 1·8 oz. at midday and 0·8 oz. during the evening period. These averages include consumer and non-consumer alike so the average amounts eaten on any one occasion cannot be calculated. Consumption declined with age and men ate larger amounts than women.

4.4.2. *Fish.* Daily consumption averaged 0·8 oz. equally distributed between the midday and evening periods. As with meat, men ate more than women and in both sexes the younger groups ate more than the older.

4.4.3. *Eggs*. The average consumption was 1·3 oz. or a little less than ¾ of an egg per day. Men ate more eggs (averaging 1·5 oz. per day) than women did. The pattern did not change significantly with age and there was no difference between areas. If anything, old people tend to eat more eggs than does the population as a whole.

4.4.4. *Cheese*. Consumption was of the order of 0·4 oz. per day, men averaging ½ oz. and women ⅓ oz.; the figures were fairly constant for all areas.

4.4.5. *Milk*. The average intake of liquid whole milk or its equivalent was 12·0 oz. per day, women taking a little less than men (11·7 oz. against 12·4 oz.). Only about one-seventh of the total was used in cooking, the greater part being drunk as milk alone or used in beverages or on cereals. These average figures conceal very wide differences in recorded milk consumption as shown by the distributions set out in Table A20 (p. 97) and Figure A1 (p. 107). Skimmed milk represented only a very small proportion of all milk used and has not been included.

4.4.6. There were small differences in the consumption of these foods according to social and economic factors which are discussed in more detail later (Ch. 7).

4.5 Nutrient Content of the Diet

4.5.1. *Comparison with National Food Survey data*. The source of most information about samples drawn on a nationally representative basis is the National Food Survey. However, comparisons between the National Food Survey results and those of the present study have to be made with reserve, and where individual foods are concerned are only possible for milk, cheese and eggs; even with these the definitions are not exactly the same. Nevertheless it is useful, subject to these limitations, to compare the average figures from the present survey with the averages for "all households" derived from the National Food Survey in order to assess how the diet of old people compares with that of the nation as a whole (Table 4.2). It is of course

Table 4.2

Comparison of daily intakes of some foods by persons in the National Food Survey (NFS) and in the Elderly Survey (DHSS)

Survey	Milk[1]		Cheese		Eggs
	fl oz	g	oz	g	g
NFS[2]					
All households 1967	15·0	426	0·48	13·6	33·6
All households 1968	14·8	420	0·49	13·9	33·2
DHSS					
Elderly 1967–68	12·0	341	0·41	11·6	37·0

NOTES: [1] Includes condensed, dried and other milk but not cream.
[2] Ministry of Agriculture, Fisheries and Food (1969). *Annual report of the National Food Survey Committee.*

necessary to take into account the fact that for many reasons old people eat less total food than younger individuals.

4.5.2. When diets are compared per 1,000 kcal (Table A21, p. 98), it is clear that there are no remarkable differences between the average intake of old people and that of the nation as a whole. The higher proportion of protein recorded for the elderly could be due to differences in the methods of recording and analysis, particularly of waste, which cannot be specifically recorded in the National Food Survey as it was in the present study.

4.5.3. *Comparison with Recommended Intakes.* Average intakes of nutrients are compared with intakes recommended by the Panel on Recommended Allowances of Nutrients (Department of Health and Social Security, 1969) in Table 4.3.

Table 4.3

Comparison of average intakes of persons in the survey with recommended daily intakes[1] *(R.A.)*

	Men		Women	
	65–74	75 and over	65–74	75 and over
Energy (kcal)	2,344	2,103	1,787	1,628
(MJ)	9·8	8·8	7·5	6·8
% R.A.	104	100	87[2]	86
Total protein (g)	74·6	67·6	59·2	53·6
% R.A.	126	128	116	112
Calcium (mg)	910	880	800	730
% R.A.	182	177	159	145
Iron (mg)	12·2	10·9	9·4	8·5
% R.A.	120	110	90	90
Thiamine (mg)	1·1	0·9	0·8	0·7
% R.A.	122	113	100	100
Riboflavine (mg)	1·6	1·4	1·3	1·1
% R.A.	94	82	100	85
Vitamin D (μg cholecalciferol)	3·3	2·7	2·3	2·1
% R.A.	132	108	92	84
Vitamin C (mg)	43	38	40	34
% R.A.	143	127	133	113
Vitamin A (μg retinol equivalents)	1,140	1,100	1,030	890
% R.A.	151	146	137	118

NOTES: [1] Report on Recommended Intakes of Nutrients (Department of Health and Social Security, 1969).

[2] The recommended intake is given for a slightly different age group, i.e. women aged 55–75.

4.5.4. Figure A2 (p. 108) shows the distribution of average energy intakes for persons in the four age/sex groups in relation to the recommended levels. Out of the possible 24 age/sex groups in the six areas only six had energy intakes as high as the recommended value. These were the younger men in Cambridgeshire, Camden and Angus and the older men in Portsmouth, Cambridgeshire and Camden. The average protein intake of all groups in all areas was higher than the recommended intake (Figure A3, p. 109).

4.5.5. Only one group of women (the younger women in Angus) met the recommended intake for iron, whereas by contrast only one group of men (the older men in Sunderland) failed to meet the recommended figure for iron. Intakes of calcium were well above the recommended allowance in all groups and all areas and the same applied to vitamin A, except for the older group of women living in Sunderland. On average, intakes of thiamine were up to the recommended level although in Sunderland all except the younger men had intakes marginally below the recommended figure, as did both groups of women in Rutherglen and the older women in Angus. The majority of subjects consumed less than the recommended intake of riboflavine (Figure A4, p. 110); only two groups, the older men in Portsmouth and the younger men in Cambridgeshire, showed an intake marginally above the prescribed figure. Vitamin C average intakes were about the recommended figure (Figure A5, p. 111) except for the older men and women in Sunderland and the older women in Rutherglen and Angus. Intakes of vitamin D by both groups of men in all areas exceeded recommended intakes (Figure A6, p. 112), but this applied to only four groups of women—the younger women in Cambridgeshire and Sunderland and the older women in Portsmouth and Camden. The contribution made by sunlight to the vitamin D status of these subjects is not known.

4.6 Percentage Contribution of Food Groups to Total Nutrient Intake

4.6.1. The histograms (Figures A7–A11, pp. 113–117) show the relative importance of the various groups of foodstuffs as contributors to the average intake of various nutrients. Such information, besides throwing light on the means by which the elderly maintain their nutritional state, indicates the foods concerning which questions need to be asked where malnutrition is suspected. On the whole a constant pattern, unaffected by age or sex, is shown throughout all areas, although in some groups and some areas minor changes are found in the order of the main contributing food groups.

4.6.2. *Energy* was, of course, provided by all foods but the main contribution came from that group of foods which includes cakes, puddings, biscuits etc., with meat and meat dishes in second place. Bread, fats and milk contributed significantly to total energy. The highest contribution from "preserves" (a group including sugar, jam etc.) was in Camden; where it was 9·2%.

4.6.3. *Total protein* in all areas was supplied primarily by meat and meat dishes (about 30%) with milk and bread in second place. In Sunderland and the two Scottish areas bread and the group of foods which included cakes and biscuits contributed a slightly higher proportion of the total protein than was the case in other areas.

4.6.4. *Total fat*. About 27% was derived from fats and oils and these together with meat and meat dishes supplied over 50% of the fat in the diet.

4.6.5. *Carbohydrate* was derived chiefly from bread and the food group containing cakes, biscuits and puddings. The pattern in Camden was slightly different from other areas in that the group of foods including sugar and preserves held first place instead of third. Potatoes provided a consistent 7–10% of the total carbohydrate in the diets of all subjects.

4.6.6. *Calcium* was supplied mainly from milk (30–50%) and the two food groups (bread and the group containing cakes and biscuits) contributed a further 25–35%. The only other significant contributor of calcium was cheese and the percentage from this source was highest in Camden.

4.6.7. *Iron* came from meat and meat dishes (about 30% of the total iron) and from flour products which made up another 25–35% between them. Eggs supplied about 7% and in Angus liver also contributed 7%.

4.6.8. *Vitamin A* was derived mainly from fats and oils which supplied 25–35% of the total intake in all areas except Angus where first place was taken by liver. A regular intake of liver caused a shift in main or subsidiary sources of several vitamins. It appears to have a greater effect than any other single food and it is of interest to note that by a coincidence an article on the value of liver in the diet appeared in the local press in Angus during the survey year.

4.6.9. *Thiamine* has for its main sources meat and bread and other flour products. In Portsmouth, Cambridgeshire and Camden meat was the biggest single contributor and in other areas this place was taken by flour products. Milk contributed about 13% and potatoes between 6 and 11%.

4.6.10. *Riboflavine* from milk amounted to about 30% in all areas. Meat and meat dishes added another 13–16% and in Angus liver accounted for an additional 10%.

4.6.11. *Nicotinic acid* was supplied mainly by meat and meat dishes in all areas except Rutherglen where first place went to "other sources". The wide distribution of this vitamin throughout the British diet is obvious. The contribution from bread was constant at 10–17% in all areas.

4.6.12. *Vitamin D* had for its chief source fish or eggs in all areas except Angus. It was not always the older (and possibly edentulous) subjects who ate more eggs. In Sunderland and Angus fats contributed a higher proportion of the total vitamin D than was the case in other areas and indeed in Angus they were the principle source. This is probably due to a higher average consumption of margarine in place of butter in these areas.

4.6.13. *Pyridoxine* was obtained mainly from meat and dishes containing meat. In all areas these foods provided about 26% of the total pyridoxine. Although absolute intakes of this vitamin differed from area to area the percentage derived from meat and meat dishes remained constant. Potatoes contributed

15–20% of the total and were the other major source of pyridoxine. Pyridoxine figures could not be given for all foods and very little is known of the possible destruction or loss of the vitamin in the preparation of food. For these reasons data on this nutrient must be regarded as the least reliable.

4.6.14. *Vitamin C* came from three main sources and there was some variation in the order of contribution from these sources both within areas (by age and sex groups) and between areas. Overall the chief source was potatoes (28%) with green vegetables and tomatoes next (22%) and citrus fruits third (16%). In Portsmouth and Camden the green vegetable group was the chief contributor (28% and 26% respectively), whilst in Sunderland the contribution from citrus fruits was very much higher (22%). Milk provided 6–10% of the ascorbic acid intake and when the intake was really low was often the only source in the diet. This was worrying because figures for vitamin C from this source should be regarded with caution. Although laboratory analyses consistently give a figure of 1 mg per 100 g for milk (even that used in cooking), it is possible that this is an over-estimate for the milk used by subjects in this age group. Storage facilities were seldom ideal and there was a tendency for milk to be heated and reheated, in which case substantial destruction of the vitamin is quite probable.

4.6.15. *Sucrose* was derived chiefly from the group of foods which includes sugar, jam, honey etc. The second most important source was the group of foods containing cakes, biscuits, puddings etc. Confectionery contributed only 5–7% of the total sucrose except in Angus where the figure was 11%. It is interesting to note that most of the old people did not eat sweets and chocolates in large quantities. The total sucrose in the diet contributed between 12% and 14% of total energy.

4.6.16. Very little alcohol was consumed. It contributed negligibly to intakes of energy and nutrients, except in Camden where, because of the heavy consumption of beer by a few subjects, 4% of energy value, 5% of riboflavine, 8% of nicotinic acid (though this is not available) and 6% of pyridoxine were derived from alcoholic beverages.

4.7 Repeat Surveys

4.7.1. Repeat studies of weekly dietary intakes were carried out in three areas. Fifty-eight subjects were re-surveyed and the time lapse between records ranged from 21 to 53 weeks. Intakes of energy, milk, meat, riboflavine and vitamin C for the two survey periods are shown in Figures A12–A16 (pp. 118–122). The second survey showed results consistent with the first in that those subjects showing high intakes in the first survey remained in the high intake group in the second survey. The reverse also applied. Although the figures for an individual showed, in some cases, a big percentage difference, his position in relation to the group as a whole remained unchanged or very slightly changed. As a validation of the method of diet recording this was a reassuring finding.

CHAPTER 5

The Overall Nutritional State

5.1 Energy Status

5.1.1. Figure A2 (p. 108) shows the variation in energy consumption by individuals during the week in which their diets were surveyed. The differences may be temporary because what is eaten in one week may not be eaten at other times, or permanent because of differences in stature and activity or the effect of diseases such as arthritis which limit activity. The differences between the areas, already referred to in paragraph 4.2.2., may also have been related to local differences in weight and stature. Table 5.1 shows the average height of men

Table 5.1

Average heights and energy intakes in each area

Area	Men				Women			
	No. measured	Average height (cm)	Energy intake[1] (kcal)	(MJ)	No. measured	Average height (cm)	Energy intake[1] (kcal)	(MJ)
All areas	409	166·5	2,235	(9·4)	414	154·1	1,711	(7·2)
Portsmouth	72	166·9	2,256	(9·4)	55	153·6	1,760	(7·4)
Cambridgeshire	86	167·1	2,375	(9·9)	89	154·9	1,769	(7·4)
Sunderland	101	165·8	2,061	(8·6)	95	153·4	1,632	(6·8)
Rutherglen	49	165·4	2,141	(9·0)	49	153·6	1,671	(7·0)
Angus	51	168·2	2,290	(9·6)	50	154·1	1,680	(7·0)
Camden	50	165·5	2,380	(10·0)	76	154·9	1,745	(7·3)

NOTE: [1]Averages of those who produced diet records (numbers given in Table A4, p. 80) including a few whose height was not measured. Similarly, a few others whose height was measured did not produce diet records.

and women in the survey compared with average energy intakes. Among the men, the highest figures for height were recorded in Angus and the lowest in Rutherglen and Camden; for the women, the highest were in Cambridgeshire and Camden and the lowest in Sunderland. If Camden is excluded, then height appears to be related to energy intake on average.

5.1.2. The *average* consumption of energy was for some groups below the recommended intake. Therefore, the possibility was examined that the deficit was due to low intakes by those whose general condition was judged by the clinicians to be worse or much worse than average (Table 5.2).

5.1.3. Obviously the state of health may be responsible for some but not all of the deficit. But women, even those whose condition was judged to be better or much better than average, had mean intakes of energy which were below the recommended intake level. Recommended intakes are admittedly based on inadequate evidence and this may be an instance in which their revision may be desirable.

Table 5.2

Mean daily intake of energy by persons judged to be in better or worse than average state of health compared with the recommended intake

Assessment	Men				Women			
	65–74		75 and over		65–74		75 and over	
	No.	kcal (MJ)	No.	kcal (MJ)	No.	kcal (MJ)	No.	kcal (MJ)
Much better	29	2,559 (10·7)	27	2,375 (9·9)	17	1,930 (8·1)	25	1,670 (7·0)
Better	112	2,373 (9·9)	79	2,153 (9·0)	100	1,798 (7·5)	66	1,670 (7·0)
Worse	57	2,203 (9·2)	57	1,854 (7·8)	85	1,748 (7·3)	74	1,606 (6·7)
Much worse	10	2,164 (9·1)	11	2,250 (9·4)	8	1,640 (6·9)	20	1,495 (6·3)
Recommended intake (assuming a sedentary life)		2,350 (9·8)		2,100 (8·8)		2,050[1] (8·6)		1,900 (7·9)
Average intake by all subjects[2]	217	2,344 (9·8)	179	2,103 (8·8)	226	1,787 (7·5)	205	1,628 (6·8)

NOTES: [1] This value is the intake recommended (Department of Health and Social Security, 1969) for a slightly different age group, i.e. women aged 55–75.
[2] This includes 9, 5, 16 and 20 subjects respectively in the four sex/age groups who were not examined clinically.

5.1.4. It could be that mild undernutrition might be so prevalent among old people that it existed even among some of those whose general condition was judged "better than average". But if this were so low energy consumption might be expected to be associated with low skinfold measurements. Table 5.3 shows no indication of this.

5.1.5. Indeed Table 5.3 shows that in general fat people have a lower energy intake than thin people (perhaps because they are better insulated or dieting or less inclined to activity). With age there is a diminution in energy intake which is independent of skinfold measurement; this could be due to a reduced energy requirement because of a decreased lean body mass or reduced activity caused by increasing disabilities. This finding was also reported by Exton-Smith and Stanton (1965) in old women living alone in London.

Table 5.3
Daily intake of energy compared with skinfold thickness

Thickness of (double) skinfold (mm)	Men				Women			
	65–74		75 and over		65–74		75 and over	
	No.	kcal (MJ)	No.	kcal (MJ)	No.	kcal (MJ)	No.	kcal (MJ)
All persons[1]	207	2,342 (9·8)	170	2,096 (8·8)	205	1,780 (7·4)	178	1,622 (6·8)
Skinfold: less than 20	59	2,278 (9·5)	59	2,079 (8·7)	11	2,164 (9·1)	26	1,585 (6·6)
20–29·9	86	2,435 (10·2)	61	2,128 (8·9)	37	1,768 (7·4)	41	1,655 (6·9)
30–39·9	48	2,332 (9·8)	33	2,045 (8·6)	58	1,817 (7·6)	51	1,631 (6·8)
40 and over	14	2,070 (8·7)	17	2,143 (9·0)	99	1,720 (7·2)	60	1,608 (6·7)

NOTE: [1] The difference in totals between Tables 5.2 and 5.3 arises because not all the persons in Table 5.2 were measured.

5.1.6. The low average energy consumption of those whose general condition was judged "worse" by the clinicians could be due to reduced requirements because disease limited their activity. Nevertheless the possibility still exists that the plight of a few thin people who were undernourished might have been masked because their intakes of energy were averaged with others who were "normally" thin and active. A search for an undernourished minority was therefore made and is described in Chapter 6.

5.1.7. Another possibility has to be considered. Mild restrictions in energy intake can be accommodated in one of two ways; either weight (mainly fat) is lost and the energy cost of moving the lighter body around falls until it is in line with the lower energy intake, or activity is reduced and with it energy expenditure. Both mechanisms may operate in varying proportions. Where the deficit of energy is small and years have elapsed to allow of adaptation, it is theoretically possible that equilibrium might be struck with normal fat covering because the subject tailors his or her activity to energy intake, whereas for most of us it is the other way round.

5.1.8. Though such adaptation might be achieved quite unconsciously by old people this is not to say that it would be desirable. To some extent "activity" can be equated with "activities" and anything that artificially accentuates the narrowing of activities which accompanies ageing is to be deplored.

5.1.9. *The effect of inefficient mastication on energy intake*. The clinicians were asked to assess whether the subjects were able to masticate efficiently either with or without dentures. Such assessments were obviously highly subjective and were liable to vary amongst the clinicians. In Portsmouth, Rutherglen and Angus

7–8% of all persons were diagnosed as inefficient masticators; 13–16% in the other areas. Generally it was found that the proportion of people with inefficient mastication was slightly higher in the older age groups. Despite its subjectivity, the results of the assessment show that for each sex/age group, apart from the younger men, the average energy intake was 200–300 kcal lower for those whose mastication was inefficient (Table 5.4). These differences

Table 5.4

Efficiency of mastication and daily intake of energy

Subjects	No.	Mastication	Mean energy intake (kcal)	(MJ)
All persons[1]	694	Efficient	1,988	(8·3)
	93	Inefficient	1,793	(7·5)
Men: 65–74	185	Efficient	2,339	(9·8)
	24	Inefficient	2,372	(9·9)
Men: 75 and over[1]	150	Efficient	2,138	(8·9)
	25	Inefficient	1,831	(7·7)
Women: 65–74[1]	199	Efficient	1,801	(7·5)
	16	Inefficient	1,585	(6·6)
Women: 75 and over[1]	160	Efficient	1,672	(7·0)
	28	Inefficient	1,381	(5·8)

NOTE: [1] Energy intake amongst the inefficient masticators was lower than in the efficient masticators. The degree of significance increased with age. $P = 0·1$ for women aged 65–74, $P = 0·01$ for men aged 75 and over and for all persons, and $P = 0·001$ for women aged 75 and over.

were significant statistically, although it cannot be concluded that the association was necessarily causal. A pointer in the same direction was the finding of a relationship between efficiency of mastication and skinfold thickness (Table 5.5). The percentage of energy derived from protein was lower for those with inefficient mastication, and this is further illustrated by the average meat intake, which was 2·9 oz. for efficient masticators compared with 2·3 oz. for inefficient masticators.

5.1.10. A special study made in Cambridge by Dr. Hyams and Professor Neill of the Guy's Hospital Dental School is reported in the Special Studies (pp. 69–71.)

5.2 Protein

5.2.1. The minimum requirement for protein was set by the Panel on Recommended Allowances of Nutrients for the United Kingdom (Department of Health and Social Security, 1969) at 39 g and 38 g daily for men aged 65 to 75 years and over 75 respectively, and 36 g and 34 g for women aged 55 to 75 years and over 75 respectively. The average consumption of protein by old people of

Table 5.5

Efficiency of mastication and skinfold thickness

Subjects	No.	Mastication	No. of persons with thickness of (double) skinfold (mm)			
			19 and under	20–29	30–39	40 and over
All persons[1]	704	Efficient	136	210	179	179
	96	Inefficient	36	28	18	14
All men[1]	348	Efficient	107	137	75	29
	56	Inefficient	25	20	8	3
All women[1]	356	Efficient	29	73	104	150
	40	Inefficient	11	8	10	11
Men: 65–74	193	Efficient	53	81	45	14
	27	Inefficient	12	10	4	1
Men: 75 and over	155	Efficient	54	56	30	15
	29	Inefficient	13	10	4	2
Women: 65–74	197	Efficient	11	35	57	94
	14	Inefficient	1	2	5	6
Women: 75 and over[1]	159	Efficient	18	38	47	56
	26	Inefficient	10	6	5	5

NOTE: [1] Skinfold thickness amongst the inefficient masticators was significantly lower in these groups than in the efficient masticators: $P = 0{\cdot}1$ for all men, $P = 0{\cdot}05$ for all women and those aged 75 and over, and $P = 0{\cdot}01$ for all persons.

both age groups in the sample was substantially above this minimum requirement and furthermore above the recommended intake (Table 4.1, p. 17, and Figure A3, p. 109).

5.3 Energy from Protein

5.3.1. The percentage of energy derived from protein was on average more than 13%, higher than the recommended level (Department of Health and Social Security, 1969), and even further above the Panel's figure for the minimum requirement. It is also higher than any of the averages recorded in the National Food Survey for any age/sex group. As already pointed out (paragraph 4.5.2.) this may reflect not a richer diet consumed by old people, but rather a difference in the method of recording and analysis.

5.3.2. A deficiency of protein can be either primary or secondary to restriction of energy intake. If severe it leads to a fall in the activity of the enzyme pseudocholinesterase in the serum. However, for the subjects in this survey there was no indication of a relationship between values of serum pseudocholinesterase and intake of energy derived from protein. Nor was there any relationship between the latter and the clinician's assessment of overall condition. These findings support the conclusion that the condition of those judged worse than average was not due to their intakes of protein being less than their requirements.

5.4 **Calcium**

5.4.1. The average intake was 60% above the recommended intake. Primary deficiency of calcium has never been described in adults, and the only diseases in which a deficiency could be involved (to our present knowledge) are osteomalacia and osteoporosis. Osteomalacia is considered in more detail later (section 5.11).

5.4.2. Some estimate of osteoporosis can be obtained from the ratio of the cortical area of the bone to its surface area, thus a high ratio means a bone which has a thick cortex in relation to its overall size (Exton-Smith, Millard, Payne and Wheeler, 1969 a, b). Measurements of the 2nd metacarpal were made on the radiographs taken of the hands of the subjects. The distribution of this ratio in percentiles was investigated in relation to the vitamin D, protein and calcium intakes of the old people, their mobility, and their "bowing index". Results are described in detail in the Special Study on p. 66. There was no sign of a significant relationship with any of these factors except possibly for the women over 75. However, the crucial period for bone formation is childhood and young adulthood, up to the age of 30 or 35, and it has been argued on these and other grounds that dietary intake in old age is unlikely to affect bone thickness.

5.4.3. In all sex/age groups intakes of calcium more than 1,000 mg were found as often in those below the 10th percentile of bone density as in those above the 90th percentile. Moreover, calcium intakes of less than 500 mg were found no more often in those below the 10th percentile than in those above the 90th percentile. This suggests that calcium intake at this age is not related to osteoporosis and indicates that 500 mg a day is adequate.

5.5 **Iron and other Haemopoietic Nutrients**

5.5.1. We are not aware of any previous survey in which detailed haematological information has been correlated with such extensive information of other sorts. Some of the findings are discussed in the Special Study on Haematology, p. 56. There emerges the surprising paradox that, though haematological values for folate and vitamin B_{12} are in many instances low if the criteria of normality of younger subjects are applied, the prevalence of anaemia in the sample was similar to that found in younger populations. Low serum iron and raised TIBC were found more often in women than in men but there was no reflection of this in the relative prevalence of anaemia in the two sexes. It is of course not known whether the criteria of haematological abnormality of younger subjects should be applied to the elderly. Further, account has to be taken of the prevalence of diseases among the elderly, some of which may affect their haematology in ways as yet unknown. However, the finding that there was no more anaemia than in younger adults is in keeping with expectation, for anaemia is commonest in younger females who are still menstruating; the iron requirements of old women must be quite low.

5.5.2. Nevertheless among the statistically significant differences in haemoglobin level that were found, those living alone or boarding had a higher incidence of anaemia. This point is taken in section 7.2 where socio-economic differences are discussed.

5.6 Vitamin A

5.6.1. Average intakes of vitamin A were high, 900–1,200 μg retinol equivalents (3,000–4,000 i.u.) daily from the preformed vitamin and precursor. These are well above the recommended intakes and no special search was made for deficiencies of vitamin A.

5.7 Thiamine (vitamin B_1)

5.7.1. Of 18 individuals diagnosed as having neuritis the lowest intake of thiamine per 1,000 kcal was 0·33 mg. The red cell transketolase test, which is used to detect thiamine deficiency by the response to thiamine pyrophosphate (the TPP effect), was made on 114 subjects, only in Portsmouth. In 39 individuals for whom the TPP effect was above 15% the intake of thiamine was not unusually low, nor in those for whom the effect was above 23%. Neither was a higher than average proportion of them rated as "worse than average" by the clinician. Whilst it is accepted that incipient or active thiamine deficiency is associated with a high TPP effect it remains to be established that the reverse is necessarily true; this study provided no support for the idea.

5.8 Nicotinic acid

5.8.1. Intakes averaged 15 mg for men and 11 mg for women. (No use was made in this study of nicotinic acid equivalents because too few figures for the tryptophan content of foods were available; the figures for nicotinic acid also include a certain amount of bound nicotinic acid.) No pellagra or pellagroid skin signs were recorded. Six subjects were reported to have an inflamed tongue. One of these also had angular stomatitis, one had been on a restricted diet following a perforated gastric ulcer, and a third suffered from mental depression. The remaining 3 were associated with non-nutritional diseases which may have precipitated this condition. No relationship was observed between low intakes and geographical tongue, atrophic tongue, or inflamed or seborrhoeic nasolabial folds.

5.9 Riboflavine

5.9.1. Although in each area the intakes of riboflavine fell short of those recommended, the amounts of riboflavine excreted in the urine, which were measured in Portsmouth and Cambridge, did not imply that dietary intakes were inadequate. This might be explained by the fact that the time of the urine collection did not always coincide with the week of the dietary survey. Nor do the clinicians' findings agree with the apparent widespread deficit. This is of interest because the clinicians were asked to be severe in their criteria of departures from normality such as angular stomatitis or cheilosis.

5.9.2. Of 778 subjects who had both medical and dietary examinations 57 were diagnosed as having either angular stomatitis or cheilosis, although the riboflavine intake of those with these lip lesions was 1·2 mg compared with an intake of 1·3 mg per day for those without. Angular stomatitis and cheilosis are not specific to riboflavine deficiency and may arise for non-nutritional reasons. Out of 23 subjects with riboflavine intakes below 0·7 mg for men and 0·55 mg for women, 4 had lip lesions. The numbers are of course very small but the possibility remains that among the elderly some prevalence of true clinical ariboflavinosis may exist; this possibility is strengthened by the fact that the clinicians diagnosed 8 subjects as malnourished who had angular stomatitis (paragraph 6.2.5).

5.9.3. There was no noteworthy relationship between fissuring or inflammation of the tongue or geographical tongue or atrophic tongue and low riboflavine intakes, nor did those with low intakes show any signs of abnormality in their tongues. Though Sunderland, with the lowest riboflavine consumption, recorded most sublingual haemorrhages, no relationship was found here or elsewhere with riboflavine intake. This applied also to sublingual varicosities. There was no relationship with purpura or with flat nails.

5.9.4. The apparent discrepancy between expectation based on dietary findings and the clinical findings is of interest; it is examined in detail below because difficulties in reconciling such findings are not peculiar to this nutrient or indeed to this survey. The Panel on Recommended Allowances of Nutrients based their initial calculations on resting metabolism as an indication of cell mass to which requirements appear to be related closely, but for practical reasons went on to relate their recommended intake to total energy expenditure. Whilst conceding that resting metabolism and energy intakes decrease with age they recommended that intakes of riboflavine should not fall with increasing age because they knew of no evidence that the requirements of the elderly are less than those of younger adults. However, lean body mass diminishes with age and it is reasonable to suggest a similar diminution in riboflavine requirements. This alone is not sufficient to account for the whole of the discrepancy between the clinical findings and the dietary intakes. The clinicians were looking for signs of deficiency and the intake recommended by the Panel is sufficient to secure tissue saturation; the Panel's Report stated "there is no evidence, however, that people with tissue saturation are more healthy than those on levels which just prevent clinical signs of deficiency" (Department of Health and Social Security, 1969).

5.9.5. The clinicians found a small number of subjects with lip lesions due to deficiency of riboflavine (or possibly other B vitamins). Over and above this there are probably a larger number of subjects with low tissue concentrations of the vitamin who are at increased risk of developing signs of deficiency. In the absence of functional tests of sub-clinical deficiency it was impossible to calculate their numbers, but the difference between the incidence of deficiency judged by recommended intakes and by clinical evidence becomes more reconcilable.

5.9.6. No apology is made for describing this exercise in detail. Not infrequently the results of published dietary studies appear to indicate that the diet of the majority of a community is gravely at fault; yet little can be found in the way of ill health. The previous paragraphs illustrate the sorts of reason for what appears *prima facie* to be a conflict of evidence. No explanation is attempted in respect of the other nutrients found to be taken frequently in amounts below recommendations, but similar explanations are possible, notably in the case of vitamin C.

5.10 Vitamin C

5.10.1. The overall average intake was 39 mg (Table 4.1), the recommended intake being 30 mg. But, as Figure A5 (p. 111) shows, many individuals consumed less, at least during the week of survey. This was particularly true in the northern urban samples and it is from Sunderland and Rutherglen that the only cases of scurvy were reported. In 2 subjects a firm diagnosis of scurvy was made, and in 2 others it was suspected (one of these was at a later date admitted to hospital with overt scurvy). The intakes of these 4 individuals were 5·4 mg, 27·8 mg, 39·4 mg and 10·4 mg. (Whilst it is surprising that only one of these intakes would be usually associated with scurvy, it needs to be remembered that the clinical examination preceded the dietary investigation and, where scurvy was diagnosed or suspected, it was the clinician's duty to give appropriate advice.)

5.10.2. Leucocyte ascorbic acid concentrations were determined in Portsmouth and Sunderland on 112 and 193 subjects respectively. In Sunderland, for each of the four sex/age groups, there was a statistically significant correlation between the amount of leucocyte ascorbic acid and the recorded intake of vitamin C; the correlations were of the order of 0·4 to 0·5. In Portsmouth the correlation coefficients were similar, but since considerably fewer subjects were tested, the values obtained were not significant except for the younger group of men. The overall correlations of 0·49 for the men and 0·36 for the women in the two areas are both highly significant ($P = 0{\cdot}001$).

5.11 Vitamin D

5.11.1. The vitamin D content of the diet averaged 104 i.u. (2·6 μg cholecalciferol) (Table 4.1), which is about the recommended intake, and per 1,000 kcal is similar to that of households in the National Food Survey (Table A21, p. 98). There may well be, however, a difference in the efficiency with which old people, compared with younger adults, are able to utilise the sun's rays falling upon their skin. The contribution which sunlight makes is probably more important than differences in their dietary consumption of vitamin D.

5.11.2. The characteristics of diets containing less than 40 i.u. vitamin D (1 μg cholecalciferol) were that they were on average 20–25% lower in energy content, with a disproportionate reduction from about 21 i.u. to 7 i.u. in the amount of vitamin D derived from eggs. The fall in the consumption of fish, the other main contributor of the vitamin, was in proportion to the decrease in consumption of energy.

5.11.3. There are many causes of constant low back pain. Thirty of our subjects complained of this pain, and there was some indication even in such a small number that the intakes of vitamin D for the week of the survey were lower than in the comparable age/sex group not complaining of back pain.

5.11.4. Osteomalacia might be expected to result from low dietary intakes of vitamin D. In the survey the degree of osteomalacia found was rarely severe enough to permit an outright diagnosis and the clinicians preferred to wait upon biochemical findings. Serum alkaline phosphatase activity is increased in osteomalacia, although there are other conditions, such as Paget's disease, in which the activity of the enzyme is also raised. The series is known to have included at least 4 subjects with Paget's disease.

5.11.5. The results for serum alkaline phosphatase measurements are not strictly comparable between the different areas (see Table C6, p. 162). Nevertheless, out of 697 subjects with dietary records for whom measurements were made, 53 had serum alkaline phosphatase levels equal to or above 13·0 K.A. units. The average dietary intake of the 53 was 86 i.u. vitamin D (2·2 μg cholecalciferol) compared with 106 i.u. (2·7 μg) for those with lower enzyme levels; the differences are not statistically significant.

5.11.6. About 20% of persons with increased enzyme activity in the serum had some form of physical disability, and among 62 who were housefast the incidence of high alkaline phosphatase values was 18% compared with 7% in 683 others on whom the measurement was made. The differences were not statistically significant but are in keeping with clinical experience. Though the housefast are potentially at special risk because they experience little direct sunlight it is also worth noting that those who were housefast in our sample were recorded as eating less food (being less active), and as a result took less vitamin D.

5.11.7. It was later thought that the critical levels of alkaline phosphatase should have been taken as 10·0 K.A. units for women and 12·0 K.A. units for men (Dent and Harper, 1962). The incidence of constant back pain was examined in relation to these levels. Of the women with alkaline phosphatase values above 10 K.A. units, 10% complained of constant back pain, compared with 5% who had pain but normal enzyme activity. The proportions of men were 7·5% with pain and alkaline phosphatase values above 12 K.A. units and 3% with pain and normal values. The relationship is significant for women at the 5% level but not significant for men.

CHAPTER 6

A Further Search for Malnutrition

6.1 General

6.1.1. The preceding chapters do not give the reader a clear idea of how much or how little malnutrition there was among the subjects of this survey. References have been made to overt and unequivocal malnutrition, but the numbers involved are very small in comparison with the total sample. Scurvy was detected, but in only two cases; ariboflavinosis and osteomalacia were suspected, and the possibility is not completely excluded of some measure of other forms of malnutrition. Where malnutrition is mild in degree it is difficult to demonstrate, largely because the margin between normality and abnormality is indefinite and because a dietary, biochemical, or anthropometric value which for one individual may spell abnormality may for another be compatible with health. If, in addition to being mild in degree, the frequency of malnutrition is low, very large numbers indeed may have to be studied in order to demonstrate its existence by statistical means.

6.1.2. It is therefore important to follow up other possible leads even by reference to the original case reports in the hope of assessing the situation more clearly. In this survey a special study was made of the records of: (1) those whom the clinicians diagnosed as being malnourished; (2) those who consumed least energy; (3) recipients of meals-on-wheels on the grounds that at some time they may have been judged to be at risk; and those who, when asked if they would take meals-on-wheels were such available, replied that they would.

6.2 Those Diagnosed Clinically as Malnourished

6.2.1. The clinician also labours under disadvantages similar to those already discussed. Confronted with obvious sheet haemorrhages he is easily able to eliminate the few possible non-nutritional causes and arrive at a firm diagnosis of scurvy. But more often he is dealing with evidence of malfunction in which the nature and degree of stress which has precipitated it may vary from a degree which is negligible in normal health, but not in the presence of an underlying impairment, to a severity too great for even the best nourished of individuals to resist. An example is angular stomatitis in which epithelium which is normally keratinised and firm becomes soggy and cracked. Where, for example, because of unsuitable dentures or none at all the skin at the angle of the mouth becomes permanently infolded, and where saliva or food render it persistently damp, the epithelium may become soggy no matter what the nutritional state of the subject may be. In contrast, marked riboflavine deficiency leads to sogginess even in people with normally formed mouths. To arrive at a diagnosis of ariboflavinosis the clinician has to decide in the first place whether the angle of the mouth is abnormal (and observers may differ) and in the second whether the abnormality can be ascribed entirely to non-nutritional stress.

6.2.2. These uncertainties are not confined to riboflavine deficiency; indeed in greater or lesser degree they apply to all forms of mild malnutrition encountered in the elderly. As a result there were substantial differences in the nature and amount of malnutrition diagnosed in the various areas, partly reflecting the special interests of each clinician, partly the severity of his criteria of malnutrition. In some instances there may have been an element of over- or under-diagnosis. In the course of his ordinary work the geriatrician may withhold his diagnosis pending the outcome of a therapeutic trial, or he may make further tests such as bone biopsy to which a volunteer in a nutrition survey cannot be expected to agree. In the absence of such tests, the survey imposed on the clinicians a task which it was impossible for them to fulfil satisfactorily.

6.2.3. Despite the unreasonable demands imposed upon the clinicians by the design of the survey, their diagnoses were of value in indicating the nature of the malnutrition they found present among the old people. Each clinician was asked to specify the type and to describe any medical, social or economic factors which might have precipitated the condition. In five areas the diagnosis was later reviewed in the light of the biochemical and other evidence; in no instance did the clinician change his diagnosis. In the sixth area the clinician delayed diagnosis until all available evidence was before him.

6.2.4. Out of the 841 subjects examined by the clinicians, the fact that only 27 were diagnosed as malnourished is reassuring. Moreover, this figure should not be taken as indicating the prevalence of malnutrition among the elderly, since the sample was biased in some respects (paragraph 3.1.2). Those subjects who were obese are not included in the 27, nor has osteomalacia been considered in this context, because little can be added to what has already been said, particularly in respect of the combined rôles of sunlight and dietary vitamin D. Diagnosis was based on one or more of the conditions noted below.

6.2.5. In 8 subjects angular stomatitis, often but not invariably associated with other manifestations, was the main reason for a diagnosis of malnutrition. Two subjects were given firm diagnoses of scurvy and the possibility was raised in 2 others. Twelve subjects, all in one area, were said to show protein-calorie malnutrition; the serum pseudocholinesterase and serum albumin levels of these subjects and their consumption of protein and energy are listed in Table C7 (p. 163) but the values do not consistently support the diagnosis. Another reason given for the diagnosis in many of the subjects was their thinness.

6.2.6. Of the 27 who were thought to be malnourished, 12 suffered from secondary malnutrition: in 1 the condition was associated with known cancer, 1 with suspected cancer, 1 with thyroid dysfunction, 2 had had gastrectomies, 5 others had conditions such as severe arthritis or previous strokes, and 2 were suspected of alcoholism (one of whom had been bereaved two years before). This leaves 15 subjects who could have been suffering from primary malnutrition. The distinction between primary and secondary malnutrition is not always clear; indeed several factors sometimes operate in the same individual. Moreover, the possibility of overdiagnosis cannot be excluded (paragraph 6.2.5). In 6 of the 15 there was a "failure adequately to cope" as indicated by the case reports of the dietitians. One other, a woman, was restricted in her expenditure on food by her husband to an extent which seemed in no way justified from what was known of his resources. There were 8 for whose condition there was no clear social or medical reason from the reported data. In some of these old people at least, malnutrition might have been prevented if the hazards had been recognised and the appropriate community services deployed.

6.2.7. Four out of the 27 were judged as unable to masticate efficiently, a proportion not very different from that in the sample as a whole. Though this was earlier seen to be associated with reduced energy intake (paragraph 5.1.9) it apparently does not lead to clinical malnutrition.

6.3 Those with Low Intakes of Energy

6.3.1. The records were examined of 41 men consuming less than 1,500 kcal (6.3 MJ) and 47 women who took less than 1,200 kcal (5·0 MJ) daily; that is, 88 subjects in all, roughly the lowest 10% of the sample. (Of these 1 man and 3 women had no medical or biochemical records and have not been included in subsequent analyses or discussion). The low dietary intakes of some subjects during the week of study may not have been typical of what happened at other times, because of mild illnesses or for other reasons.

6.3.2. Of these subjects 14, all women, were reported as overweight or obese and were either deliberately dieting or "watching their weight". These were not considered further.

6.3.3. Of the others, the general condition of 22 was assessed by the clinician as "better than average" although 3 of these were also diagnosed as possible cases of protein-calorie malnutrition, presumably because they were thin. A somewhat lean old person may well be in better shape than average. Some of the others in the category "better than average" were lean, but none (out of 18 on whom the test was made) had low serum pseudocholinesterase values, though 3 had serum albumin levels below 3·5 g/100 ml. Many of this group may have had "naturally" low energy requirements but the margin between this and very mild degrees of undernutrition is obviously difficult to decide on clinical grounds.

6.3.4. A third group of 24 subjects was distinguishable for whom, because of the nature of the non-nutritional diseases with which they were afflicted, there seemed little or no prospect of securing improvements in health simply by supplying more food. Some had low intakes because their activity was restricted by diseases such as strokes or generalised crippling arthritis. In others the desire for food was considered as likely to be restricted by mental depression or by gastrointestinal disease. In this group only 1 out of 11 subjects had a borderline serum albumin concentration of 3·5 g/100 ml and only 2 had reduced serum pseudocholinesterase activity out of the 15 tested.

6.3.5. A further 17 had some condition which impeded preparation or consumption of food, such as failing vision or osteoarthritis of the hands. Nine of these had low skinfold measurements. Out of 13 whose serum albumin was measured 4 had low levels and of these 3 had also a lowered serum pseudocholinesterase. One other whose serum albumin was not measured also had a low pseudocholinesterase result.

6.3.6. Finally, 7 subjects, of whom 5 were 75 or over, were grouped as suffering from "senile degenerative states". One refused medical examination. Of the others, 4 were very thin, 2 had reduced pseudocholinesterase levels and 1 of these had a low serum albumin value; 1 other with a "normal" pseudocholinesterase level also showed low serum albumin concentration.

6.3.7. Low energy consumers are of interest from the point of view of the methodology of dietary surveys. Low intakes of one or other nutrients are often encountered and it is impossible as a rule to say to what extent this is due to some inadequacy of the method employed (such as too short a period of observation), or to extremes of individual variation in physiological requirements, or to true deficiencies of intakes compared with requirements. In this group the frequency with which low values for skinfold measurements and for serum pseudocholinesterase occurred was greater to a statistically significant degree than in the whole sample, although this did not apply to the frequency of low serum albumin levels. The exclusion from consideration of those subjects who were deliberately restricting their energy intake led to a further increase in the proportion whose biochemical and physical measurements were indicative of undernutrition; it is therefore fair to infer that some of the low energy consumers were indeed undernourished. How many cannot, of course, be said, since we are dealing with a condition of which the parameters shade off into normality.

6.3.8. Considering that many of these subjects who ate little food were receiving much smaller than average amounts of most nutrients, it is of interest that only 6 of the 88 having low energy intakes were diagnosed as malnourished by the clinicians.

6.3.9. The biochemistry of the group tends to support the clinicians. Serum albumin and pseudocholinesterase results have already been considered. The prevalence of anaemia as shown by haemoglobin levels below 13 g/100 ml for men and 12 g/100 ml for women was 15% compared with 7% in the whole sample. Four per cent of red cell folate values were below 100 ng/ml, a figure identical with that of the whole sample. Serum vitamin B_{12} levels showed no remarkable difference from those in the rest of the sample, 2·5% having less than 100 pg/ml compared with 1% in the sample as a whole. Of 10 subjects in this group in Portsmouth on whom vitamin C measurements were made, only 1 had less than 10 μg ascorbic acid/10^8 leucocytes; in Sunderland there were 10 with such levels out of 35 tested, the percentage for the whole Sunderland sample being 23%. The proportion of people in this group with raised serum alkaline phosphatase levels was no higher than in the sample as a whole.

6.3.10. These unimpressive deviations from the prevalence of abnormal biochemical findings in the main sample lend little support to the hypothesis that specific deficiency disease as opposed to undernutrition can arise through a general reduction in the amounts of nutrients consumed *pari passu* with reduction in the overall amount of food. Where little food is eaten the active cell mass may also be reduced and its metabolic activity low, and the requirements for nutrients may be correspondingly less. It is relevant that caloric undernutrition rather than nutrient deficiency was the common experience of war-stricken populations.

6.4 **Those receiving Meals-on-wheels and Those who would have had them if available**

6.4.1. The number of days on which meals were delivered ranged from 1 to 5. Twenty-one subjects were receiving meals-on-wheels. Among the recipients 5 had been diagnosed as malnourished by the clinicians, and of 7 who were thin 6 had been included among the "low energy consumers". Eight had skinfold measurements averaging more than 40 mm for the sum of the two measurements taken, i.e. they were "well covered", 2 only of these were described as housefast and unable to cook. The energy consumption of the others was similar to the average energy consumption of their age/sex group.

6.4.2. Subjects in the survey were asked if they would like to have meals-on-wheels if they were available. Among 35 who said they would, 18 were either fat or adequately covered and, as far as could be judged from the case reports, were not in any real need of the service but only "felt they would like it". At least 7 seemed in genuine need because they were thin and 1 had been diagnosed as malnourished (with scurvy and angular stomatitis).

6.5 **Summation**

6.5.1. The special searches described above did not reveal much more than that which had been found by the clinicians. It may well be that they had interpreted as normal the thinness of certain individuals where in fact it was due to caloric restriction; but equally, it is extremely difficult to establish by any means what does or does not constitute undernutrition. Among the clinicians' cases the part played by non-nutritional exacerbating disease was very important. The additional undernutrition revealed by the special searches concerned a few subjects who were afflicted with diseases that prevented them from preparing food, and some others who were characteristically decrepit old people, either holding out in the surroundings and circumstances which were familiar to them, or remaining where they were for longer than they should because of lack of satisfactory alternatives. No assessment could be made of the part played by younger relatives in preventing malnutrition either by caring for such people within the family or by cooking for them. It must have been very important.

CHAPTER 7

Socio-Economic Aspects

7.1 Introduction

7.1.1. In previous chapters an attempt has been made to examine the amount and nature of under- and malnutrition which was demonstrated among the subjects of the survey, and to explain it in terms of diet, ageing and non-nutritional pre-disposing disease. Certain social and economic factors were also investigated.

7.2 Mode of Living

7.2.1. The mode of living was known for 824 subjects, of whom 225 lived alone, 417 with their spouses (with or without other relatives), and 163 with relatives. There were 19 living in other ways, e.g. with persons not relatives, who were not considered further. Table A22 and A23 (pp. 99, 100) show the average values for intakes of energy and nutrients by men and women of the two age groups according to their mode of living. The differences were not very great though some of them deserve mention. For example, men aged 75 years and over living alone fared worse than their fellows in respect of a large number of nutrients and foods, and this was in some measure reflected in the numbers recorded as having biochemical values below certain arbitrary limits (Tables A24, A25, pp. 101, 102). A higher proportion were recorded as having skinfold thickness below 20 mm (for the sum of two skinfold measurements) despite the fact that their energy intake was not importantly different from what was found in other groups. For men aged 65–74 there was less to choose between the three modes of living; many of this age group who lived alone were no doubt fairly well able to look after themselves. Women aged 75 years and over living alone also appeared able to manage for themselves, and at ages less than 75 years fared better than any of the other groups. The position as regards foods of animal origin is set out in Figure A17 (p. 123); though differences existed, particularly in respect of milk consumption, they were in no instance great.

7.2.2. The finding that older men living alone were in general particularly vulnerable is to be expected. There is an additional hazard of illness or accident in the absence of companions, which, of course, applies to both sexes. In the Special Study on Haematology (p. 56) it is remarked that those living alone had a statistically significant higher incidence of anaemia than other groups. This probably is a reflection of their diet, though their meat consumption was no lower than that of other people. The significance of anaemia among the elderly has not emerged clearly from the survey.

7.3 Source of Income

7.3.1. Subjects were divided into three groups according to the source of their income: Group 1, those living on normal Social Security pension only; Group 2, those receiving Supplementary Benefit; and Group 3, those not receiving Supplementary Benefit but with other sources of income apart from normal Social Security pension. Most of the subjects in Group 1 were living with relations, probably because some were too frail or ill to manage alone. In such cases the level of requirements by Supplementary Benefit standards is lower than that of persons living alone and those receiving normal Social Security pensions are therefore less likely to qualify for Supplementary Benefit. When the subject was living alone but received Social Security pension only it could frequently be inferred from the case records that he or she had private resources of a nature which was not specifically recorded in the present investigation. For these reasons, it was difficult to interpret the economic findings in Group 1, and most of the comparisons below relate to those receiving Supplementary Benefit (Group 2) and those whose income was derived from "other sources" (Group 3).

7.3.2. Tables A26 and A27 (pp. 103, 104) show the intakes of energy and nutrients by age and sex of the three groups. Those with "other sources of income" (Group 3) have higher average intakes of many nutrients than do the other members of their age/sex group. The differences are small, however. A part of this is attributable to their higher energy intake, as can be seen from the similarity in the percentage of energy derived from protein in the various groups. In respect of most of the biochemical determinations Group 3 men had fewer low values than their fellows but the comparisons are less obvious in the women.

Table 7.1
Energy intakes of men and women of the two age-groups according to the source of their income

Group	Persons	Men				Women			
		65–74		75 and over		65–74		75 and over	
		No.	kcal (MJ)	No.	kcal (MJ)	No.	kcal (MJ)	No.	kcal (MJ)
All	All[1]	217	2,344 (9·8)	179	2,103 (8·8)	226	1,787 (7·5)	205	1,628 (6·8)
1	Persons receiving Social Security pension only	19	2,151 (9·0)	33	2,118 (8·9)	28	1,770 (7·4)	36	1,610 (6·7)
2	Persons receiving Supplementary Benefit	40	2,202 (9·2)	47	1,955 (8·2)	77	1,725 (7·2)	83	1,567 (6·6)
3	Persons with income from other sources[2]	156	2,408 (10·1)	98	2,170 (9·1)	121	1,830 (7·7)	82	1,705 (7·1)

NOTES: [1] Includes 7 whose source of income is unknown (2 men 65–74; 1 man over 75; 4 women over 75).
[2] i.e. other than Social Security pension or Supplementary Benefit.

7.3.3. Those who received Supplementary Benefit (Group 2) consumed diets of lower energy content than did those who were not dependent on the state for funds (Group 3) (Table 7.1). Supplementary Benefit is paid to those who would otherwise have too little income from earned or unearned sources and/or from old age pensions, to meet their needs of food, fuel, rent, etc. The amount of their requirements is assessed in accordance with the Ministry of Social Security Act, and if this falls below the level of their income, the difference is made up by way of Supplementary Benefit. In assessing requirements an allowance may be made for any special expense a person necessarily incurs, for example, for special diet. The possibility therefore had to be considered that the assessment was too tight and this was examined in detail.

7.3.4. The group with income from other sources (Group 3) included some people who were still working. Work involving activity increases energy requirements and therefore intake is also increased where this is limited only by appetite. If those who were still at work are excluded from this group, the difference in energy intake between those who remain in Group 3 and subjects

Table 7.2

Energy intakes of men and women of the two age-groups receiving Supplementary Benefit compared with those of non-workers whose income came from other sources

Persons	Men				Women			
	65–74		75 and over		65–74		75 and over	
	No.	kcal (MJ)	No.	kcal (MJ)	No.	kcal (MJ)	No.	kcal (MJ)
Persons receiving Supplementary Benefit	40	2,202 (9·2)	47	1,955 (8·2)	77	1,725 (7·2)	83	1,567 (6·6)
Persons with income from other sources and not working	103	2,311 (9·7)	86	2,116 (8·9)	99	1,860 (7·8)	75	1,693 (7·1)

Table 7.3

Energy intakes per kg bodyweight of men and women of the two age-groups receiving Supplementary Benefit and of those whose income came from other sources

Group	Persons	Men				Women			
		65–74		75 and over		65–74		75 and over	
		No.	kcal/kg	No.	kcal/kg	No.	kcal/kg	No.	kcal/kg
2	Persons receiving Supplementary Benefit	40	32	47	29	77	27	83	26
3	Persons with income from other sources	156	33	98	32	121	28	82	26

in Group 2 was reduced but not eliminated (Table 7.2). In general, subjects in Group 2 were likely to have been born of parents less prosperous than those of Group 3, and the periods of economic and other disturbance before, during, and after the First World War could have affected adversely their growth and ultimate stature. Table 7.3 shows that when the energy intakes of subjects in Groups 2 and 3 are expressed in terms of bodyweight, the difference was reduced slightly but did not disappear altogether.

7.3.5. Figure A18 (p. 123) shows the distribution of the ratio of weight to the square of the height (Quetelet's index) which was obviously irregular in both sexes. Figure A19 (p. 124) makes the same comparison of skinfold measurements, those of women being again irregular while those of men still show some tendency towards thinness in Group 2 (the relationship is significant only at the 10% level). Except for this tendency in men the findings were compatible with the hypothesis that the lower consumption of energy by persons in Group 2 was because they were smaller people or less active as opposed to being currently less adequately nourished.

7.3.6. The further step was taken of analysing the intake of expensive foods of animal origin. Table 7.4 shows a difference in absolute amounts, but the

Table 7.4

Average daily intakes of some animal protein foods by men and women receiving Supplementary Benefit and by those whose income came from other sources

Persons		No.	Mean daily intake (g) of			
			meat	fish	eggs	total
Men:	Group 2	87	79·1	28·1	38·3	145·5
	Group 3	254	96·7	25·2	43·1	165·0
Women:	Group 2	160	64·4	18·1	31·5	114·0
	Group 3	203	71·7	19·6	32·6	123·9

difference in the total consumption of these was proportionate to the difference in energy intake between the groups (i.e. of the order of 10%). It would be reasonable to expect some, perhaps a considerable, shift towards replacement of expensive sources of food by cheap sources of energy such as bread, before energy needs were allowed to go unmet; but little or nothing seems to have been published on the ways in which old people do behave in this respect.

7.3.7. Within the limits of the available tests and of our current knowledge of old people's dietary behaviour, no caloric restriction arising out of the difference in income between the two groups has been demonstrated.

7.4 Amount Spent on Food

7.4.1. Within the somewhat severe limits of the capacity of the old people to provide information, expenditure on food was determined. Tables A28 and A29 (pp. 105, 106) show a direct relationship between the amount spent on food and the energy and nutrient content of the diet, which may be partly because the more one eats the more one spends. But the groups spending most consume between 13% and 24% more protein and have higher intakes of vitamins than the groups spending least; this is partly reflected also in the percentage of energy derived from animal protein. The consumption of meat by the group spending least was about 20% less than that of the group who spent most and the difference was not made up in cheese or other animal foods, or in milk. Their energy intake was between 8% and 13% less so that the reduction in quality of their diet was less impressive than might otherwise appear.

7.4.2. Whether any element of over- or under-nutrition operated would need to be determined by other means. Table 7.5 shows virtually no relationship between

Table 7.5

Percentage of men and women spending different amounts on food in relation to their skinfold thickness

Thickness of (double) skinfold (mm)	Men			Women		
	£1·49 and under	£1·50 to £1·99	£2·00 and over	£1·49 and under	£1·50 to £1·99	£2·00 and over
Under 20	28	33	30	11	12	6
20–29·9	49	38	39	30	16	17
30–39·9	11·5	24	23	33	24	29
40 and over	11·5	5	8	26	48	48
Total no. of persons	43	96	199	61	89	187

NOTE: The relationship is significant at the 5% level for women.

expenditure on food and the percentage of thin men as judged by their skinfold thickness. Among women, when both age groups are considered together, there was a tendency, significant at the 5% level, for fewer of the thinnest women to be in the highest expenditure group and fewer of the fattest women in the lowest expenditure group; but the proportion of thin women was the same among the groups spending less than £1·50 and £1·50–£2·00 and was less than among any of the 3 groups of men. There appeared to be no criteria of what is a "natural" or "normal" range of leanness or fatness for old men and women.

7.5 Social Class

7.5.1. A social gradient in meat consumption was observable, but it amounted only to about 10% between Social Classes I, II and Classes IV, V, a finding in keeping with the similarity in pattern of intake of those on Supplementary Benefit and those with other sources of income (paragraph 7.3.6).

7.5.2. On average only 0·4 oz. of cheese was eaten daily; there was no tendency at all for higher consumption than average in Social Classes IV and V or by those dependent on Supplementary Benefit. Insofar as cheese has been traditionally a poor man's standby for consumption with bread, this finding is encouraging, but not otherwise.

7.6 Discussion

7.6.1. A general impression emerges that those whom one would expect on social or economic grounds to eat a "richer" diet on average did so, though the differences were often small or inconsistent in different groups and in some instances were due in part or wholly to differences in energy intake. This is not to say that those on diets poorer in nutrients were inadequately nourished. To decide this it is necessary to study the effects on the consumers.

7.6.2. Some of these were not very impressive. For example the highest percentage of thin men under 75 years was in the group spending least on food (Table A28, p. 105); however, among men aged 75 or over the highest proportion was in the middle expenditure group, as it was also in women aged less than 75 years. For serum albumin and pseudocholinesterase levels the pattern was the same except that among the oldest women the "worst" situation was among those who spent most on food. Men with income from sources other than Supplementary Benefit had the least likelihood of abnormally low biochemical or anthropometric values but this was not true of women. In the preceding chapters reasons have been indicated in terms of non-nutritional disease or senescence for some of these low values; those in whom they were found may well have spent less on food because they were not well, or may have appeared in the sample as members of the economically or socially less favoured groups who preferred to live on in their own homes because the alternatives that were open to them were less attractive. In other words, the dietary and physical differences consequent on income were unimpressive, and their causes were indirectly rather than directly economic.

7.6.3. The interpretation of these findings in relation to the present needs of the elderly is made difficult because of the time which has elapsed since the work of the survey was done. Since 1968 there has been a considerable change in the rate at which the cost of living, including that of food, is increasing. The annual review of Supplementary Benefit and the biennial review of retirement pensions both take count of this by increasing these allowances to an extent which is somewhat greater than would be required to restore the position at the time of review; but in times of rapid inflation this surplus is used up more quickly so that a larger part of the period up to the next review is spent in deficit instead of credit than it would be in more stable times. This situation should be eased, however, because from 1972 retirement pensions in common with Supplementary Benefit will be reviewed annually.

III EVALUATION AND RECOMMENDATIONS

CHAPTER 8

Evaluation by the Panel on Nutrition of the Elderly

8.1 The Design of the Survey

8.1.1. Before evaluating the findings we consider the survey itself, because there are lessons to be learnt for future studies and because the limitations of surveys are pertinent to evaluation of their findings.

8.1.2. First, it is cross-sectional, not longitudinal. The distinction is important because the experience of those of us who are practising geriatricians is that old people manage their diets well enough to begin with, but later they often become progressively less able to manage on their own, particularly if they have developed significant multiple pathology. Whether or not they then become malnourished is dependent largely upon the speed and effectiveness of the measures taken to help them. An important part of the problem is to identify the subjects at this vulnerable stage, or earlier if possible. Some, perhaps most, of the individuals described in Chapter 6 and especially in section 6.3 are examples of people who have reached this unhappy stage or even passed it. Although there were not many of them, it needs to be remembered that others, at present in reasonable health, may in due course reach the same stage unless preventive measures are taken. It would be informative to repeat the survey (with of course appropriate modifications) on the same people after an interval of 5 years; the prognostic value of the information recorded on the first occasion could then be judged by comparison with the results of the second survey. We recommend that this be done.

8.1.3. The next limitation to the survey relates to the tests performed. Whilst we have based a decision as to whether malnutrition exists on evidence of disturbance of form or function, some of the available tests are insensitive and others, though sensitive, are non-specific. The ranges of normality are uncertain even for younger populations. Nor do we consider that malnutrition is necessarily present when concentrations of nutrients measured in blood fall below what are often arbitrary standards, or when amounts of energy and nutrients consumed by an individual are less than the recommended intakes. We think that there is scope for a further special examination of the material of this survey with a view to establishing biochemical and/or anthropometric standards of normality among old people. If this proves impossible, we should be able to indicate ways in which the data of the repeat study which we recommend in paragraph 8.1.2. may be collected to that end.

8.1.4. We have to comment upon the lapse of time between the field work (mostly in 1968) and the publication of the report in 1972. Where a new and very complex survey such as this is made, each analysis leads to further topics for investigation by re-analysis of the data either by computer, or by hand analysis, or, where coding is inadequate for the purpose, perusal of the original records. This takes time and so reduces the value of the survey because obviously our comments refer to 1968 and since then the economic situation has changed considerably (see paragraph 7.6.3). It is fair to add that had we ourselves seen urgent need for action while the findings were collated we would have advised the responsible authorities. Nevertheless the possibility of publishing provisional findings deserves to be kept in mind for future occasions.

8.1.5. This said, we wish to record our view that the survey is unique, and that we are better supplied with evidence on the elderly than we have ever been before. Though it is true that, even when allowance is made for stratification by age, the sample is not necessarily representative of the country as a whole, for the reasons given in paragraph 3.1.3. we regard the results as broadly indicative of the general situation. They undoubtedly provide a firmer basis for food policy than has hitherto been available.

8.2 Survey Findings

8.2.1. *The dietary evidence.* The dietary evidence confirms the view expressed in the King Edward's Hospital Fund (1965) Report, and quoted in our First Report (Department of Health and Social Security, 1970) that "the popular idea that many old people who live alone exist almost entirely on bread, butter, jam, biscuits and cups of sweetened tea was not borne out". The foods that old people eat are much the same as those eaten by other people. Indeed from Table 4.2 (p. 20) it is clear that when allowance is made for the lower energy expenditure of the elderly the diet of old people is not very different on average from that of "all households" surveyed by the National Food Survey. The nutrient content of the diet of old people per 1,000 kcal is also much the same as that of the nation (Table A21, p. 98).

8.2.2. *Physical findings.* The clinicians' findings indicate that there is some but not much overt malnutrition. This also is in keeping with the views that we expressed in our First Report (Department of Health and Social Security, 1970). The outstanding impression gained from the clinical records and the case reports of the dietary investigators was that the most important reason for mal- or under-nutrition, when it occurred, was that the subject was biologically very old, often with multiple pathology.

8.2.3. The critical question is how much malnutrition there is of a sub-clinical kind beneath that which is overt. To define precisely its extent is manifestly impossible. However, we consider below certain points.

8.2.4. It was established that in certain groups in the survey there were more thin people than in others, and biochemical evidence confirmed our idea that some of these were undernourished. The plane of undernutrition was so slight that in most instances the clinicians had not considered that the individuals concerned were abnormally thin. The causes were in general clear-cut, and we will consider them later, but one point should here be made. In section 7.3 of the report we showed that the elderly with sources of income other than the state pension and Supplementary Benefit consumed rather more of energy and nutrients than those receiving Supplementary Benefit although the differences were small. But in Tables A26, A27 (pp. 103, 104) we were unable to demonstrate that this was associated with biochemical or other evidence of harm. The elderly living on Supplementary Benefit were not as heavy as those with other sources of income and when expressed as energy intake per unit of body weight the differences in absolute levels of energy intake were somewhat reduced, but were not eliminated (Table 7.3). There was no statistical and very little actual difference in the amount of body surface fat between those who had sources of income other than what was provided by the State and those who had not. The possibility has not been excluded that the differences in energy expenditure per unit of body weight were due to those without "other income" having to restrict their activity because they had less to spend on the various pursuits that go to make up a full life. As stated in paragraph 5.1.8, this involves an equation of "activity" and activities, but we think a further investigation of this possibility deserves to be made. It would suggest that sharp increases in cost of living compared with their income might have substantial effects upon the quality of the lives of the elderly of a sort which can only be indirectly indicated in a strictly nutritional survey.

8.2.5. Section 5.9 suggests that there is probably ariboflavinosis among some of those who show mouth lesions. Besides the few who were diagnosed as having or were suspected of having scurvy there no doubt exist some (as shown by low content of ascorbic acid in leucocytes) who are on the brink. In both instances this is a problem of a small proportion, not the generality. There was no evidence of deficiency of protein (primary), thiamine, nicotinic acid or calcium. Haematological findings were conflicting on iron; more women than men had low serum iron and high TIBC, yet the prevalence of anaemia was not importantly different in the sexes. Though concentrations of folate in red cells and serum were lower than in younger adults, this was not reflected in the prevalence of anaemia or other sign. Some values of vitamin B_{12} were low, but the individuals concerned were usually not anaemic. We may learn more about the significance of low concentrations of folate and B_{12} when the same subjects are examined in the follow-up survey.

8.2.6. This leaves the question of vitamin D and osteomalacia and it is appropriately left to the last because of our uncertainty as to whether the prevalence of osteomalacia warrants some general measure to rectify the deficiency. The difficulty here is that some of the procedures used in hospital to establish the diagnosis of osteomalacia are unsuited to field work. We have had to rely on biochemical measurements, such as the concentration in serum of alkaline phosphatase which can be altered by conditions other than osteomalacia and of which the limits of normality are uncertain. However, more women aged 75 and over with low bone density tended to have raised serum alkaline phosphatase values and lowered serum calcium values and to be housebound than those with denser bones. Thus osteomalacia may contribute to skeletal rarefaction in very old women. Vitamin D deficiency may be due as much to inadequate exposure to sunlight as to low dietary intakes.

8.3 **Practical Considerations**

8.3.1. In the course of the survey some malnutrition was brought to light which otherwise would not have been known. The experience emphasises the need to identify and treat individuals before their disabilities render them malnourished. It would be valuable if an up-to-date register of patients according to age could be maintained by every general practitioner with a view to the elderly among them being regularly visited. Ideally, they would be seen in the first place by a member of the community nursing services attached to a practice and the doctor would be advised of those who appear to need a more detailed assessment.

8.3.2. The problem of preventing sub-clinical malnutrition is also one of identifying speedily those individuals who are at risk. There may be recognisable causes such as catastrophes of illness or the loss of a spouse leaving the individual unable or unwilling to manage his or her affairs, or the gradual impairment of physical and mental ability due to non-nutritional disease. If on the other hand sub-clinical malnutrition is more widespread, then measures would be called for which could be applied generally to all the elderly. These might range from fortification with some nutrient of some food commonly consumed by them (and by most other people) to an increase in the level of their income.

8.3.3. The survey indicated the sort of food that old people want; it is the same as other people have. Further, provided it is properly prepared and suitably varied, it is also what they need to prevent the development of malnutrition. What is less simple, once an old person has been identified as being at risk, is to ensure that he or she does receive such food. The appropriate measures depend upon the situation and may include cookery lessons, practical advice on budgeting and food selection, improved kitchen layout and/or storage facilities, or provision of meals at clubs or day centres. Meals-on-wheels already provide a valuable service, which, from the evidence cited in paragraph 6.4.2, is appreciated and could with advantage be extended.

8.3.4. There is also an opening for industry in the development of processed foods of known nutritional value which are easily prepared as well as cheap, and on sale in conveniently small quantities. Most foods of this sort at present available are expensive.

8.3.5. The survey revealed that 28% of men and 21% of women over 75 had meals provided for them by relatives other than their spouses or by other helpers, and that 24% and 32% respectively were living with relatives other than their spouses. Obviously, relatives play an invaluable part in caring for the elderly and their service should be encouraged and supported lest it wane without replacement.

8.3.6. The possibility of making a milk preparation fortified with several nutrients available to those identified as in special need, either as an extension of the meals-on-wheels service or as a separate project, would need to be preceded by adequate preliminary trials and an evaluation of the result. The milk might need to be of a longer lasting sort than the usual pasteurised product so that a week's delivery could be made at a time and kept without spoilage. It might also be useful to use a fortified dried milk in the dishes prepared as meals-on-wheels or in day centres (or in club kitchens). We recommend that these possible uses of fortified milk be studied.

8.3.7. There is also the question of the best way to prevent osteomalacia. We think that a trial should be made of the prophylactic administration of vitamin D to old people at risk in the course of the regular visits that we recommend in paragraph 8.3.1. Should osteomalacia persist in the community the fortification of the liquid milk supply with vitamin D would need to be considered.

8.3.8. The relationship between inefficient mastication and reduced consumption of food is not in harmony with the findings in the Special Study on Mastication (p. 69). One possible reason is that in the work described on pp. 69–71 the tests employed were indeed of efficiency or inefficiency of mastication whereas the clinicians may have been influenced in their decisions by the degree of discomfort experienced by the subject when eating. There are other possible reasons and the most decisive test would be to replace some dentures which have become old, uncomfortable and inefficient by new comfortable ones and observe any change. We understand that this has been initiated.

8.3.9. We should like to see any change in the retail of milk to metric quantities made the occasion of a change to containers capable of preserving more of the riboflavine and vitamin C from destruction by sunlight. But the real remedy is to detect early those at risk as described in paragraph 8.3.1 and to treat them appropriately.

8.3.10. Health education for the elderly themselves is important and we would encourage the expansion of the number of "Preparation for Retirement" courses. Some instruction about care of the elderly should be included in school teaching programmes. We think that more extensive use could be made of the skills of dietitians, health visitors and social workers.

CHAPTER 9

Summary

9.1 Plan of the Survey

9.1.1. The survey covered 879 men and women aged 65 and over living alone or with their spouses, relatives or other people in six areas in England and Scotland. The subjects were selected from the registers of the local Executive Councils of the National Health Service. Though it was not possible to design the sample to be representative of the country as a whole the spectrum of different social, economic and environmental conditions was covered. The survey consisted of three main parts: (1) a record of quantified dietary intakes over a period of one week, during which some socio-economic information was also collected; (2) a medical examination which included a radiograph of the hand on which measurements were made of the 2nd metacarpal bone to assess skeletal status; (3) biochemical analyses of a blood sample.

9.1.2. In a short summary of what was a very extensive piece of work, it is only possible to select a few points of interest.

9.2 The Dietary Survey

9.2.1. The survey showed that the diets contained foods and nutrients in much the same proportion as they are consumed by the population as a whole, though in smaller quantities. For men, the mean daily intakes of energy were about 2,340 and 2,100 kcal (9·8 and 8·8 MJ) for the two age groups 65–74 and 75 and over respectively. These correspond almost exactly to the recommended intakes; but women in these two age groups took about 1,790 and 1,630 kcal (7·5 and 6·8 MJ) respectively, which were 13–14% below the recommendation. Nevertheless, women were fatter than men. Whilst the average intakes of nearly all nutrients were close to the recommended intakes there was a wide scatter above and below these averages in the amounts of nutrients consumed during the survey week.

9.3 The Clinical Examination

9.3.1. Only 27 subjects (3·2%) were judged to be malnourished, the reason given in most cases being their excessive thinness. Two of these subjects had frank scurvy and eight had angular stomatitis. Twelve had major medical disorders which may have contributed to the malnutrition and for seven there were socio-economic causes. For the remaining eight there was no clear reason for the condition. The prevalence of osteomalacia could only be assessed indirectly (see paragraph 9.5.2).

9.4 Socio-economic Findings

9.4.1. Those subjects who spent less on food ate a poorer diet and had lower intakes of energy, protein and most other nutrients. But we could find no evidence that the abnormal values in the various biochemical and other tests were more prevalent in those who spent less than in those who spent more on food. A comparison between those who were receiving Supplementary Benefit and those who had other sources of income did not reveal evidence of inadequacy arising for economic reasons.

9.5 Laboratory Investigations

9.5.1. The most clear-cut finding was that the incidence of anaemia was 7·3% with little difference between men and women. Most haematological measurements, and in particular serum folate, showed means lower than those which occur in younger populations. Thirteen per cent of all subjects had serum albumin concentrations of less than 3·5 g/100 ml, and 8% had serum pseudocholinesterase activities of less than 150 units. There were some correlations between these variables and the clinician's assessment of the state of health, and low activity of serum pseudocholinesterase was also correlated with skinfold thickness.

9.5.2. Particular attention was directed towards osteomalacia since this is a condition likely to affect older women and especially those who are housebound. For women over 75 a statistical relationship was found between raised serum alkaline phosphatase values and low bone mass as calculated from the radiographs of the hand. This association requires further investigation, but it suggests that osteomalacia may be contributing to skeletal rarefaction in women in the higher age groups. Apart from this there was no evidence to show that the thinning of bone, which occurs in most elderly people of both sexes and which leads to osteoporosis, is related to calcium or protein intakes.

9.6 Comment

9.6.1. Results of the survey confirmed that some overt malnutrition exists among the elderly, but not much. Early detection of incipient malnutrition by regular visits to all elderly people from a doctor, or member of the community nursing services, would seem to be the key to the problem.

9.6.2. Recommendations put forward by the Panel are listed in the following chapter.

CHAPTER 10

Recommendations by the Panel

1. We recommend that the survey be repeated after an appropriate interval to provide fresh knowledge on the prognostic significance of some of the signs which we have observed and to extend our knowledge of what happens to old people as they grow older. (8.1.2)

2. We recommend that the data be re-examined, either as they now are or in conjunction with material from the next survey, with a view to establishing biochemical and anthropometric standards of normality for the elderly. (8.1.3)

3. We recommend that registers of all elderly patients be maintained by general practitioners. Every elderly patient on every doctor's list ideally should be seen not less than once a year by the doctor, or a member of the community nursing services, to facilitate the early detection of those with some condition which renders them at risk of malnutrition. (8.3.1)

4. We recommend that possible uses of a milk fortified with several nutrients be studied, for example in the preparation of meals in club or day centres or in the meals-on-wheels service. (8.3.6)

5. We recommend that for the prevention of osteomalacia a trial should be made in which prophylactic vitamin D is given to all persons at risk. Should this fail, the fortification of liquid milk with vitamin D would need to be considered. (8.3.7)

6. We recommend that any change to metric measures for the retailing of milk should be made the occasion for the introduction of containers capable of preserving milk against the effects of sunlight. (8.3.9)

7. We recommend that industry be made aware of the potential market and beneficial function of cheap, convenience foods of known nutritional content for old people and that these should be put on sale in suitably small quantities. (8.3.4)

8. We recommend that health education for and about the elderly be extended as an important preventive measure. The number of "Preparation for Retirement" courses should be increased and more extensive use be made of the skills of dietitians, health visitors and social workers. (8.3.10)

IV SPECIAL STUDIES

1. Haematological Investigation of the Elderly

By Barbara B. Anderson, B. Brozovic, D. L. Mollin, Alison M. Unwin and A. H. Waters, Department of Haematology, St. Bartholomew's Hospital and Medical College, London.

1 Introduction

1.1. Samples of blood taken from the elderly subjects in the survey (paragraph 2.3.1, p. 5) were submitted to the Department of Haematology, St. Bartholomew's Hospital, London, where the concentrations of serum and red cell folates, serum vitamins B_{12} and B_6, serum iron and total iron-binding capacity were determined. Methods are given in Table H1. (See also Appendix B

Table H1

Methods used for haematological measurements

Measurement	*Reference*
Serum folate	Waters and Mollin (1961)
Red cell folate	Hoffbrand, Newcombe and Mollin (1966)
Serum vitamin B_{12}	Anderson (1964)
Serum vitamin B_6	Anderson, Peart and Fulford-Jones (1970)
Serum iron	Garry and Owen (1967)
Total iron-binding capacity	Brozovic and Copestake (1969)

(p. 145) for details of collection of blood samples.) Haemoglobin concentrations were measured in the individual areas, but for the sake of completeness the results are considered here in relation to the other haematological results. With the exception of haemoglobin concentration to which the WHO (1968) criteria were applied, the ranges taken as normal were those determined and currently used at St. Bartholomew's Hospital, London, for a healthy adult population of less than 65 years of age (Table H3). These criteria are essentially the same as those used at present by the WHO. No attempt to introduce ranges for "normality" for the elderly was made at this stage of the investigation. The results have been analysed primarily with the aim of investigating factors which may lead to or have already caused anaemia due to nutritional deficiency. In the analysis, first, the distribution and incidence of "abnormal" values for each measurement were studied, and secondly, relationships between each measurement and a number of other factors were investigated and submitted to the chi-squared test as described in paragraph 2.5.2 (p. 6).

1.2. In the ensuing paragraphs the use of inverted commas in relation to the words normal and abnormal, and indeed to almost all the value judgements made, have been omitted but ought to be taken as read.

2 Results and Discussion

2.1. Mean values for the measurements on the four different age/sex groups are shown in Table H2; the numbers of subjects with normal and abnormal values are given in the Appendix (Table C1, p. 149). The factors examined for a statistically significant relationship are listed in Table C2 (p. 150).

Table H2

Mean values for haematological measurements in the different age and sex groups

Measurement	Units	All persons	Men 65–74	Men 75 and over	All men	Women 65–74	Women 75 and over	All women
Haemoglobin	g/100 ml	—[1]	15·1	14·6	14·9	13·9	13·9	13·9
Serum iron	μg/100 ml	—[1]	91	88	90	82	79	81
Total iron-binding capacity	μg/100 ml	—[1]	360	339	350	383	383	383
Serum folate	ng/ml	6·1	5·8	5·8	5·8	6·6	6·2	6·4
Red cell folate	ng/ml	252	258	242	250	260	245	253
Serum vitamin B_{12}	pg/ml	420	414	375	396	394	508	446
Serum vitamin B_6	ng/ml	3·9	4·1	3·8	3·9	3·7	3·9	3·9

NOTE: [1] Not presented because of known difference between the sexes.

2.2 Haemoglobin Concentration

2.2.1. The distribution, mean value and percentage of subnormal values for haemoglobin concentration (Hb) obtained in the survey are presented in Figure C1 (p. 152). The mean haemoglobin values for men and women were 14·9 and 13·9 g/100 ml respectively. The range, the mean and the difference between the mean haemoglobin concentration for men and women were essentially the same as in a population younger than 65 years (Waters, 1971). The overall frequency of anaemia, i.e. Hb less than 13 g/100 ml for men and 12 g/100 ml for women (WHO, 1968), was 7·3% and was about the same for men and women.

2.2.2. The only factors for which a significant relationship with Hb concentration were found were mode of living and serum iron concentration (Table C2, p. 150).

2.2.3. When all persons were grouped together, those living alone or boarding had a higher incidence of anaemia (significant at 1% level). Of the 165 subjects living alone, 15 (9%) were anaemic, compared with 31 (6%) of the 492 who lived with their spouses or other relatives. No significant relationship between

Hb concentration and social class was found in the sample, but this may have been because the numbers were not large enough.

2.2.4. The relationship between normal and subnormal Hb concentrations and other haematological measurements is shown in Table H3.

Table H3

Relationship between haemoglobin concentration and some other haematological measurements

Measurement	Range	Number of subjects		
		Total	With normal haemoglobin	With subnormal haemoglobin
Serum iron	Normal	525	511	14
	Subnormal	127	95	32
	Total	652	606	46
Serum folate	Normal	247	232	15
	Borderline	312	291	21
	Subnormal	94	83	11
	Total	653	606	47
Red cell folate	Normal	504	468	36
	Borderline	103	94	9
	Subnormal	22	20	2
	Total	629	582	47
Serum vitamin B_{12}	Normal	584	549	35
	Borderline	65	54	11
	Subnormal	7	6	1
	Total	656	609	47

2.2.5. The relationship between the Hb concentration and serum iron concentration was significant (at the 1% level) when all persons were grouped together. This was probably due to the overweighting by those anaemic subjects who had subnormal serum iron concentration.

2.2.6. Of the subjects with subnormal serum iron concentration only a fifth were anaemic. This is similar to findings in younger populations (Fairbanks, Fahey and Beutler, 1971).

2.2.7. The analysis of all the haematological data for each anaemic subject revealed that iron deficiency was the sole cause of anaemia in only 12·9%. Iron deficiency associated with subnormal serum folate and vitamin B_6 was found in 22·6% and 8·1% of anaemic subjects respectively, and in a further 19·3% of anaemic subjects the serum iron, serum folate and vitamin B_6 were all subnormal. A high proportion (35·5%) of persons with anaemia had a normal serum iron concentration and in nearly a half of those (14·6%) serum iron, serum folate, serum vitamin B_6 and B_{12} levels were normal.

2.3 Serum Iron Concentration and Total Iron-binding Capacity

2.3.1. In an assessment of the body iron status both the serum iron concentration (SI) and total iron-binding capacity (TIBC) were estimated.

2.3.2. The distribution of SI in the elderly is illustrated in Fig. C2 (p. 152). The mean values of SI for men and women were 90 and 81 μg/100 ml respectively. Subnormal values were found in 17·1% of men and 22·9% of women. Similar figures were reported for the elderly in a random sample from Wales (Jacobs, Waters, Campbell and Barrow, 1969).

2.3.3. The mean TIBC values for men and women were 350 and 383 μg/100 ml, respectively. These values are essentially the same as in the population below 65 years of age. However, the distribution of TIBC values (Fig. C3, p. 153) was much wider than normal and only 61·5% of men and 53·5% of women fell within this range. There was a considerable difference in the proportion of abnormal values for men and women: twice as many men as women had a TIBC below the normal range, but twice as many women as men had a TIBC above the normal range.

2.3.4. From the correlation between the SI and TIBC (Figs. C4, C5, pp. 154–5) it can be seen that only a small proportion of men appear to have iron deficiency as compared with women. Overt iron deficiency, as measured by SI less than 60 μg/100 ml and TIBC higher than 400 μg/100 ml (Bainton and Finch, 1964), was found in 4·7% of the male and 13·2% of the female population. The cause of this is not clear but the lower iron intakes of most groups of women compared with those of the men (paragraph 4.5.5) may have some bearing on it. It is not possible to say to what extent, if any, chronic diseases were capable of reducing TIBC and thus masking iron deficiency in men.

2.3.5. When women of both age groups and all persons were grouped together those who were very alert for their age had a lower incidence of low SI than the others. There is no obvious explanation for this statistically significant correlation. However, it is reasonable to assume that those persons who were classified by the clinician as mentally very alert for their age were also capable of taking better care of themselves than those who were abnormal. The relationship between the Hb concentration and SI has been already discussed (2·25, p. 58).

2.4 Serum and Red Cell Folate Concentrations

2.4.1. The distribution of serum folate concentrations (SF) is shown in Figure C6 (p. 156); the majority of values lie in the borderline range between 3 and 6 ng/ml. About 60% of all the subjects investigated had a SF concentration of less than 6 ng/ml, and as many as 14·6% had concentrations of less than 3 ng/ml which would usually be taken as indicating the presence of folate deficiency. The distribution of red cell folate concentrations (RCF) is shown in Figure C7 (p. 156). Most of the subjects had RCF values within the normal range and only 16·1% had evidence of chronic folate deficiency as measured by RCF of less than 150 ng/ml. RCF values of less than 100 ng/ml were found in 3·7% of subjects studied.

2.4.2. There was a significant relationship between SF and RCF at the 1% level for men and women of the older age groups and for all persons taken together. There was no significant difference between the SF and RCF levels for men and women.

2.4.3. There was no apparent relationship between the Hb concentration and the SF and RCF. This was probably due to the low incidence of anaemia among subjects with chronic folate deficiency. Of 629 subjects in whom both Hb and RCF were measured 22 had RCF levels below 100 ng/ml and of these only 2 women were mildly anaemic (Hb between 11 and 12 g/100 ml) (Table H3).

2.4.4. The taking of tranquillisers and barbiturates was significantly related to the reduced SF concentration (Table C2, p. 150) but this does not necessarily indicate a causal relationship. There was no significant relationship between SF and RCF and the clinician's assessment of mental state.

2.5 Serum Vitamin B_{12} Concentration

2.5.1. The distribution of serum vitamin B_{12} concentrations is shown in Figure C8 (p. 157). The incidence of serum B_{12} concentrations in the range found in overt pernicious anaemia (<100 pg/ml) was 1%, which is ten times the incidence of "clinical" pernicious anaemia reported in Britain by Scott (1960). The survey also revealed a 10% incidence of serum B_{12} concentrations in the borderline range (100–200 pg/ml). While such levels must occur at some stage in pernicious anaemia, they are also found in atrophic gastritis, following partial gastrectomy and in the malabsorption syndrome. Their significance as an index of B_{12} deficiency remains uncertain.

2.5.2. The numbers of persons with subnormal Hb concentrations in these ranges of B_{12} concentrations are given in Table H3.

2.5.3. The highest incidence of subnormal serum B_{12} concentrations (at the 10% level of significance) was found in women over 75 living alone. There was no significant relationship between serum B_{12} concentration and mental state.

2.6 Serum Vitamin B_6 Concentration

2.6.1. Serum vitamin B_6 normally decreases with age and in subjects under 40 years the levels are higher in men than in women (Anderson, Peart and Fulford-Jones, 1970). In this study of elderly people, where ages varied from 65 to 90 years, no significant decrease could be detected with increasing age and there was no difference between the sexes. There appeared, however, to be some relationship between the serum B_6 concentrations and dietary intakes, though this may be a chance result because the content of this vitamin in food is not known with certainty.

2.6.2. In younger subjects, levels of serum B_6 less than 3 ng/ml are considered subnormal. In this survey, 35% of subjects had levels less than 3 ng/ml and 10·4% less than 2 ng/ml (Figure C9, p. 157). However, because the serum B_6 concentration decreases with age in people under 65 years the significance of these levels is uncertain in elderly people.

3 Conclusions

3.1.1. The incidence of anaemia was only 7·3% and was similar for men and women.

3.1.2. The mean values for serum iron, folate, vitamin B_{12}, and vitamin B_6 concentrations were lower than in the population below 65 years of age. There was a higher proportion of subnormal values than in the younger population.

3.1.3. Very few of the patients with subnormal blood levels of iron, vitamin B_{12}, folate and vitamin B_6 were anaemic, but on the other hand 14·6% of the anaemic subjects had normal values for these nutrients. This raises the possibility that other factors peculiar to this age group may be important in suppressing haemopoiesis.

2. Biochemistry of the Elderly

1 Methods

1.1. The biochemical measurements which were made on the elderly subjects are listed in Table C3 (p. 000), together with the methods used by the different area laboratories. Apart from the haematological measurements, the tests used in the survey fall into three groups: those which might identify protein or calorie deficiency of even mild degree, e.g. serum albumin concentration, pseudocholinesterase activity; those which might reveal some functional disturbance, e.g. alkaline phosphatase; and those which measure vitamin status.

2 Results

2.1. The mean values for all the results on the standard age and sex groups are given in Table B1 (p. 65). The results on the standard bloods distributed to the areas (para. 2.3.2, p. 5) are shown in Tables C4, C5, C6 (pp. 160–162). The variability which they show has already been commented on (paragraph 2.3.2).

3 Interpretation of Results

3.1. The results for serum albumin were of some slight value in indicating possible undernutrition. For example, when results for all subjects were grouped together higher albumin levels were related at the 10% level of significance with the clinician's assessment as better than average. There was also a statistical relationship between albumin levels and the presence of oedema ($P = 0{\cdot}05$). There was a higher incidence of lower levels of serum albumin amongst women aged 65–74 who were living alone ($P = 0{\cdot}05$) suggesting that this mode of living might be a predisposing factor to marginal malnutrition.

3.2. On the other hand low values of pseudocholinesterase were correlated with factors such as skinfold thickness ($P = 0{\cdot}01$ for all men and all persons), clinician's assessment ($P = 0{\cdot}05$ for men aged 65–74 and $P = 0{\cdot}10$ for all men) and radius of the lean arm ($P = 0{\cdot}05$ for women aged 65–74). Only when men of both age-groups were grouped together could any correlation be found between pseudocholinesterase activity and serum albumin concentration. Then it appeared that low albumin levels were related to pseudocholinesterase values of less than 200 at the 5% level of significance. Table C7 (p. 163) shows results for twelve patients who were considered to be malnourished with possible protein-calorie malnutrition; low albumin and low cholinesterase values did not go together in the individual patients. This lack of relationship was also found by Hutchinson, McCance and Widdowson (1951) in their studies in Wuppertal.

3.3. It appeared that neither pseudocholinesterase nor clinician's assessment were significantly correlated with energy from protein (paragraph 5.3.2, p. 29), although pseudocholinesterase did show a relationship with clinician's assessment. This suggests that serum pseudocholinesterase activity depends on factors other than intake of protein.

3.4. As an indicator of general state of health, therefore, the measurement of pseudocholinesterase activity seems in this survey to have been slightly more valuable than that of serum albumin. The relationship between the clinicians' assessment of general condition and serum pseudocholinesterase level is of interest as indicating that degrees of well-being involve biochemical change, but what that change may be is not clear. At present a wide range of conditions contribute to the categorisation of "general condition" and no doubt individual clinicians also differ widely.

3.5. The relationship between serum albumin level and oedema is of interest as illustrating how non-nutritional stress of a sort that can by itself cause oedema, particularly cardiac failure, can do so with greater frequency where serum albumin levels are somewhat, but not very, low. Although a fall in serum albumin concentration is a recognised index of protein depletion, it may not be so effective in the more borderline cases since mechanisms come into play which keep the circulating albumin mass constant as long as possible (Waterlow, 1968).

3.6. In the first analysis serum alkaline phosphatase showed no significant correlation with factors such as mobility or bowing index. However, some indication of its bearing on osteomalacia is given by the numbers of those who were housefast and the mean values of their alkaline phosphatase measurements (paragraph 5.11.6, p. 34). In the second analysis 11% of all men had values for alkaline phosphatase higher than 12 K.A. units, and 30% of all women had values higher than 10 K.A. units. The product of the serum calcium and serum phosphorus values was said by Exton-Smith, Hodkinson and Stanton (1966) to be a more sensitive indicator of vitamin D deficiency than a high alkaline phosphatase value. In the analysis of our results, however, no correlation of this product with mobility or bowing index was found. With regard to osteomalacia, therefore, it would seem that the statement by Anderson, Campbell, Dunn Runciman (1966) that "biochemical findings . . . are often equivocal. Of the 3 blood chemical determinations, serum calcium, phosphate and alkaline phosphatase, one or even 2 may be normal," is relevant. The measurement of serum alkaline phosphatase is not by itself an adequate tool for studying the epidemiology of osteomalacia although it is for the moment the only one we have. The relationship of some biochemical findings with bone density as measured by the metacarpal index are considered by Exton-Smith (pp. 66–68).

3.7. The distribution of results for the leucocyte ascorbic acid and red cell transketolase measurements are shown in Figures C10 and C11 (pp. 164, 165). The spread for leucocyte ascorbic acid levels is wide and the difference between men and women is clearly seen. While 26% of men had values of less than

10 $\mu g/10^8$ cells only 12% of women had values as low as this, and while 21% of men had values above 19 $\mu g/10^8$ cells, the corresponding figure for women was 38%. For the red cell transketolase or thiamine pyrophosphate test, the reverse was true, because there were more women than men with a TPP effect above 25%. However, this test was done on only a comparatively small number of subjects (114) and in only one area.

3.8. A correlation was found between vitamin C intakes and white cell levels of ascorbic acid (paragraph 5.10.2), but in the other tests for vitamin status, red cell transketolase and riboflavine excretion, no link was found either with the clinicians' diagnoses or with dietary intakes of thiamine or riboflavine.

4 Conclusion

4.1. In general, the biochemical investigation was disappointing in the support which it gave to the clinicians or the dietitians in their findings. This is partly because the proportion of individuals in the survey who were even moderately malnourished was small. It is to be hoped that, if further biochemical tests are done on the same subjects when the survey is repeated, a comparison of the two sets of results will prove more illuminating in relation to the clinical progress of the subjects. It will be of particular interest to study the subsequent progress of those whose level of vitamin C, folates, and B_{12} was judged to be marginal.

Table B1

Mean values for biochemical measurements in the age and sex groups

Biochemical measurement	Units	All persons	Men		All men	Women		All women
			65–74	75 and over		65–74	75 and over	
Haemoglobin	g/100 ml	14·4	15·1	14·6	14·9	13·9	13·9	13·9
Serum alkaline phosphatase	KA units	8·8	8·1	9·6	8·8	8·4	9·2	8·8
Serum calcium	mg/100 ml	9·5	9·5	9·4	9·4	9·5	9·5	9·5
Serum phosphorus	mg/100 ml	3·02	2·84	2·91	2·87	3·19	3·16	3·17
Serum albumin	g/100 ml	4·03	4·10	3·97	4·04	4·03	4·03	4·03
Serum pseudocholinesterase	units	219	215	211	213	229	218	224
Leucocyte ascorbic acid	μg/10^8 cells	16·4	15·4	13·0	14·4	19·6	18·1	18·9

3. Skeletal Status and Nutrient Intakes

1 Introduction

1.1. It has been shown (Exton-Smith, Millard, Payne and Wheeler, 1969a) that the transverse cortical area ($D^2–d^2$) measured at the mid-point of the length of the metacarpal correlates well with the ash content of the bone (where D is the outside diameter, d the inside diameter and L the length of the bone). The skeletal status can be assessed by using the ratio of cortical area to surface area, namely, $\frac{D^2–d^2}{DL}$, which corrects for differing size of metacarpals. Thus the amount of bone in the individual can be compared with others of the same age and sex using the percentile ranking curves which have been established by measurements made on males and females in the age range of 2–85 years (Exton-Smith, Millard, Payne and Wheeler, 1969b; Gryfe, Exton-Smith, Payne and Wheeler, 1971).

2 Results

2.1. Measurements were made by one observer on the second metacarpal from the radiographs of the hand of 708 subjects who participated in the survey. The values of the ratio cortical area/surface area are shown in Table S1; the ratios

Table S1

Numbers of persons in each percentile group for the ratio cortical area/surface area and the mean values of the ratio for each group

No. of subjects		Percentile group											
		0–10		10–25		25–50		50–75		75–90		90–100	
		No.	Mean value	No.	Mean value	No.	Mean value	No.	Mean value	No.	Mean value	No.	Mean value
Men	65–74	21	0·078	31	0·088	54	0·097	43	0·104	30	0·110	20	0·124
	75 & over	16	0·077	26	0·086	44	0·094	40	0·101	19	0·107	16	0·116
Women	65–74	27	0·072	29	0·080	49	0·085	54	0·093	26	0·099	18	0·107
	75 & over	16	0·060	27	0·073	32	0·081	37	0·087	24	0·095	13	0·109

have been placed in six groups according to the position on the percentile ranking curves. It will be seen that the ratio is higher in males than in females and higher in the younger age group than in the older.

2.2. The ratio was examined in relation to various factors: high serum alkaline phosphatase levels (above 10 K.A. units for women and above 12 K.A. units for men), low serum calcium (less than 8·9 mg/100 ml), low vitamin D intakes (less than 40 i.u. (1 μg cholecalciferol) daily), impaired mobility leading to a housebound condition, and a low bowing index (total height/trochanteric height ratio of less than 1·69). Men of both age groups and women aged 65–74 with abnormal values of these biochemical indices and impaired mobility were found within all the percentile groups of bone mass, and no significant association could be found between the amount of bone and these various factors for men, or the younger group of women.

2.3. The group of women aged 75 and over was considered separately (Table S2)· Abnormal values and the housebound state were more often found in those with high bone mass (above 90th percentile). These differences were not statistically significant except for serum alkaline phosphatase where those subjects with low

Table S2

Number of women aged 75 and over in the different percentile groups who had abnormal values or who were housebound

	Number in percentile group:					
	0–10	10–25	25–50	50–75	75–90	90–100
All women 75 and over	16	27	32	37	24	13
Subjects with:						
alkaline phosphatase >10	10	12	6	6	7	1
serum calcium <8·9	3	6	5	2	3	0
vitamin D intake <40 i.u.	4	4	10	8	6	0
bowing index <1·70	5	5	4	4	2	0
Subjects who were:						
housebound	5	2	2	3	3	1

bone mass tended to have high alkaline phosphatase levels ($P<0{\cdot}01$). This association requires further investigation but it suggests that osteomalacia may be contributing to skeletal rarefaction in women in the higher age groups. This finding is consistent with other published data (Anderson, Campbell, Dunn and Runciman, 1966; Chalmers, Conacher, Gardner and Scott, 1967: Exton-Smith, Hodkinson and Stanton, 1966).

2.4. It will be seen from Table S3 that low energy intakes (less than 90 kcal/kg$^{0\cdot73}$ were found just as often in those of good skeletal status (ratio within the 90–100th percentile range) as in those of poor skeletal status (ratio within the 0–10th percentile range). Similarly, calcium intakes at this age were unrelated to skeletal status; individuals with calcium intakes of less than 500 mg per day were found just as often above the 90th percentile as below the 10th percentile for bone mass. Conversely, those subjects having a high calcium intake (over 1,000 mg per day) just as often had a low bone mass as a high one.

Table S3

Percentage of subjects in each percentile group who had low energy intakes and low or high calcium intakes

(See Table S1 for actual numbers in percentile groups)

Intake	Subjects		Percentile group					
			0–10	10–25	25–50	50–75	75–90	90–100
Energy:								
<90 kcal/kg$^{0 \cdot 73}$	Men:	65–74	14	29	20	23	20	40
		75 & over	50	35	30	15	26	44
	Women:	65–74	41	28	41	56	50	78
		75 & over	50	56	53	54	75	69
Calcium:								
<500 mg	Men:	65–74	0	10	6	12	3	0
		75 & over	19	23	7	3	5	13
	Women:	65–74	4	7	12	7	8	22
		75 & over	13	26	25	8	29	8
1,000 mg and over	Men:	65–74	33	38	35	21	33	10
		75 & over	13	19	34	43	16	19
	Women:	65–74	30	17	20	17	15	11
		75 & over	38	11	3	11	4	8

3 Conclusion

3.1. It is, therefore, concluded that bone mass in old people is unrelated to calcium intake at this age, and osteoporosis is found no more frequently in those whose intake is low. In women aged 75 and over, there is some evidence that osteomalacia may contribute to skeletal rarefaction but confirmation would depend on further investigation of suspect cases of osteomalacia by such means as bone biopsy, radiographic examination and response to vitamin D—procedures which were beyond the scope of this survey.

4. Masticatory Studies

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1 Introduction

1.1. A previous investigation (Neill and Phillips, 1970) on 53 elderly male subjects living in an institution (Chelsea Pensioners) had shown that the quality of their dentures had a direct bearing on their masticatory performance. Despite their relatively poor ability to chew, most subjects consumed an adequate diet. Although there appeared to be a trend suggesting that those subjects with the most efficient dentition consumed a larger amount of each of the principal nutrients this did not reach the level of statistical significance. There was no obvious correlation between dietary intake and the patient's physical health.

1.2. The survey of the elderly undertaken by the Department of Health and Social Security offered the opportunity of carrying out dental examinations and masticatory performance tests on a further group of subjects. Due to the widely scattered centres and the advanced state of the investigation it was only possible to study 50 of the subjects living in the Cambridge area.

2 Results

2.1. Forty subjects were edentulous and were wearing dentures. These were scored and classified as good, fair or poor. In order to assess masticatory performance each subject chewed a standard sample of cooked ham twenty times and emptied the mouth contents into a receiver. The degree of comminution achieved was measured as the percentage volume of the original mass which would pass through a twenty mesh USS sieve. We also determined the number of chews each subject would use before swallowing the test food.

Table M1
Scores for masticatory performance of two groups of elderly subjects

Condition of dentures	Cambridge		Chelsea	
	Score	No. of subjects	Score	No. of subjects
None	4·5	2	7·5	7
Poor	9·6	17	12·7	19
Fair	13·5	15	20·0	17
Good	21·5	8	—	—
Some natural teeth	11·0	8	11·6	10
Average age of subjects (years)	74 ± 5		78	
Average age of dentures (years)	16 ± 11		13	

2.2. Table M1 shows the mean masticatory performance achieved by each class of subjects in both the present study and the Chelsea group. The relationship between the quality of the subjects' dentures and their masticatory performance has thus been demonstrated a second time. Those subjects who had a few teeth remaining but no dentures performed about as well as those wearing dentures of indifferent quality.

2.3. Table M2 shows the mean value of the daily intake of main nutrients for subjects with good (greater than 20), fair (10 to 20), and poor (less than 10) masticatory performances. These results show that there are no trends relating

Table M2

Mean daily intake of nutrients by subjects with different masticatory scores

Score	CHO (g)	Animal protein (g)	Total protein (g)	Fat (g)	Energy (kcal)	(MJ)
Men						
Over 20	315	51·8	75·1	128	2684	11·2
10–20	199	45·7	64·4	122	2225[1]	9·3
Under 10	296	44·2	69·2	114	2483	10·4
Women						
Over 20	189	36·1	51·7	106	1880	7·9
10–20	207	41·9	55·4	88	1801	7·5
Under 10	209	40·9	57·9	89	1833	7·7

NOTE: [1] One subject whose caloric intake was only 876 kcal (3·7 MJ) has been excluded from this mean.

dietary intake with masticatory performance. It should be pointed out, however, that the number of subjects in each group was small and the possibility of continuing this study to increase the size of the sample should be considered. In the present group of subjects 7 out of 8 of those classified as obese had a masticatory performance below 10. The possibility exists therefore that in some subjects impaired masticatory ability may have caused them to select food which was more readily assimilable having a high caloric value, i.e. carbohydrates and fats. However, the examination of the data does not reveal evidence that at the time of this study the subjects were consuming diets high in carbohydrate and low in animal protein. It is, of course, possible that subjects who knew themselves to be overweight may have been voluntarily taking steps to restrict their diet.

2.4. There was little evidence that impairment of masticatory performance adversely affected the subjects' health. One man with adequate dentures and satisfactory masticatory performance had a diet the caloric intake of which amounted to only 876 kcal; it was subsequently found that he was suffering from carcinoma of the stomach. There was one subject with a gastric ulcer whose masticatory efficiency was very high and one subject who was suspected of having a duodenal ulcer whose performance was poor. Subjects with impaired masticatory performance did not attempt to compensate for their deficiencies by chewing their food longer.

3 Conclusions

3.1. Although inefficient dentures seemingly do not result in any obvious evidence of disability it is notable that many patients who experienced difficulty in chewing with their dentures had to avoid certain types of food. There are obviously diets entirely adequate in all nutrients requiring the minimum of mastication, but usually these are unappetising and since elderly subjects frequently have few pleasures left in life their ability to enjoy to the full a wide variety of foodstuffs is important to them.

We are grateful to Dr. Hyams for allowing us access to this material and to the dietitians for particulars of the individual food intakes.

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VI APPENDICES

Appendix A

Detailed Tables A 1—A 29
and Figures A 1—A 19

(For index to Appendices, see pp. vi, vii, viii and ix)

Table A1

The distribution of participants in the survey by sex and 5-year age bands

	All areas		Portsmouth		Cambridge-shire		Sunderland		Rutherglen		Angus		Camden	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Men:														
under 70	104	24	25	33	19	20	29	29	15	30	16	31	—	—
70–74	127	30	16	22	33	34	31	30	9	18	9	18	29	56
75–79	117	28	19	25	27	28	26	26	13	26	16	31	16	31
80–84	54	13	13	17	9	10	9	9	10	20	7	14	6	11
85 and over	23	5	2	3	8	8	6	6	3	6	3	6	1	2
All men:	425	100	75	100	96	100	101	100	50	100	51	100	52	100
Women:														
under 70	110	24	16	24	26	25	38	39	15	30	14	28	1	1
70–74	126	28	19	29	30	29	19	19	10	20	11	22	37	44
75–79	125	28	18	27	30	29	24	25	15	30	10	20	28	33
80–84	59	13	7	10	10	10	12	12	8	16	9	18	13	15
85 and over	34	7	7	10	8	7	5	5	2	4	6	12	6	7
All women:	454	100	67	100	104	100	98	100	50	100	50	100	85	100

Table A2

The distribution in the areas (excluding Camden) by sex and age groups of participants in the survey and non-participants

		Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus
All participants		142	200	199	100	101
Men:	65–74	41	52	60	24	25
	75 and over	34	44	41	26	26
	All men	75	96	101	50	51
Women:	65–74	35	56	57	25	25
	75 and over	32	48	41	25	25
	All women	67	104	98	50	50
All non-participants		134	52	91	9	37
Men:	65–74	35	7	14	1	6
	75 and over	25	9	21	2	6
	Not known	1	10	—	—	—
	All men	61	26	35	3	12
Women:	65–74	38	6	27	3	11
	75 and over	33	11	29	3	14
	Not known	2	9	—	—	—
	All women	73	26	56	6	25

Table A3

The distribution in the areas (excluding Camden) by mode of living, competence and dependency of participants in the survey and non-participants

	Portsmouth		Cambridgeshire		Sunderland		Rutherglen		Angus	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
All participants	75	67	96	104	101	98	50	50	51	50
All non-participants	61	73	26	26	35	56	3	6	12	25
Mode of living:										
Participants										
Living alone[1]	8	21	10	35	12	40	9	19	9	22
Living with spouse	59	23	71	50	67	32	35	12	33	11
Living with relatives other than spouse	7	15	15	17	22	24	6	19	9	15
Others	1	8	—	2	—	2	—	—	—	2
Not known	—	—	—	—	—	—	—	—	—	—
Non-participants										
Living alone[1]	6	16	—	4	10	28	—	3	2	6
Living with spouse	28	14	14	10	21	15	1	—	8	6
Living with relatives other than spouse	8	15	2	4	4	12	2	3	—	5
Others	—	2	2	—	—	1	—	—	—	1
Not known	19	26	8	8	—	—	—	—	2	7
Mental competence:										
Participants										
Fully alert	58	49	83	90	56	48	44	44	49	46
Adequate	16	15	10	9	42	44	5	5	1	3
Confused	1	3	3	5	3	6	1	1	1	1
Not known	—	—	—	—	—	—	—	—	—	—
Non-participants										
Fully alert	30	35	14	14	29	44	1	4	9	18
Adequate	8	10	—	4	6	10	1	2	1	1
Confused	1	2	1	1	—	1	1	—	—	—
Not known	22	26	11	7	—	1	—	—	2	6

Table A3 (continued)

	Portsmouth		Cambridgeshire		Sunderland		Rutherglen		Angus	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
All participants	75	67	96	104	101	98	50	50	51	50
All non-participants	61	73	26	26	35	56	3	6	12	25
Physical competence:										
Participants										
Fully mobile and competent	54	50	76	75	76	70	39	34	45	44
Limited	20	16	19	27	23	26	10	16	6	6
Helpless	1	1	1	2	2	2	1	—	—	—
Not known	—	—	—	—	—	—	—	—	—	—
Non-participants										
Fully mobile and competent	25	29	13	14	29	45	2	4	9	16
Limited	14	14	3	5	5	11	1	2	1	3
Helpless	1	1	—	—	—	—	—	—	—	—
Not known	21	29	10	7	1	—	—	—	2	6
Overall dependency:										
Participants										
Independent	56	49	71	76	77	72	42	41	47	43
Partially dependent on others	14	15	11	17	20	21	8	8	3	7
Wholly dependent on others	5	3	14	11	4	5	—	1	1	—
Not known	—	—	—	—	—	—	—	—	—	—
Non-participants										
Independent	24	32	11	14	30	47	2	4	9	15
Partially dependent on others	11	10	3	2	3	8	1	2	1	3
Wholly dependent on others	4	2	1	2	1	1	—	—	—	—
Not known	22	29	11	8	1	—	—	—	2	7

[1] Includes those boarding with people other than relatives.

Table A4

Numbers of persons for whom records were obtained

	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Dietary records All persons	827	142	197	198	99	95	96
Men: 65–74	217	41	51	60	24	22	19
75 & over	179	34	43	40	25	23	14
Women: 65–74	226	35	55	57	25	25	29
75 & over	205	32	48	41	25	25	34
Medical records All persons	841	131	175	197	100	101	137
Men: 65–74	223	40	45	60	24	25	29
75 & over	191	34	41	41	26	26	23
Women: 65–74	226	30	52	56	25	25	38
75 & over	201	27	37	40	25	25	47
Biochemical records All persons	815	115	166	197	100	101	136
Men: 65–74	219	37	44	60	24	25	29
75 & over	188	31	41	41	26	26	23
Women: 65–74	218	26	48	56	25	25	38
75 & over	190	21	33	40	25	25	46

Table A5

The distribution by social class of persons whose diets were recorded

Social class	All areas	Portsmouth	Cambridge-shire	Sunderland	Rutherglen	Angus	Camden
All persons	827	142 (100%)	197 (100%)	198 (100%)	99 (100%)	95 (100%)	96 (100%)
Men							
I and II	57	9	21	7	3	10	7
III Non-manual	38	7	3	12	9	3	4
III Manual	147	32	19	49	23	14	10
IV and V	139	16	50	31	14	17	11
Others	15	11	1	1	—	1	1
Women							
I and II	78	7	23	12	5	17	14
III Non-manual	41	5	7	5	12	4	8
III Manual	144	18	28	39	22	18	19
IV and V	141	25	42	39	11	7	17
Others	27	12	3	3	—	4	5
Men and women							
I and II	135	16 (11)	44 (22)	19 (10)	8 (8)	27 (29)	21 (22)
III Non-manual	79	12 (9)	10 (5)	17 (9)	21 (21)	7 (7)	12 (13)
III Manual	291	50 (35)	47 (24)	88 (44)	45 (46)	32 (34)	29 (30)
IV and V	280	41 (29)	92 (47)	70 (35)	25 (25)	24 (25)	28 (29)
Others	42	23 (16)	4 (2)	4 (2)	—	5 (5)	6 (6)

Table A6

The distribution by social class of persons aged 65 and over in the survey (omitting those not classified) compared with persons of the same age group in the total population

Social class	Census 1966	Survey 1968
	(%)	(%) (No. of persons in brackets)
I	3	17 (135)
II	18	
III Non-manual	40	10 (79)
III Manual		37 (291)
IV	26	36 (280)
V	13	

Table A7

The distribution by marital status of persons whose diets were recorded

Marital status	All areas		Portsmouth	Cambridgeshire	Sunderland	Rutherglen	Angus	Camden
	No.	%	No.	No.	No.	No.	No.	No.
All persons	805[1]	—	142	197	195	99	95	77
Men								
All men	390	100	75	94	98	49	45	29
Single	20	5	4	5	4	—	6	1
Married	281	72	59	70	66	35	29	22
Widowed or divorced								
less than 1 year	6	2	—	2	3	—	—	1
1 year or more	83	21	12	17	25	14	10	5
Women								
All women	415	100	67	103	97	50	50	48
Single	64	15	9	12	6	8	16	13
Married	140	34	25	49	32	12	11	11
Widowed or divorced								
less than 1 year	15	4	2	—	7	3	2	1
1 year or more	196	47	31	42	52	27	21	23

NOTE: [1] Excludes 6 men and 16 women whose marital status was not known.

Table A8

The distribution by mode of living of persons whose diets were recorded

Mode of living	All areas		Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
	No.	%	No.	No.	No.	No.	No.	No.
All persons	824[1]	—	142	197	195	99	95	96
Men								
All men	395	100	75	94	99	49	45	33
Living alone[2]	53	13	8	10	12	9	8	6
Living with wife	280	71	59	69	66	35	29	22
Living with relatives other than wife	60	15	7	15	21	5	8	4
Others	2	1	1	—	—	—	—	1
Women								
All women	429	100	67	103	96	50	50	63
Living alone[2]	172	40	21	35	39	19	22	36
Living with husband	137	32	23	49	31	12	11	11
Living with relatives other than husband	103	24	15	17	24	19	15	13
Others	17	4	8	2	2	—	2	3

NOTE: [1] Excludes 1 man and 2 women whose mode of living was not known.
[2] Includes those boarding with people other than relatives.

Table A9

The number of persons receiving meals-on-wheels in the areas of the survey compared with the total number in England and Wales

No. of times per week	In England and Wales		In all areas of survey		Portsmouth	Cambridge-shire	Sunderland	Rutherglen	Angus	Camden
	No. of persons	% of total	No. of persons	% of total						
7	636	1	—	—	—	—	—	—	—	—
6	783	1	—	—	—	—	—	—	—	—
5	12,200	12	6	29	—	2	—	—	—	4
4	6,485	6	1	5	—	1	—	—	—	—
3	11,540	11	2	9	—	2	—	—	—	—
2	56,107	56	9	43	1	1	4	2	1	—
1	12,568	13	3	14	—	—	1	—	2	—
Total	100,319	100	21	100	1	6	5	2	3	4

Table A10

The numbers of persons whose diets were recorded who received or wished to receive meals-on-wheels

	All areas		Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
	No.	%	No.	No.	No.	No.	No.	No.
Receiving meals on wheels	21	3	1	6	5	2	3	4
Not receiving, but would like to	35	4	5	12	12	2	3	1
Not receiving, and would not like to	765	93	136	178	176	95	89	91
Totals	821	100	142	196	193	99	95	96

Table A11

Preparation of meals for persons whose diets were recorded

Meals usually prepared by:	All areas		Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
	No.	%	No.	No.	No.	No.	No.	No.
All persons	823[1]	—	142	196	195	99	95	96
Men								
All men	394	100	75	93	99	49	45	33
Self or wife	328	83	66	73	81	43	35	30
Other relatives	59	15	7	17	18	5	10	2
Helpers etc.	7	2	2	3	—	1	—	1
Women								
All women	429	100	67	103	96	50	50	63
Self or husband	367	86	60	90	80	38	42	57
Other relatives	48	11	6	10	13	11	5	3
Helpers etc.	14	3	1	3	3	1	3	3

NOTE: [1] Excludes 2 men and 2 women where preparer of meals was not known.

Table A12

The distribution by sources of income of persons in the different areas whose diets were recorded

Group	Source of income	All areas		Portsmouth	Cambridge-shire	Sunderland	Rutherglen	Angus	Camden
		No.	%	No.	No.	No.	No.	No.	No.
	All persons	820[1]	100	140	197	194	99	94	96
1	Social Security pension only	116	14	13	31	35	15	6	16
2 (i)	Social Security pension and Supplementary Benefit only	167	20	25	29	55	25	12	21
(ii)	Supplementary Benefit only	2	—	—	—	1	—	1	—
(iii)	Supplementary Benefit and income from other sources[2]	7	1	1	1	4	1	—	—
(iv)	Supplementary Benefit and Social Security pension and income from other sources	71	9	10	16	14	16	6	9
3 (i)	Social Security pension and income from other sources[2]	425	52	85	111	80	39	63	47
(ii)	Income from other sources only[2]	32	4	6	9	5	3	6	3

NOTE: [1] Excludes 7 persons whose source of income was not known.
[2] i.e. Sources other than Social Security pension or Supplementary Benefit.

Table A13

The distribution by sources of income of men and women in the two age-groups whose diets were recorded

Group	Source of income	All persons		Men				Women			
				65–74		75 and over		65–74		75 and over	
		No.	%	No.	%	No.	%	No.	%	No.	%
	All persons	820[1]	100	215	100	178	100	226	100	201	100
1	Social Security pension only	116	14	19	9	33	19	28	12	36	18
2 (i)	Social Security pension and Supplementary Benefit only	167	20	18	8	32	18	51	23	66	33
(ii) (iii) (iv)	Supplementary Benefit only; Supplementary Benefit and income from other sources[2]; Supplementary Benefit and Social Security pension and income from other sources	80	10	22	10	15	8	26	11	17	8
3 (i) (ii)	Social Security pension and income from other sources[2]; Income from other sources[2] only	457	56	156	73	98	55	121	54	82	41

[1] Excludes 7 persons whose source of income was not known.
[2] i.e. Sources other than Social Security pension or Supplementary Benefit.

Table A14

Average daily intakes of energy and nutrients in the six areas

1. Men: 65–74

Nutrient	Unit	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Energy value	kcal	2,344	2,272	2,476	2,225	2,320	2,504	2,364
	MJ	9·8	9·5	10·4	9·3	9·7	10·5	9·9
Calories from protein	%	12·9	13·9	12·4	12·9	12·2	13·1	12·9
Total protein	g	74·6	77·7	75·7	70·7	70·8	81·7	74·3
Fat	g	110	103	121	104	105	121	103
Carbohydrate	g	266	266	274	250	282	281	263
Calcium	mg	910	950	1,000	820	810	980	900
Iron	mg	12·2	12·5	12·2	11·6	11·6	13·9	12·1
Vitamin A	i.u.	3,790	3,230	3,950	3,440	3,730	5,220	4,070
	μg	1,140	970	1,190	1,030	1,120	1,570	1,220
Thiamine	mg	1·1	1·2	1·1	1·0	1·0	1·1	1·0
Riboflavine	mg	1·6	1·6	1·7	1·4	1·4	1·6	1·6
Nicotinic acid	mg	16·8	17·8	18·9	15·5	17·5	14·1	15·5
Pyridoxine	mg	1·4	1·4	1·5	1·3	1·2	1·3	1·5
Vitamin C	mg	43	51	51	33	38	35	48
Vitamin D	i.u.	133	143	138	104	112	191	149
	μg	3·3	3·6	3·5	2·6	2·8	4·8	3·7

2. Men: 75 and over

Nutrient	Unit	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Energy value	kcal	2,103	2,237	2,256	1,816	1,969	2,086	2,401
	MJ	8·8	9·4	9·4	7·6	8·2	8·7	10·0
Calories from protein	%	13·0	13·4	11·8	13·3	13·9	14·0	11·9
Total protein	g	67·6	73·2	66·3	60·3	67·3	72·5	71·4
Fat	g	98	100	108	88	90	100	102
Carbohydrate	g	244	261	264	207	233	233	287
Calcium	mg	880	990	930	680	890	910	1,000
Iron	mg	10·9	11·6	11·2	9·4	10·5	12·0	11·4
Vitamin A	i.u.	3,650	4,660	3,520	2,620	3,490	3,930	4,340
	μg	1,100	1,400	1,060	790	1,050	1,180	1,300
Thiamine	mg	0·9	1·0	1·0	0·8	0·9	0·9	1·0
Riboflavine	mg	1·4	1·7	1·4	1·0	1·3	1·5	1·7
Nicotinic acid	mg	13·6	15·0	13·3	12·5	15·0	12·2	13·6
Pyridoxine	mg	1·2	1·4	1·2	0·9	1·1	1·2	1·4
Vitamin C	mg	38	45	45	25	34	31	48
Vitamin D	i.u.	107	122	119	74	99	138	95
	μg	2·7	3·1	3·0	1·9	2·5	3·5	2·4

Table A14 (continued)

Average daily intakes of energy and nutrients in the six areas

3. Women: 65–74

Nutrient	Unit	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Energy value	kcal	1,787	1,828	1,831	1,730	1,735	1,823	1,779
	MJ	7·5	7·6	7·7	7·2	7·3	7·6	7·4
Calories from protein	%	13·6	14·1	12·5	14·6	13·8	13·7	13·2
Total protein	g	59·2	62·9	56·4	60·1	58·0	62·0	57·0
Fat	g	87	88	90	87	88	88	82
Carbohydrate	g	200	205	208	187	189	206	207
Calcium	mg	800	850	830	760	750	810	760
Iron	mg	9·4	9·8	9·4	8·8	9·5	10·3	9·2
Vitamin A	i.u.	3,420	3,120	3,650	3,080	3,790	3,720	3,450
	µg	1,030	940	1,100	920	1,140	1,120	1,040
Thiamine	mg	0·8	0·9	0·8	0·8	0·8	0·9	0·8
Riboflavine	mg	1·3	1·4	1·3	1·1	1·2	1·3	1·3
Nicotinic acid	mg	11·5	13·7	12·0	11·0	11·3	10·4	9·9
Pyridoxine	mg	1·0	1·1	1·0	0·9	1·0	1·0	1·1
Vitamin C	mg	40	48	44	33	33	34	51
Vitamin D	i.u.	92	80	110	101	79	77	82
	µg	2·3	2·0	2·8	2·5	2·0	1·9	2·1

4. Women: 75 and over

Nutrient	Unit	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Energy value	kcal	1,628	1,685	1,697	1,496	1,606	1,537	1,716
	MJ	6·8	7·1	7·1	6·3	6·7	6·4	7·2
Calories from protein	%	13·3	13·9	12·7	13·8	13·0	13·1	13·7
Total protein	g	53·6	57·8	53·0	50·5	51·6	50·4	57·7
Fat	g	78	78	82	73	76	71	83
Carbohydrate	g	187	195	197	169	188	183	191
Calcium	mg	730	850	720	640	640	700	810
Iron	mg	8·5	8·9	8·5	7·5	8·6	8·2	9·3
Vitamin A	i.u.	2,960	3,020	3,020	2,230	3,020	3,010	3,610
	µg	890	910	910	670	910	900	1,080
Thiamine	mg	0·7	0·8	0·8	0·7	0·7	0·7	0·8
Riboflavine	mg	1·1	1·4	1·1	0·9	1·0	1·1	1·3
Nicotinic acid	mg	10·2	11·4	10·2	9·0	11·8	8·4	10·5
Pyridoxine	mg	0·9	1·0	1·0	0·8	0·9	0·8	1·1
Vitamin C	mg	34	39	41	25	25	24	43
Vitamin D	i.u.	84	100	69	92	59	66	111
	µg	2·1	2·5	1·7	2·3	1·5	1·7	2·8

Table A15

Percentage distribution of average daily intakes of energy in the six areas

Range of average daily intake of calories (kcal)	All areas	Portsmouth	Cambridgeshire	Sunderland	Rutherglen	Angus	Camden
1. Men: 65–74							
Under 500	—	—	—	—	—	—	—
500–999	1	2	—	—	—	4	—
1,000–1,499	6	5	4	15	—	—	—
1,500–1,999	18	24	14	20	21	4	26
2,000–2,499	40	42	35	37	46	46	47
2,500–2,999	25	15	33	20	33	32	16
3,000 and over	10	12	14	8	—	14	11
Average daily intake (kcal, MJ)	2,344 (9·8)	2,272 (9·5)	2,476 (10·4)	2,225 (9·3)	2,320 (9·7)	2,504 (10·5)	2,364 (9·9)
2. Men: 75 and over							
Under 500	—	—	—	—	—	—	—
500–999	2	—	2	5	—	—	—
1,000–1,499	13	9	7	25	24	4	—
1,500–1,999	27	20	19	35	32	39	14
2,000–2,499	37	41	39	22	32	44	57
2,500–2,999	16	24	28	10	4	9	15
3,000 and over	5	6	5	3	8	4	14
Average daily intake (kcal, MJ)	2,103 (8·8)	2,237 (9·4)	2,256 (9·4)	1,816 (7·6)	1,969 (8·2)	2,086 (8·7)	2,401 (10·0)

Table A15 (continued)

Percentage distribution of average daily intakes of energy in the six areas

3. Women: 65–74

Range of average daily intake of calories (kcal)	All areas	Portsmouth	Cambridgeshire	Sunderland	Rutherglen	Angus	Camden
Under 500	—	—	—	2	—	—	—
500–999	4	9	4	5	4	—	—
1,000–1,499	20	11	18	21	12	28	28
1,500–1,999	47	40	44	47	68	36	48
2,000–2,499	24	34	29	21	12	32	14
2,500–2,999	5	6	5	4	4	4	7
3,000 and over	—	—	—	—	—	—	3
Average daily intake (kcal, MJ)	1,787 (7·5)	1,828 (7·6)	1,831 (7·7)	1,730 (7·2)	1,735 (7·3)	1,823 (7·6)	1,779 (7·4)

4. Women: 75 and over

Range of average daily intake of calories (kcal)	All areas	Portsmouth	Cambridgeshire	Sunderland	Rutherglen	Angus	Camden
Under 500	—	—	—	—	—	—	—
500–999	5	3	4	10	—	8	3
1,000–1,499	33	25	27	44	40	32	29
1,500–1,999	48	56	48	42	48	56	44
2,000–2,499	11	13	15	2	8	4	21
2,500–2,999	3	3	6	2	4	—	3
3,000 and over	—	—	—	—	—	—	—
Average daily intake (kcal, MJ)	1,628 (6·8)	1,685 (7·1)	1,697 (7·1)	1,496 (6·3)	1,606 (6·7)	1,537 (6·4)	1,716 (7·2)

Table A16

Percentage distribution of average daily intakes of protein in the six areas

1. Men: 65–74

Range of average daily intake of protein (g)	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Under 30	—	—	—	—	—	—	—
30–59·9	19	17	16	32	17	4	16
60–89·9	66	61	70	55	75	73	74
90–119·9	13	20	14	10	8	18	10
120–149·9	1	2	—	2	—	5	—
150 and over	1	—	—	1	—	—	—
Average daily intake (g)	74·6	77·7	75·7	70·7	70·8	81·7	74·3

2. Men: 75 and over

Range of average daily intake of protein (g)	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Under 30	1	—	—	2	—	—	—
30–59·9	33	20	35	53	32	17	29
60–89·9	57	62	56	40	64	70	64
90–119·9	9	18	9	3	4	13	7
120–149·9	—	—	—	—	—	—	—
150 and over	—	—	—	2	—	—	—
Average daily intake (g)	67·6	73·2	66·3	60·3	67·3	72·5	71·4

3. Women: 65–74

Range of average daily intake of protein (g)	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Under 30	2	—	4	2	—	—	3
30–59·9	54	51	54	49	72	52	52
60–89·9	42	40	42	47	24	44	45
90–119·9	2	9	—	2	4	4	—
120–149·9	—	—	—	—	—	—	—
150 and over	—	—	—	—	—	—	—
Average daily intake (g)	59·2	62·9	56·4	60·1	58·0	62·0	57·0

4. Women: 75 and over

Range of average daily intake of protein (g)	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Under 30	3	3	4	2	—	4	3
30–59·9	66	47	69	73	80	64	62
60–89·9	31	47	27	25	20	32	35
90–119·9	—	3	—	—	—	—	—
120–149·9	—	—	—	—	—	—	—
150 and over	—	—	—	—	—	—	—
Average daily intake (g)	53·6	57·8	53·0	50·5	51·6	50·4	57·7

Table A17

Percentage distribution of average daily intakes of riboflavine in the six areas

1. Men: 65–74

Range of average daily intake of riboflavine (mg)	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Under 0·49	—	—	—	—	—	—	—
0·50–0·99	11	2	8	23	8	9	11
1·00–1·49	42	42	31	43	63	46	32
1·50–1·99	29	29	33	23	29	18	47
2·00–2·49	14	25	22	9	—	18	5
2·50–2·99	3	2	4	2	—	9	—
3·00 and over	1	—	2	—	—	—	5
Average daily intake (mg)	1·6	1·6	1·7	1·4	1·4	1·6	1·6

2. Men: 75 and over

Range of average daily intake of riboflavine (mg)	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Under 0·49	1	—	2	—	—	—	—
0·50–0·99	21	12	12	2	24	9	—
1·00–1·49	42	21	51	50	48	52	43
1·50–1·99	23	38	19	40	24	30	36
2·00–2·49	8	17	12	8	4	4	14
2·50–2·99	4	12	2	—	—	5	7
3·00 and over	1	—	2	—	—	—	—
Average daily intake (mg)	1·4	1·7	1·4	1·0	1·3	1·5	1·7

3. Women: 65–74

Range of average daily intake of riboflavine (mg)	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Under 0·49	—	—	—	2	—	—	—
0·50–0·99	26	11	20	32	44	28	24
1·00–1·49	47	46	51	52	36	40	48
1·50–1·99	23	37	25	14	16	20	24
2·00–2·49	3	6	4	—	—	12	—
2·50–2·99	—	—	—	—	—	—	—
3·00 and over	1	—	—	—	4	—	4
Average daily intake (mg)	1·3	1·4	1·3	1·1	1·2	1·3	1·3

4. Women: 75 and over

Range of average daily intake of riboflavine (mg)	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Under 0·49	3	3	—	7	—	8	—
0·50–0·99	37	16	42	61	44	32	18
1·00–1·49	47	53	48	29	52	48	59
1·50–1·99	10	22	10	—	—	12	17
2·00–2·49	2	—	—	3	4	—	6
2·50–2·99	1	6	—	—	—	—	—
3·00 and over	—	—	—	—	—	—	—
Average daily intake (mg)	1·1	1·4	1·1	0·9	1·0	1·1	1·3

Table A18

Percentage distribution of average daily intakes of vitamin C in the six areas

1. Men: 65–74

Range of average daily intake of vitamin C (mg)	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Under 10	2	—	—	5	8	—	—
10–19·99	12	2	2	28	21	14	—
20–29·99	20	17	14	30	8	32	16
30–49·99	36	37	49	18	38	36	47
50–69·99	18	20	25	12	13	14	26
70–99·99	10	22	6	5	12	4	11
100 and over	2	2	4	2	—	—	—
Average daily intake (mg)	43	51	51	33	38	35	48

2. Men: 75 and over

Range of average daily intake of vitamin C (mg)	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Under 10	5	—	5	10	12	—	—
10–19·99	13	3	5	33	20	13	—
20–29·99	25	14	21	27	28	39	21
30–49·99	37	56	46	23	24	35	36
50–69·99	13	18	14	5	4	13	36
70–99·99	5	9	5	2	8	—	7
100 and over	2	—	4	—	4	—	—
Average daily intake (mg)	38	45	45	25	34	31	48

3. Women: 65–74

Range of average daily intake of vitamin C (mg)	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Under 10	1	—	—	2	4	4	—
10–19·99	19	11	7	33	32	28	—
20–29·99	26	29	20	32	28	24	21
30–49·99	30	34	44	16	16	24	45
50–69·99	11	11	18	9	12	8	7
70–99·99	9	9	7	3	4	12	24
100 and over	4	6	4	5	4	—	3
Average daily intake (mg)	40	48	44	33	33	34	51

4. Women: 75 and over

Range of average daily intake of vitamin C (mg)	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Under 10	6	3	—	10	12	12	3
10–19·99	17	9	6	29	20	32	12
20–29·99	30	19	29	44	40	32	18
30–49·99	31	47	44	12	24	20	32
50–69·99	11	16	11	2	4	4	29
70–99·99	3	6	4	—	—	—	3
100 and over	2	—	6	3	—	—	3
Average daily intake (mg)	34	39	41	25	25	24	43

Table A19

Percentage distribution of average daily intakes of vitamin D in the six areas

1. Men: 65–74

Range of average daily intake of vitamin D (i.u.)	All areas	Portsmouth	Cambridgeshire	Sunderland	Rutherglen	Angus	Camden
Under 50	17	15	14	23	21	5	21
50–99·9	40	44	45	37	46	32	26
100–149·9	14	10	15	17	17	9	16
150–199·9	12	12	14	12	4	9	16
200 and over	17	19	12	11	12	45	21
Average daily intake (i.u., μg)	133 (3·3)	143 (3·6)	138 (3·5)	104 (2·6)	112 (2·8)	191 (4·8)	149 (3·7)

2. Men: 75 and over

Range of average daily intake of vitamin D (i.u.)	All areas	Portsmouth	Cambridgeshire	Sunderland	Rutherglen	Angus	Camden
Under 50	25	20	16	48	24	13	14
50–99·9	39	32	42	32	56	30	43
100–149·9	14	18	14	8	4	22	36
150–199·9	9	12	9	7	4	17	—
200 and over	13	18	19	5	12	18	7
Average daily intake (i.u., μg)	107 (2·7)	122 (3·1)	119 (3·0)	74 (1·9)	99 (2·5)	138 (3·5)	95 (2·4)

Table A19 (continued)

Percentage distribution of average daily intakes of vitamin D in the six areas

3. Women: 65–74

Range of average daily intake of vitamin D (i.u.)	All areas	Portsmouth	Cambridgeshire	Sunderland	Rutherglen	Angus	Camden
Under 50	36	54	34	30	24	32	41
50–99·9	38	20	29	39	64	52	38
100–149·9	11	9	11	16	8	4	10
150–199·9	8	9	15	5	—	12	4
200 and over	7	8	11	10	4	—	7
Average daily intake (i.u., μg)	92 (2·3)	80 (2·0)	110 (2·8)	101 (2·5)	79 (2·0)	77 (1·9)	82 (2·1)

4. Women: 75 and over

Range of average daily intake of vitamin D (i.u.)	All areas	Portsmouth	Cambridgeshire	Sunderland	Rutherglen	Angus	Camden
Under 50	37	38	36	44	48	36	23
50–99·9	41	22	50	37	44	48	44
100–149·9	8	9	8	7	4	12	3
150–199·9	7	22	6	—	4	—	12
200 and over	7	9	—	12	—	4	18
Average daily intake (i.u., μg)	84 (2·1)	100 (2·5)	69 (1·7)	92 (2·3)	59 (1·5)	66 (1·7)	111 (2·8)

Table A20

Percentage distribution of average daily intakes of liquid whole milk in the six areas

1. Men: 65–74

Range of average daily intake of milk (oz.)	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Under 5	10	2	2	25	8	9	11
5–9·99	31	29	14	40	50	23	37
10–14·99	31	32	37	22	34	36	32
15–19·99	16	20	25	8	4	23	10
20 and over	12	17	22	5	4	9	10
Average daily intake (oz.)	12·2	13·9	15·4	9·4	9·7	12·7	11·3

2. Men: 75 and over

Range of average daily intake of milk (oz.)	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Under 5	12	9	7	23	12	9	7
5–9·99	29	21	26	50	36	13	14
10–14·99	26	23	23	20	28	39	36
15–19·99	20	21	26	5	12	35	29
20 and over	13	26	18	2	12	4	14
Average daily intake (oz.)	12·6	15·3	14·0	8·2	11·5	13·5	14·8

3. Women: 65–74

Range of average daily intake of milk (oz.)	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Under 5	9	17	2	12	12	4	7
5–9·99	29	26	24	23	60	28	31
10–14·99	37	17	49	47	20	36	34
15–19·99	17	20	13	14	8	20	28
20 and over	8	20	12	4	—	12	—
Average daily intake (oz.)	11·8	12·7	13·4	11·0	9·3	12·4	11·3

4. Women: 75 and over

Range of average daily intake of milk (oz.)	All areas	Ports-mouth	Cam-bridge-shire	Sunder-land	Ruther-glen	Angus	Camden
Under 5	10	—	2	27	20	8	3
5–9·99	34	16	48	39	48	32	18
10–14·99	35	47	29	24	20	44	50
15–19·99	13	25	10	3	8	12	23
20 and over	8	12	11	7	4	4	6
Average daily intake (oz.)	11·5	15·3	11·3	9·9	8·8	11·0	12·7

Table A21

Comparison of daily intakes of nutrients and some foods per 1,000 kcal by persons in the National Food Survey (NFS 1967) and the Elderly Survey (DHSS 1967–68)

Nutrient or food	NFS, 1967 All households	DHSS, 1967–68 Elderly
Animal protein (g)	18·1	22·3
Total protein (g)	29·3	32·5
Fat (g)	46	48
Carbohydrate (g)	125	114
Calcium (mg)	400	420
Iron (mg)	5·4	5·2
Vitamin A (i.u.)	1,800	1,760
(retinol equivalents)	540	530
Thiamine (mg)	0·5	0·5
Riboflavine (mg)	0·7	0·7
Nicotinic acid (mg)	5·8	6·6
Vitamin C (mg)	20	20
Vitamin D (i.u.)	50	53
(μg cholecalciferol)	1·25	1·33
Milk[1] (oz.)	5·8	6·1
(g)	165	173
Cheese (g)	5·4	5·7
Eggs (g)	13·0	18·9

NOTE: [1] Includes condensed, dried and other milk but not cream.

Table A22

Intakes of energy, nutrients and some foods for men of two age-groups according to their mode of living

Men	65–74				75 and over			
Mode of living	All	Alone	With spouse	With other relatives	All	Alone	With spouse	With other relatives
Numbers of men	217[1]	20	179	17	179[1]	33	101	43
Energy (kcal)	2,344	2,278	2,352	2,340	2,103	2,122	2,095	2,092
Percentage of calories from:								
total protein	12·9	13·1	12·9	13·0	13·0	12·2	13·3	13·0
animal protein	8·7	8·7	8·6	8·8	8·7	7·7	9·0	8·9
Total protein (g)	74·6	73·6	74·7	75·1	67·6	64·8	68·3	67·8
Animal protein (g)	50·7	49·6	50·8	51·3	45·9	40·6	47·2	46·3
Riboflavine (mg)	1·5	1·6	1·5	1·6	1·4	1·2	1·4	1·4
Vitamin C (mg)	43	41	43	38	38	34	39	36
Vitamin D (i.u.)	133	98	139	117	107	122	109	93
1. Meat (total) (oz.)	3·5	3·3	3·5	3·4	2·9	2·6	3·0	2·9
2. Fish (total) (oz.)	0·9	1·1	0·9	1·0	0·8	0·6	0·9	0·8
3. Eggs (total) (oz.)	1·5	1·5	1·5	1·7	1·4	1·3	1·4	1·3
4. Cheese (total) (oz.)	0·5	0·4	0·5	0·5	0·5	0·4	0·5	0·4
Total 1–4	6·4	6·3	6·4	6·6	5·6	4·9	5·8	5·4
Milk (total) (oz.)	12·5	11·7	12·6	12·8	12·9	12·0	12·4	14·1

NOTE: [1] Includes men living with persons other than relatives, and those whose mode of living is not known.

Table A23

Intakes of energy, nutrients and some foods for women of two age-groups according to their mode of living

Women	65–74				75 and over			
Mode of living	All	Alone	With spouse	With other relatives	All	Alone	With spouse	With other relatives
Numbers of women	226[1]	81	99	39	205[1]	91	38	64
Energy (kcal)	1,787	1,783	1,777	1,814	1,628	1,646	1,617	1,588
Percentage of calories from:								
total protein	13·6	13·8	13·6	13·5	13·3	13·4	13·3	13·4
animal protein	9·2	9·4	9·0	9·1	9·2	9·3	9·2	9·1
Total protein (g)	59·2	59·6	58·2	60·7	53·6	54·3	53·6	52·3
Animal protein (g)	41·1	42·1	40·0	41·3	37·3	38·3	37·1	36·3
Riboflavine (mg)	1·3	1·3	1·2	1·3	1·1	1·1	1·1	1·1
Vitamin C (mg)	40	45	38	36	34	38	30	29
Vitamin D (i.u.)	92	90	93	83	84	86	73	81
1. Meat (total) (oz.)	2·5	2·4	2·5	2·6	2·3	2·3	2·3	2·3
2. Fish (total) (oz.)	0·7	0·8	0·7	0·7	0·6	0·6	0·5	0·6
3. Eggs (total) (oz.)	1·2	1·3	1·1	1·1	1·1	1·1	1·1	1·0
4. Cheese (total (oz.)	0·4	0·5	0·4	0·5	0·3	0·3	0·4	0·3
Total 1–4	4·8	5·0	4·7	4·9	4·3	4·3	4·3	4·2
Milk (total) (oz.)	12·4	12·7	12·3	12·0	11·9	12·8	11·2	10·8

NOTE: [1] Includes women living with persons other than relatives, and those whose mode of living is not known.

Table A24

Some anthropometric, medical and biochemical indices for men of two age-groups according to their mode of living

Men	65–74				75 and over			
Mode of living	All	Alone	With spouse	With other relatives	All	Alone	With spouse	With other relatives
Mental state								
Number of persons	207	19	171	17	174	33	99	42
% abnormal	3·9	10·5	3·5	—	5·7	6·1	4·0	9·5
Hb level								
Number of persons	182	15	152	15	157	29	89	39
% below 13 g/100 ml	5·5	—	6·6	—	9·6	13·8	9·0	7·7
Skinfold thickness								
Number of persons	206	19	170	17	168	32	96	40
% below 20 mm	28·6	26·3	27·6	41·2	33·9	40·6	36·5	22·5
Serum albumin								
Number of persons	121	13	94	14	98	21	53	24
% below 3·5 g/100 ml	10·7	15·4	8·5	21·4	15·3	19·0	9·4	25·0
Red cell transketolase								
Number of persons	37	1	35	1	29	3	20	6
% above 23%	5·4	—	5·7	—	10·3	—	10·0	16·7
Leucocyte ascorbic acid								
Number of persons	95	4	80	11	69	13	39	17
% below 7·0 μg/10^8 cells	6·3	50·0	3·8	9·1	15·9	30·8	7·7	23·5
Serum vitamin B_{12}								
Number of persons	182	15	151	16	154	28	86	40
% below 100 pg/ml	0·5	—	0·7	—	2·6	3·6	3·5	—
Serum folate								
Number of persons	182	15	151	16	152	27	85	40
% below 3·0 ng/ml	14·8	20·0	15·9	—	14·5	25·9	11·8	12·5
Red cell folate								
Number of persons	175	15	146	14	148	26	82	40
% below 100 ng/ml	2·9	—	3·4	—	2·7	3·8	1·2	5·0
Serum iron								
Number of persons	182	15	151	16	154	28	86	40
% below 60 μg/100 ml	15·9	—	17·2	18·8	16·9	14·3	15·1	22·5

Table A25

Some anthropometric, medical and biochemical indices for women of two age-groups according to their mode of living

Women	65–74				75 and over			
Mode of living	All	Alone	With spouse	With other relatives	All	Alone	With spouse	With other relatives
Mental state								
Number of persons	205	77	91	37	176	84	33	59
% abnormal	11·2	18·2	6·6	8·1	15·9	17·9	12·1	15·3
Hb level								
Number of persons	172	61	78	33	133	60	29	44
% below 12 g/100 ml	8·1	11·5	3·8	12·1	5·3	6·7	6·9	2·3
Skinfold thickness								
Number of persons	199	73	89	37	168	82	31	55
% below 20 mm	4·5	2·7	5·6	5·4	14·9	15·9	12·9	14·5
Serum albumin								
Number of persons	127	54	47	26	118	60	15	43
% below 3·5 g/100 ml	10·2	1·9	17·0	15·4	13·6	16·7	—	14·0
Red cell transketolase								
Number of persons	25	5	15	5	16	9	3	4
% above 23%	16·0	20·0	6·7	40·0	6·3	—	—	25·0
Leucocyte ascorbic acid								
Number of persons	76	24	39	13	53	28	9	16
% below 7·0 μg/10[8] cells	2·6	—	5·1	—	5·7	3·6	11·1	6·3
Serum vitamin B_{12}								
Number of persons	171	62	76	33	139	66	28	45
% below 100 pg/ml	1·2	1·6	—	3·0	0·7	1·5	—	—
Serum folate								
Number of persons	170	62	76	32	139	66	28	45
% below 3·0 ng/ml	10·6	8·1	10·5	15·6	18·0	16·7	10·7	24·4
Red cell folate								
Number of persons	162	58	75	29	135	65	28	42
% below 100 ng/ml	2·5	1·7	2·7	3·4	5·9	6·2	3·6	7·1
Serum iron								
Number of persons	171	61	76	34	138	66	28	44
% below 60 μg/100 ml	20·5	21·3	14·5	32·4	24·6	25·8	21·4	25·0

Table A26

Intakes of energy, nutrients and some foods and some biochemical measurements of men of two age-groups according to the source of their income

Group 1: Social Security pension only
Group 2: Supplementary Benefit
Group 3: Income from other sources

Men	65–74				75 and over			
Source of income	All groups	Group 1	Group 2	Group 3	All groups	Group 1	Group 2	Group 3
Numbers of men	217[1]	19	40	156	179[1]	33	47	98
Energy (kcal)	2,344	2,151	2,202	2,408	2,103	2,118	1,955	2,170
Percentage of calories from:								
total protein	12·9	12·9	12·9	12·9	13·0	12·6	13·0	13·2
animal protein	8·7	8·5	8·4	8·7	8·7	8·2	8·5	9·1
Total protein (g)	74·6	67·4	69·1	77·0	67·6	66·5	62·7	70·3
Animal protein (g)	50·7	45·7	46·4	52·5	45·9	43·2	41·3	49·1
Riboflavine (mg)	1·5	1·3	1·5	1·6	1·4	1·3	1·2	1·5
Vitamin C (mg)	43	39	39	44	38	35	30	42
Vitamin D (i.u.)	133	86	115	144	107	108	106	108
1. Meat (total) (oz.)	3·5	3·3	3·2	3·6	2·9	3·0	2·5	3·1
2. Fish (total) (oz.)	0·9	0·7	1·1	0·9	0·9	0·7	0·9	0·9
3. Eggs (total (oz.)	1·6	1·6	1·3	1·6	1·4	1·3	1·4	1·4
4. Cheese (total) (oz.)	0·5	0·4	0·5	0·5	0·5	0·4	0·3	0·5
Total 1–4	6·5	6·0	6·1	6·6	5·7	5·4	5·1	5·9
Milk (total) (oz.)	12·5	10·6	11·0	13·1	12·9	11·3	12·2	13·8
Animal protein per kg bodyweight (g)	0·72	0·67	0·67	0·74	0·69	0·68	0·62	0·73
Total protein per kg bodyweight (g)	1·06	1·00	1·02	1·08	1·02	1·05	0·95	1·05
Hb level								
Number of persons	182	13	32	137	157	28	43	86
% below 13 g/100 ml	5·5	7·7	12·5	3·6	9·6	3·6	14·0	9·3
Skinfold thickness								
Number of persons	205	17	37	151	169	32	46	91
% below 20 mm	28·8	47·1	43·2	23·2	34·3	40·6	37·0	30·8
Serum albumin								
Number of persons	121	13	24	84	98	17	36	45
% below 3·5 g/100 ml	10·7	15·4	16·7	8·3	15·3	11·8	22·2	11·1
Serum pseudocholinesterase								
Number of persons	105	9	22	74	86	14	33	39
% below 140 units	7·6	11·1	9·1	6·8	10·5	7·1	24·2	—
Quetelet's index								
Number of persons	204	18	36	150	172	32	45	95
% below 2·4	50·0	66·7	58·3	46·0	52·3	65·6	55·6	46·3

NOTE: [1] Includes men whose source of income is not known.

Table A27

Intakes of energy, nutrients and some foods and some biochemical measurements of women of two age-group according to the source of their income

Group 1: Social Security pension only
Group 2: Supplementary Benefit
Group 3: Income from other sources

Women	65–74				75 and over			
Source of income	All groups	Group 1	Group 2	Group 3	All groups	Group 1	Group 2	Group 3
Numbers of women	226[1]	28	77	121	205[1]	36	83	82
Energy (kcal)	1,787	1,770	1,725	1,830	1,628	1,610	1,567	1,705
Percentage of calories from:								
total protein	13·6	13·3	13·6	13·7	13·3	13·4	13·3	13·4
animal protein	9·2	8·9	9·1	9·3	9·2	8·9	9·2	9·4
Total protein (g)	59·2	58·1	57·3	60·7	53·6	52·7	51·5	56·4
Animal protein (g)	41·1	39·5	39·3	42·7	37·3	35·7	35·9	40·0
Riboflavine (mg)	1·3	1·3	1·2	1·3	1·1	1·2	1·1	1·2
Vitamin C (mg)	40	35	34	45	34	30	31	39
Vitamin D (i.u.)	92	76	89	98	84	83	79	88
1. Meat (total) (oz.)	2·5	2·4	2·4	2·5	2·3	2·1	2·1	2·6
2. Fish (total) (oz.)	0·7	0·6	0·7	0·7	0·6	0·6	0·6	0·6
3. Eggs (total) (oz.)	1·2	1·1	1·1	1·2	1·1	1·0	1·1	1·0
4. Cheese (total) (oz.)	0·4	0·4	0·4	0·5	0·3	0·2	0·3	0·4
Total 1–4	4·8	4·5	4·6	4·9	4·3	3·9	4·1	4·6
Milk (total) (oz.)	12·4	12·3	11·7	12·9	11·9	12·7	11·2	12·3
Animal protein per kg bodyweight (g)	0·65	0·66	0·62	0·67	0·59	0·58	0·59	0·60
Total protein per kg bodyweight (g)	0·94	0·98	0·91	0·95	0·85	0·85	0·85	0·86
Hb level								
Number of persons	178	22	64	92	138	24	61	53
% below 12 g/100 ml	7·9	9·1	12·5	4·3	5·1	—	8·2	3·8
Skinfold thickness								
Number of persons	205	26	70	109	176	31	76	69
% below 20 mm	5·4	7·7	2·9	6·4	14·8	19·4	18·4	8·7
Serum albumin								
Number of persons	131	17	50	64	120	24	51	45
% below 3·5 g/100 ml	10·7	17·6	6·0	12·5	14·2	12·5	11·8	17·8
Serum pseudocholinesterase								
Number of persons	106	13	43	50	87	20	37	30
% below 140 units	3·8	—	4·7	4·0	2·3	—	2·7	3·3
Quetelet's Index								
Number of persons	212	28	73	111	178	30	77	71
% below 2·4	38·7	42·9	27·4	45·0	46·1	53·3	46·8	42·3

NOTE: [1] Includes women whose source of income is not known.

Table A28

Intakes of energy, nutrients and some foods and some biochemical measurements for men of two age-groups according to the amount they spent on food per week

Men	65–74				75 and over			
Amount per head per week spent on food	All	£1·49 and under	£1·50 to £1·99	£2·00 and over	All	£1·49 and under	£1·50 to £1·99	£2·00 and over
Numbers of men	217[1]	19	55	124	179[1]	27	47	83
Energy (kcal)	2,344	2,083	2,316	2,407	2,103	1,883	2,068	2,173
Percentage of calories from:								
total protein	12·9	12·3	12·8	13·1	13·0	12·3	13·0	13·4
animal protein	8·7	7·4	8·4	8·9	8·7	8·0	8·7	9·0
Total protein (g)	74·6	63·6	72·2	78·0	67·6	57·6	65·9	71·5
Animal protein (g)	50·7	38·7	48·8	53·8	45·9	37·5	45·2	48·6
Riboflavine (mg)	1·5	1·3	1·5	1·6	1·4	1·1	1·3	1·5
Vitamin C (mg)	43	33	36	48	38	29	40	38
Vitamin D (i.u.)	133	94	145	133	107	97	84	128
1. Meat (total (oz.)	3·5	2·8	3·3	3·7	2·9	2·5	2·8	3·0
2. Fish (total) (oz.)	0·9	0·6	0·9	0·9	0·8	0·5	0·8	1·0
3. Eggs (total) (oz.)	1·5	1·2	1·5	1·6	1·4	1·2	1·4	1·4
4. Cheese (total) (oz.)	0·5	0·3	0·6	0·5	0·5	0·5	0·4	0·5
Total 1–4	6·4	4·9	6·3	6·7	5·6	4·7	5·4	5·9
Milk (total) (oz.)	12·5	9·4	11·8	13·7	12·9	9·7	12·9	13·8
Skinfold thickness								
Number of persons	188	18	51	119	150	25	45	80
% below 20 mm	27·7	33·3	21·6	29·4	34·0	24·0	46·7	30·0
Serum albumin								
Number of persons	109	14	29	66	85	16	25	44
% below 3·5 g/100 ml	11·0	14·2	10·3	10·6	17·6	18·8	20·0	15·9
Serum pseudocholinesterase								
Number of persons	98	13	29	56	79	16	23	40
% below 140 units	7·1	15·4	6·8	5·4	11·4	12·5	21·7	5·0

NOTE: [1] Includes men where the amount spent is not known.

Table A29

Intakes of energy, nutrients and some foods and some biochemical measurements for women of two age-groups according to the amount they spent on food per week

Women	65–74				75 and over			
Amount per head per week spent on food	All	£1·49 and under	£1·50 to £1·99	£2·00 and over	All	£1·49 and under	£1·50 to £1·99	£2·00 and over
Numbers of women	226[1]	37	55	114	205[1]	30	47	91
Energy (kcal)	1,787	1,682	1,793	1,827	1,628	1,497	1,625	1,682
Percentage of calories from:								
total protein	13·6	14·0	13·0	13·9	13·3	12·6	13·1	13·8
animal protein	9·2	8·8	8·5	9·6	9·2	8·3	8·6	9·8
Total protein (g)	59·2	55·0	57·2	62·0	53·6	46·5	52·0	57·3
Animal protein (g)	41·1	36·8	38·3	44·0	37·3	31·1	34·8	41·2
Riboflavine (mg)	1·3	1·1	1·2	1·4	1·1	1·0	1·0	1·2
Vitamin C (mg)	40	30	35	43	34	28	31	39
Vitamin D (i.u.)	92	88	105	93	84	56	91	83
1. Meat (total) (oz.)	2·5	2·1	2·4	2·6	2·3	2·0	2·0	2·5
2. Fish (total) (oz.)	0·7	0·7	0·6	0·8	0·6	0·5	0·6	0·6
3. Eggs (total) (oz.)	1·2	1·3	1·0	1·3	1·1	0·8	1·1	1·2
4. Cheese (total) (oz.)	0·4	0·4	0·5	0·5	0·3	0·3	0·3	0·3
Total 1–4	4·8	4·5	4·5	5·2	4·3	3·6	4·0	4·6
Milk (total) (oz.)	12·4	11·6	11·3	13·3	11·9	10·5	11·0	12·9
Skinfold thickness								
Number of persons	191	35	50	106	146	26	39	81
% below 20 mm	5·2	2·9	8·0	4·7	13·7	23·1	17·9	8·6
Serum albumin								
Number of persons	124	22	31	71	96	17	27	52
% below 3·5 g/100 ml	10·5	9·1	12·9	9·9	14·6	11·8	14·8	15·4
Serum pseudocholinesterase								
Number of persons	104	22	27	55	73	16	23	34
% below 140 units	3·8	—	7·4	3·6	2·8	—	—	5·8

NOTE: [1] Includes women where the amount spent is not known.

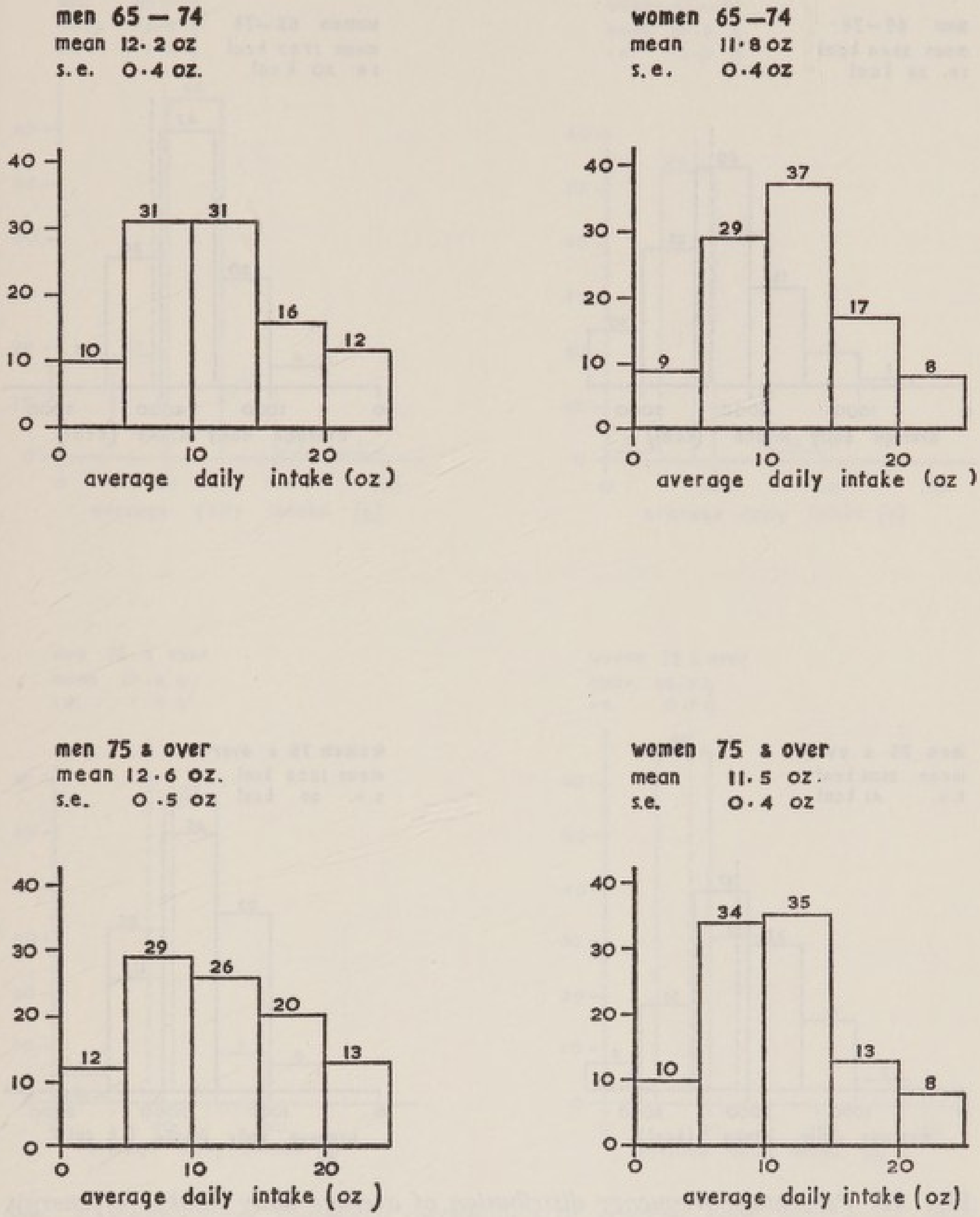

Fig. A1. *Percentage frequency distribution of average daily intakes of liquid whole milk.*

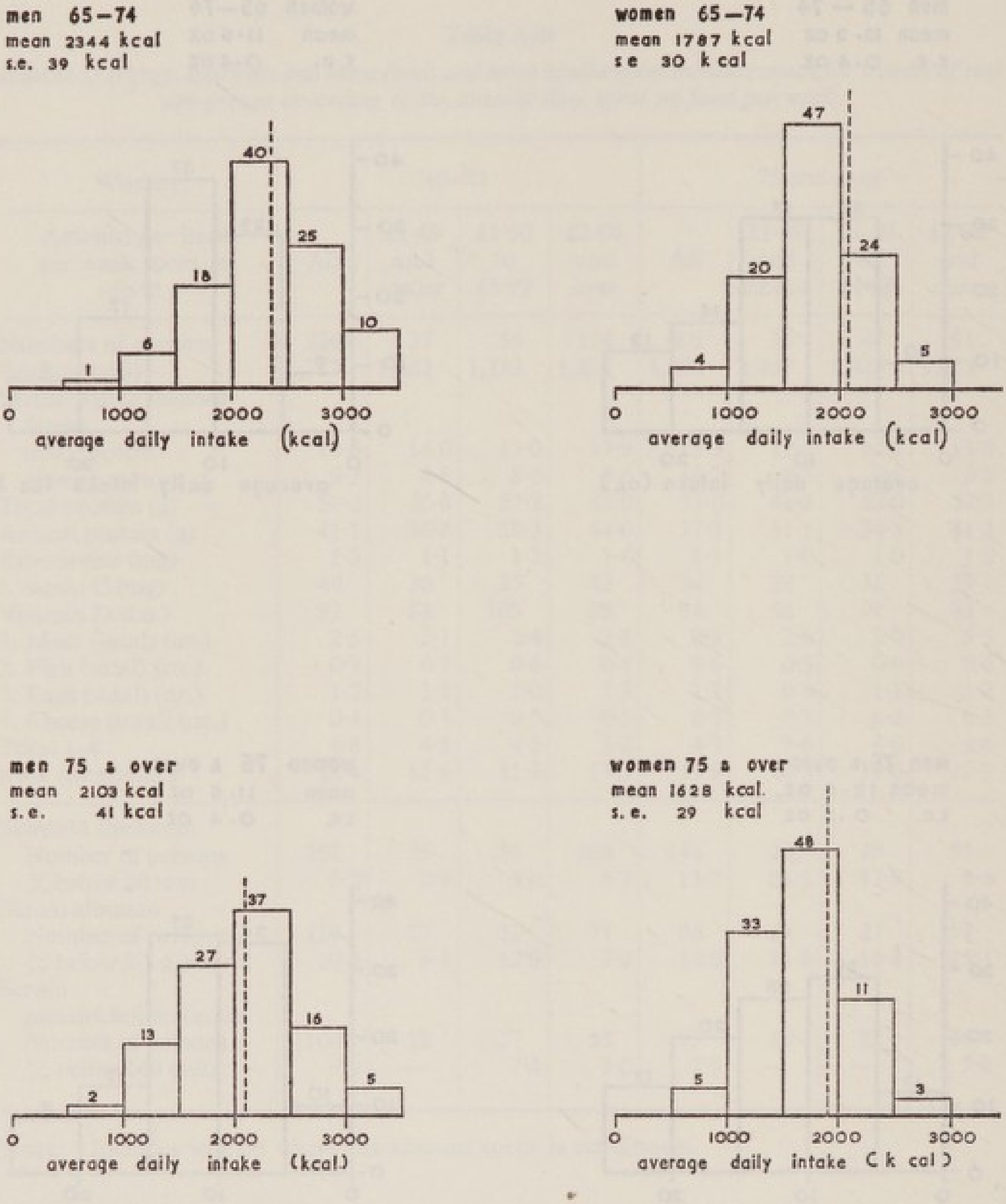

Fig. A2. *Percentage frequency distribution of average daily intakes of energy. The recommended intake is shown by the vertical broken line.*

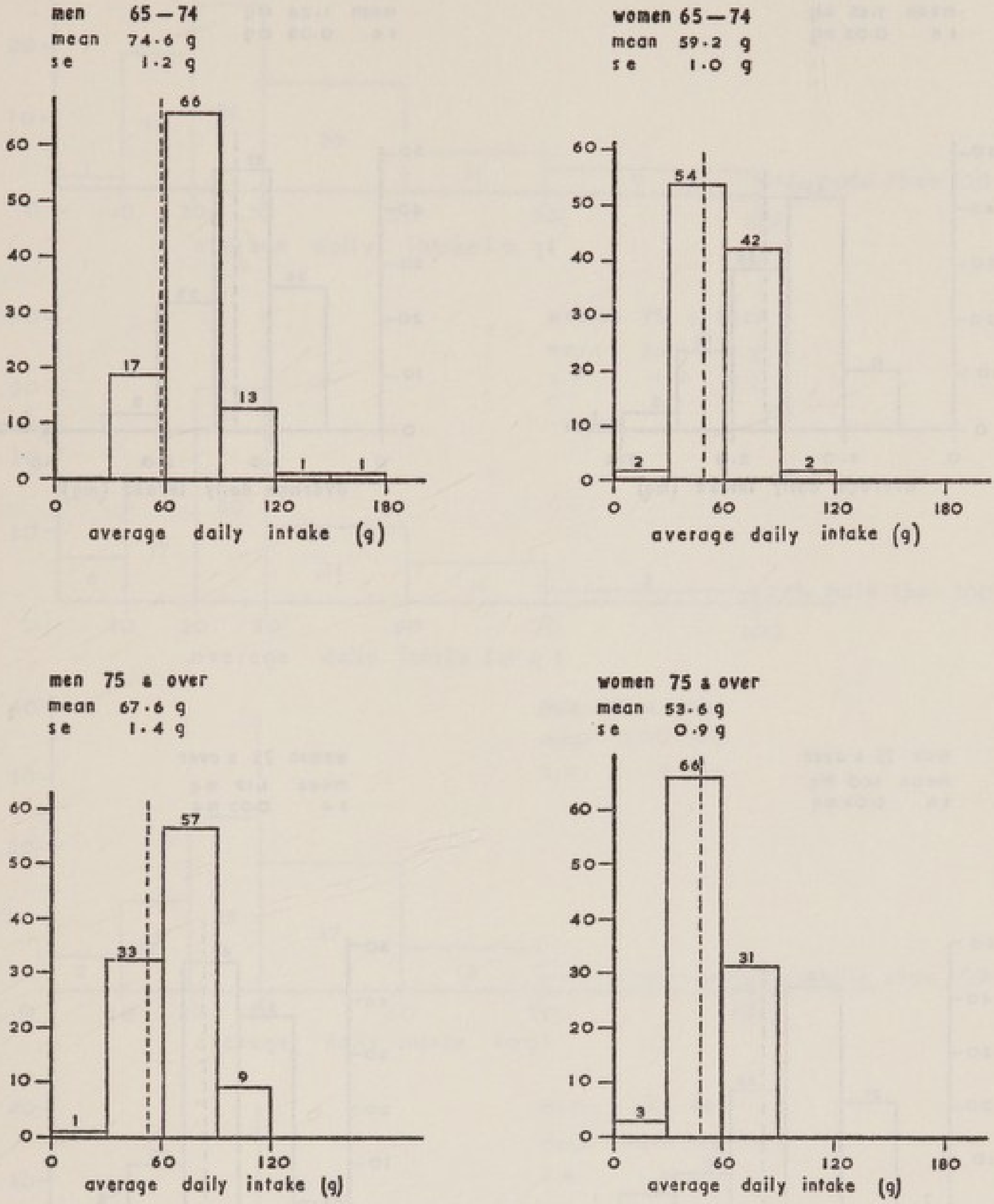

Fig. A3. *Percentage frequency distribution of average daily intakes of total protein. The recommended intake is shown by the vertical broken line.*

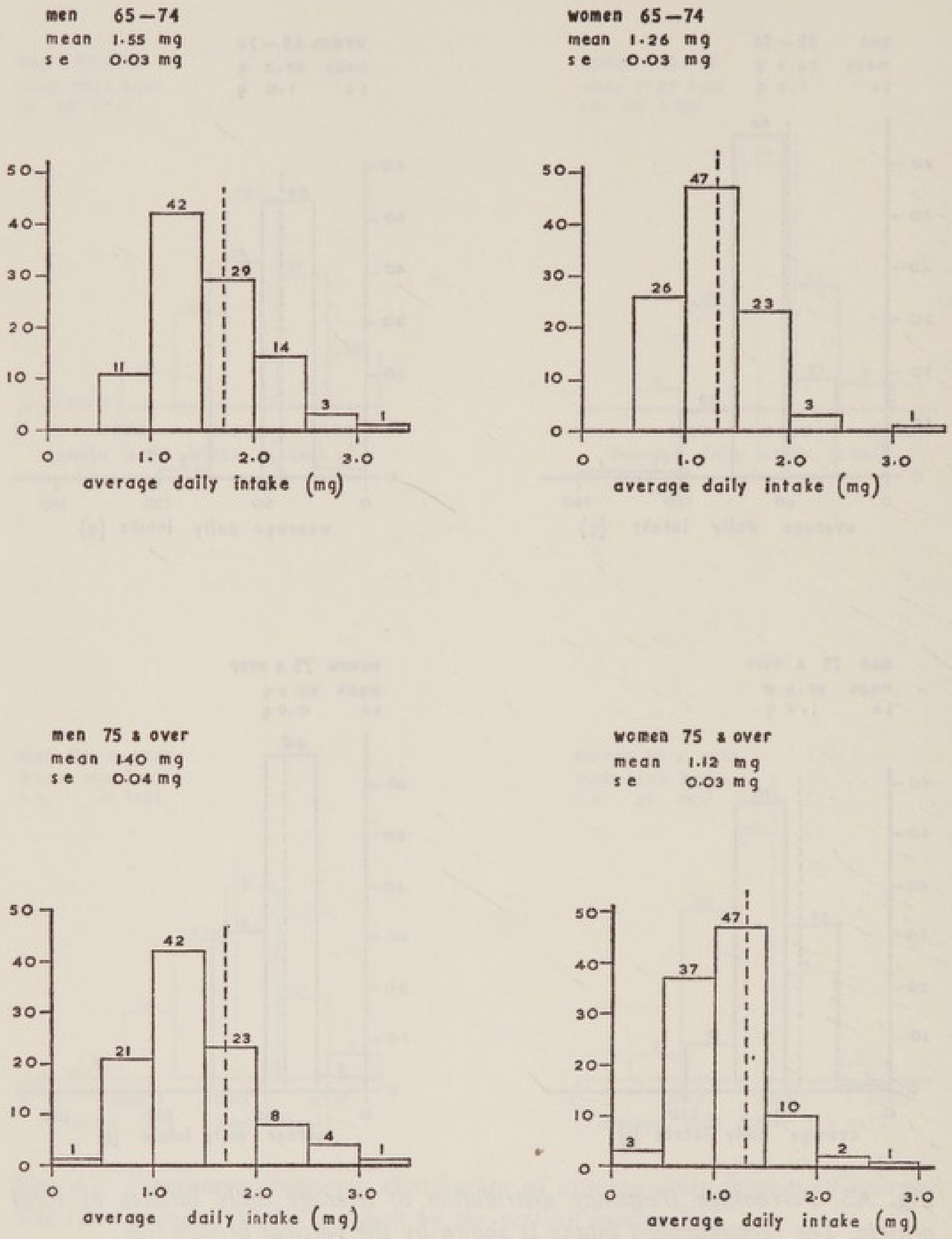

Fig. A4. *Percentage frequency distribution of average daily intakes of riboflavine. The recommended intake is shown by the vertical broken line.*

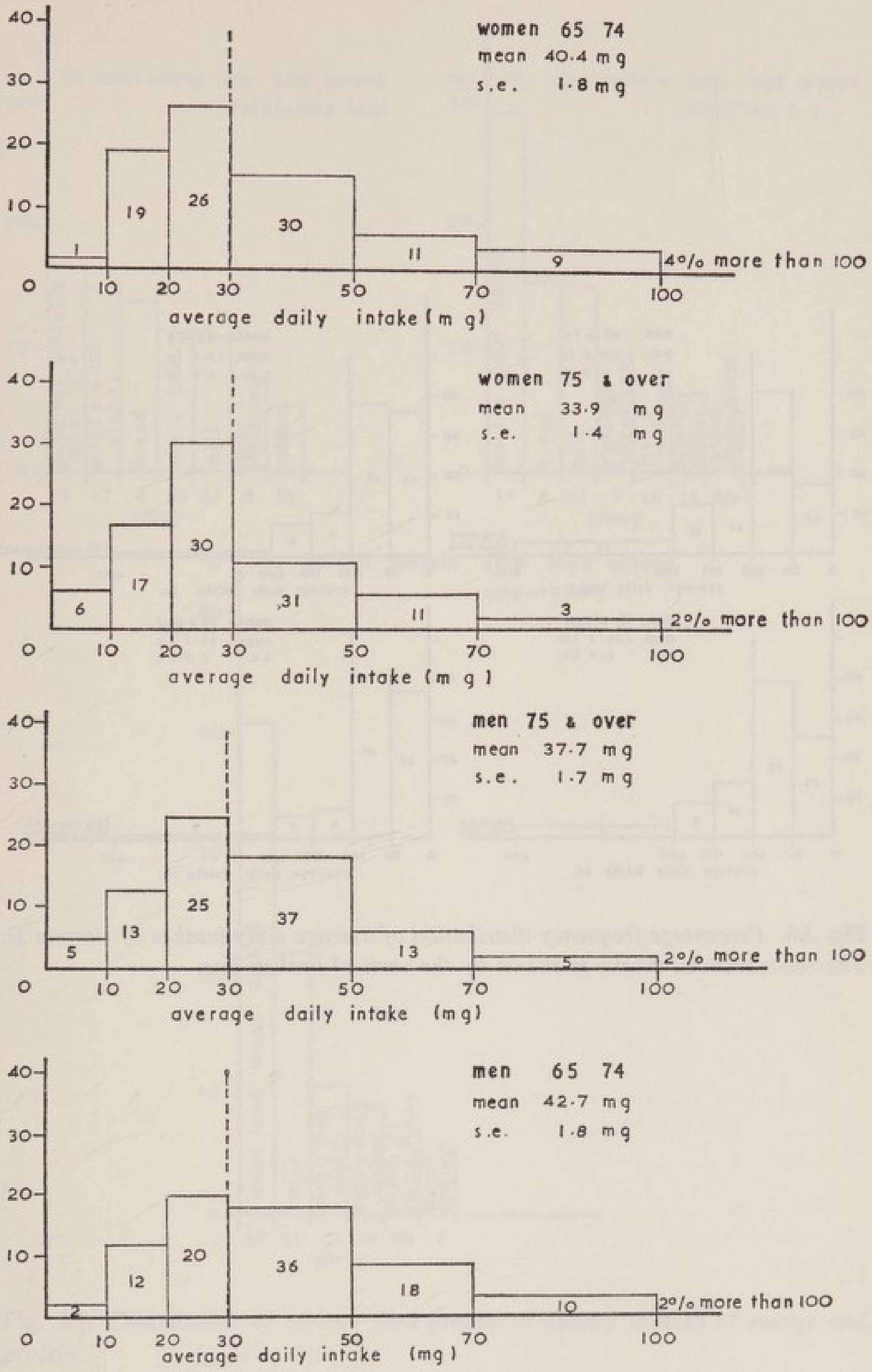

Fig. A5. *Percentage frequency distribution of average daily intakes of vitamin C. The recommended intake is shown by the vertical broken line.*

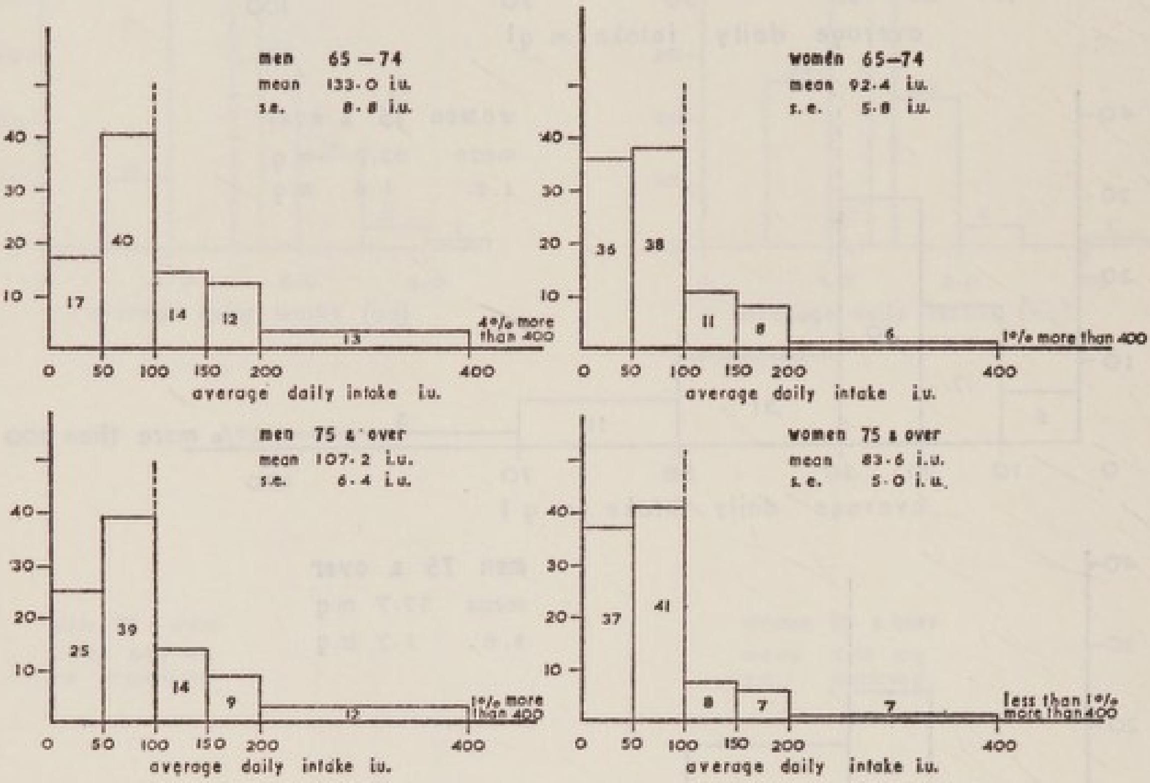

Fig. A6. *Percentage frequency distribution of average daily intakes of vitamin D. The recommended intake is shown by the vertical broken line.*

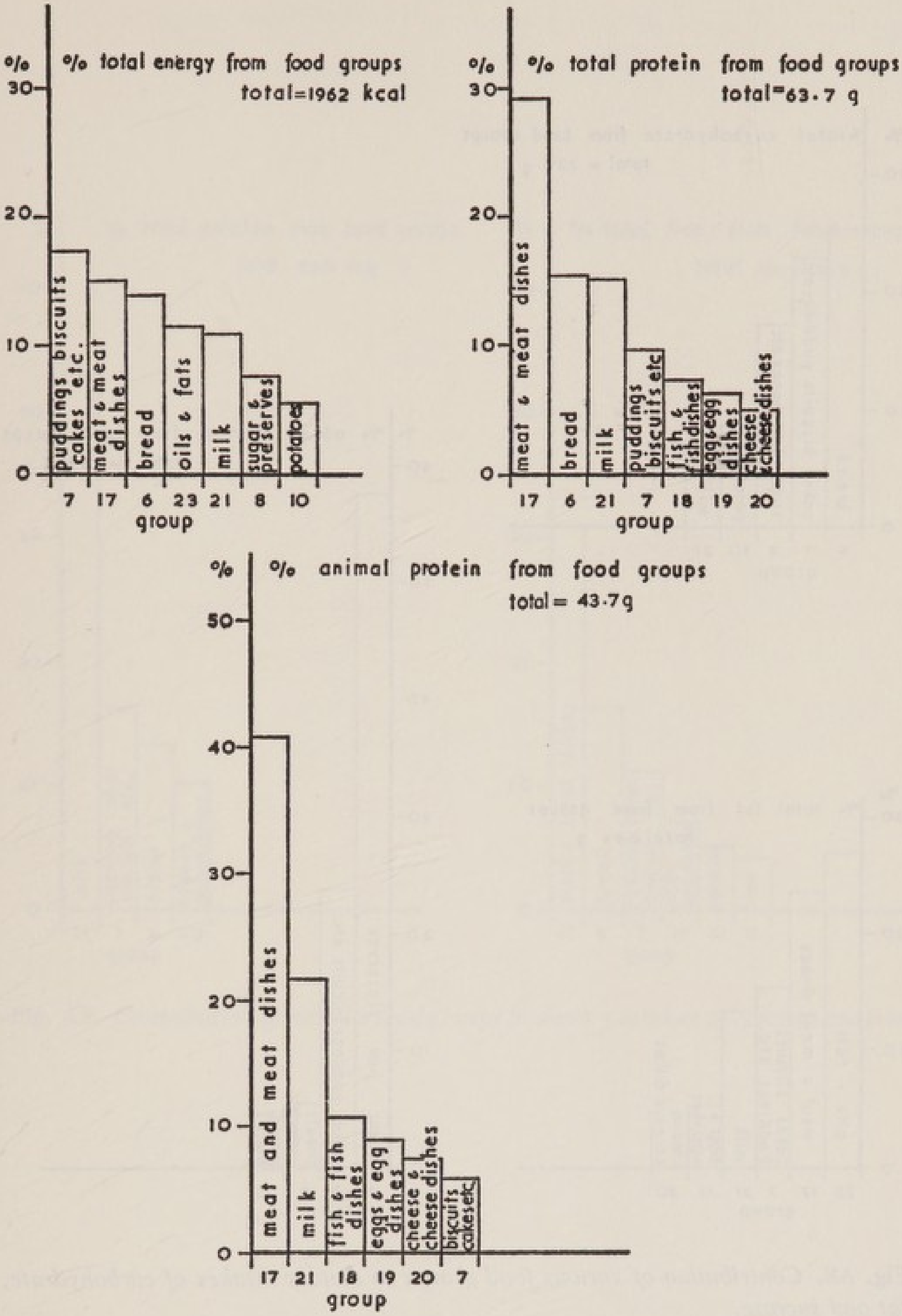

Fig. A7. *Contribution of various food groups to dietary intakes of energy and protein.*

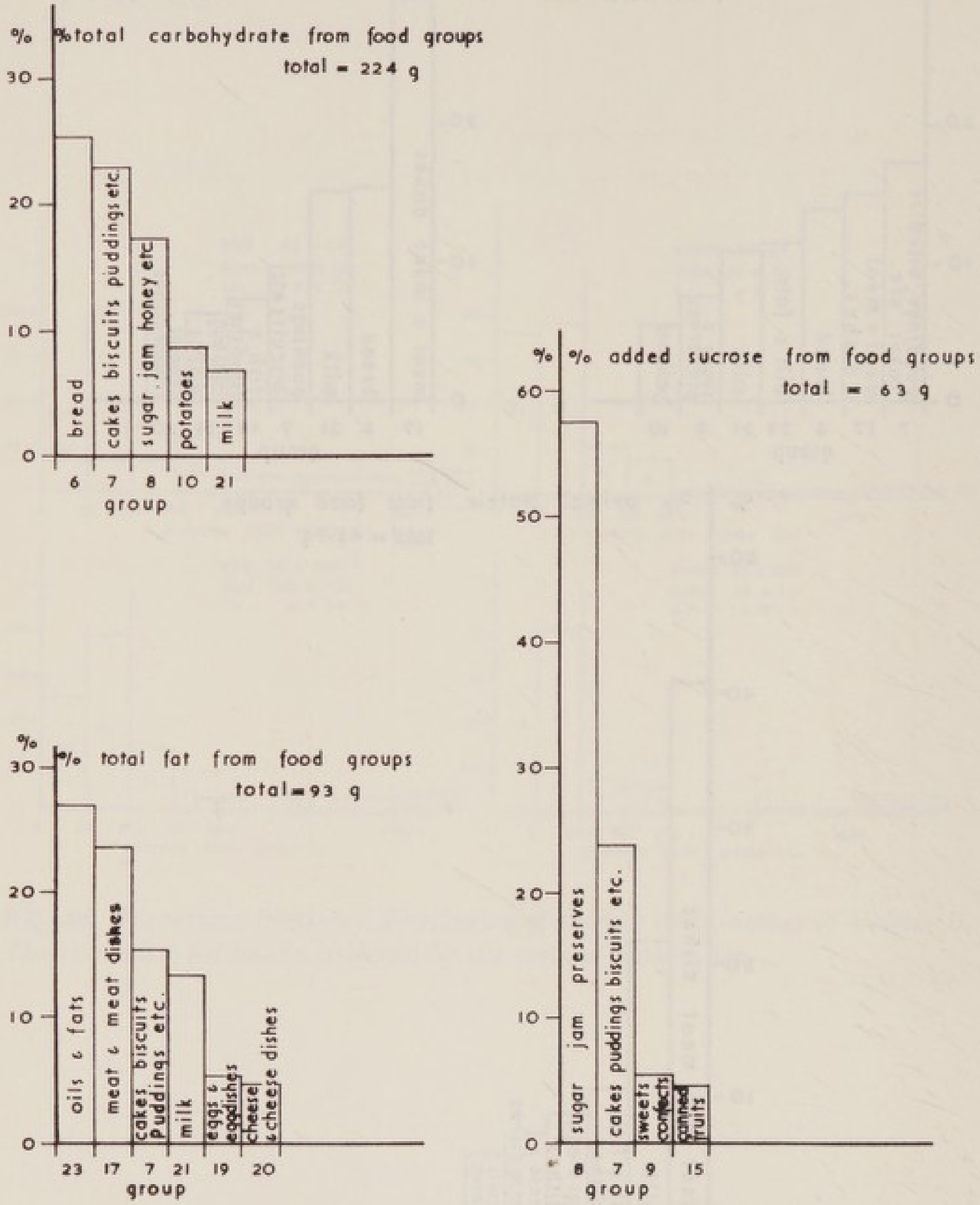

Fig. A8. *Contribution of various food groups to dietary intakes of carbohydrate, fat and sucrose.*

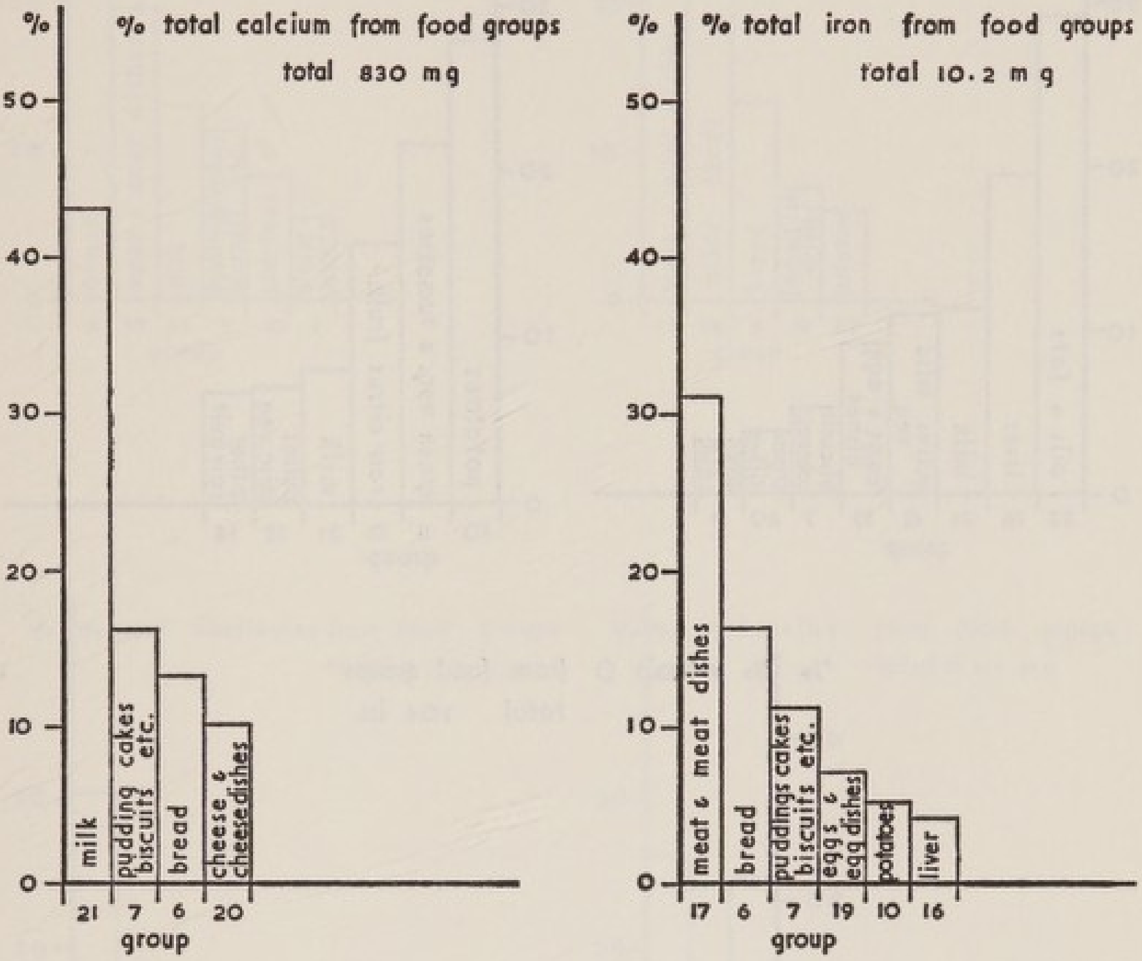

Fig. A9. *Contribution of various food groups to dietary intakes of calcium and iron.*

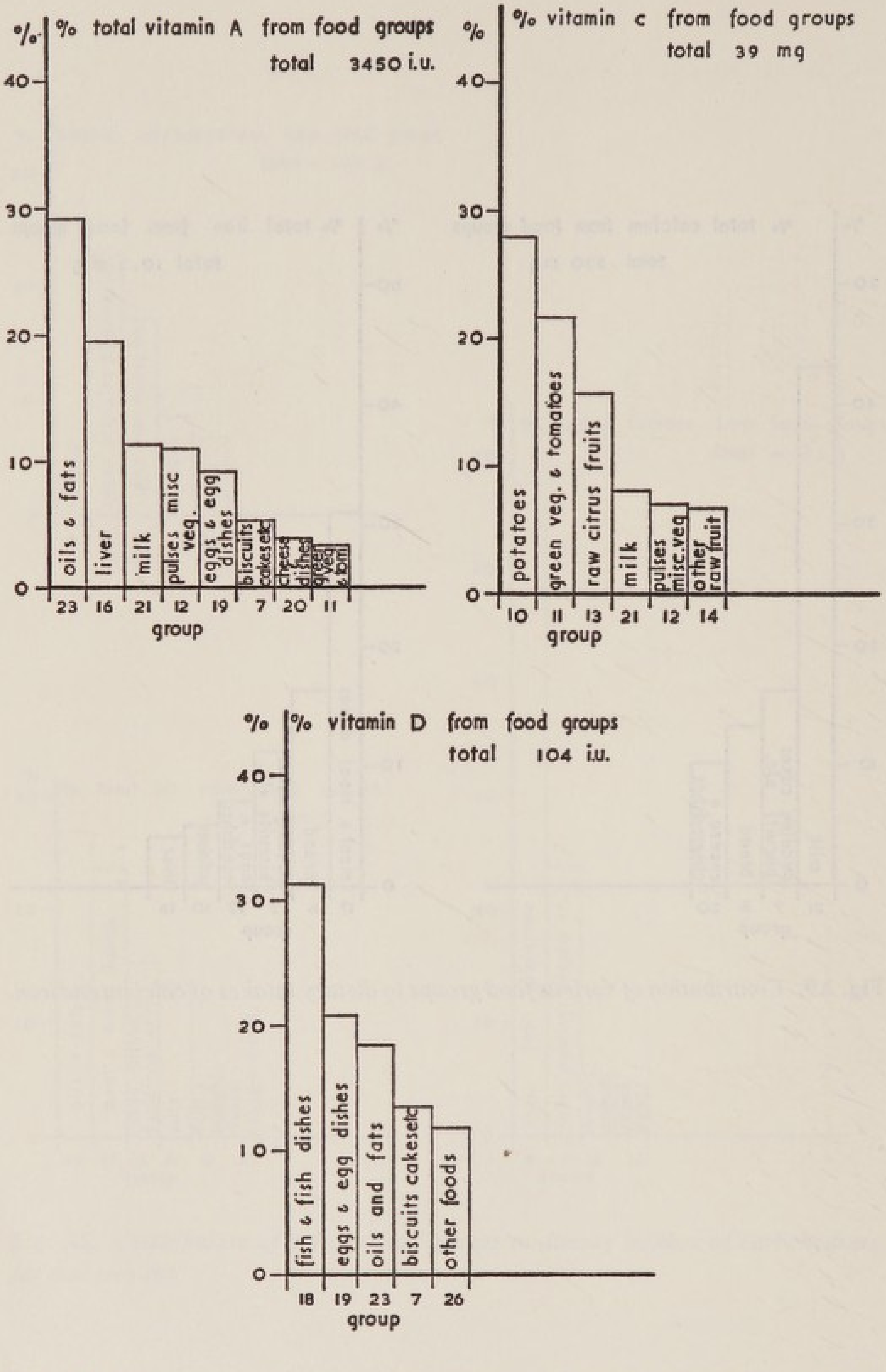

Fig. A10. *Contribution of various food groups to dietary intakes of vitamins A, C and D.*

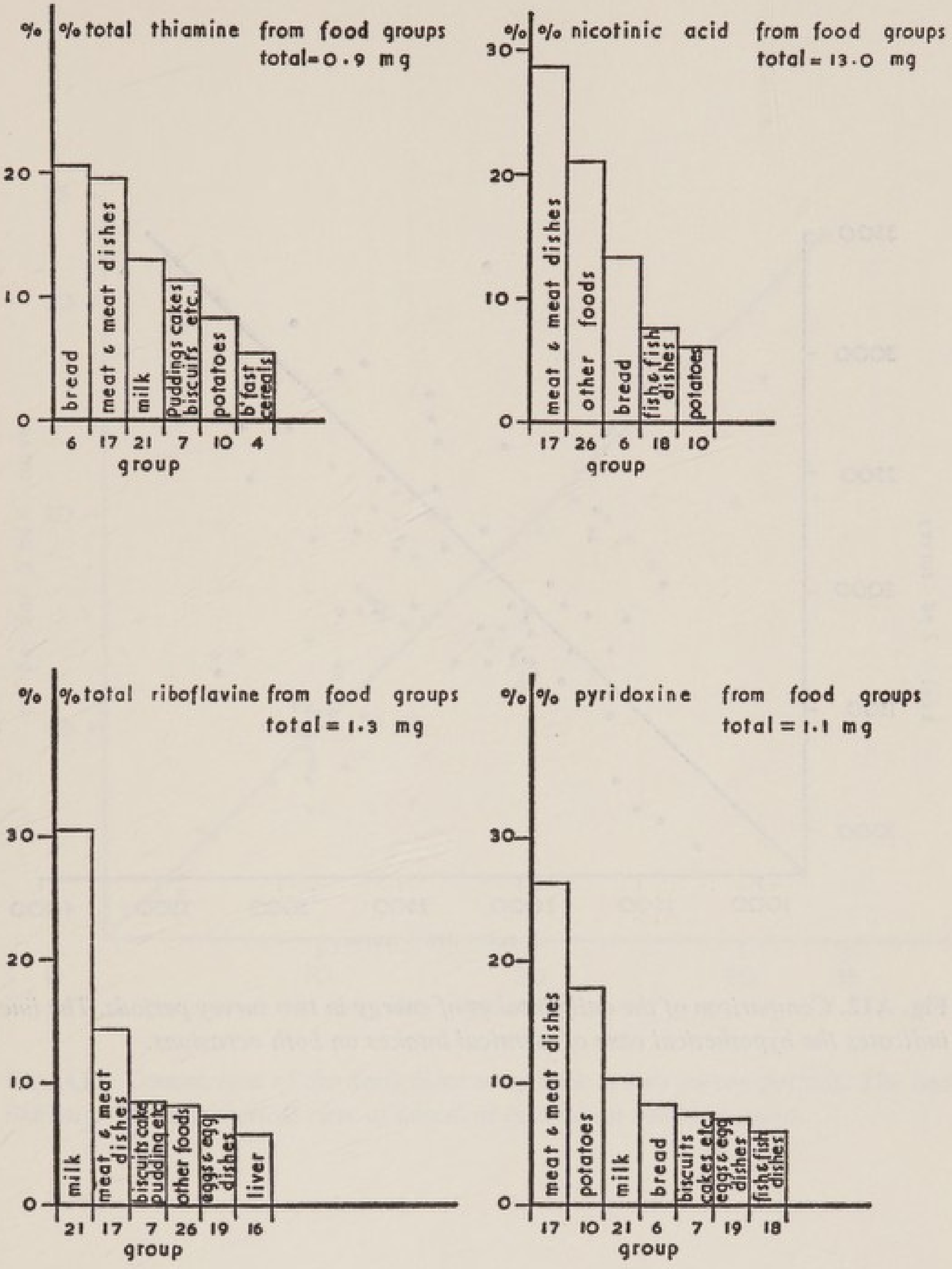

Fig. A11. *Contribution of various food groups to dietary intakes of thiamine, riboflavine, nicotinic acid and pyridoxine.*

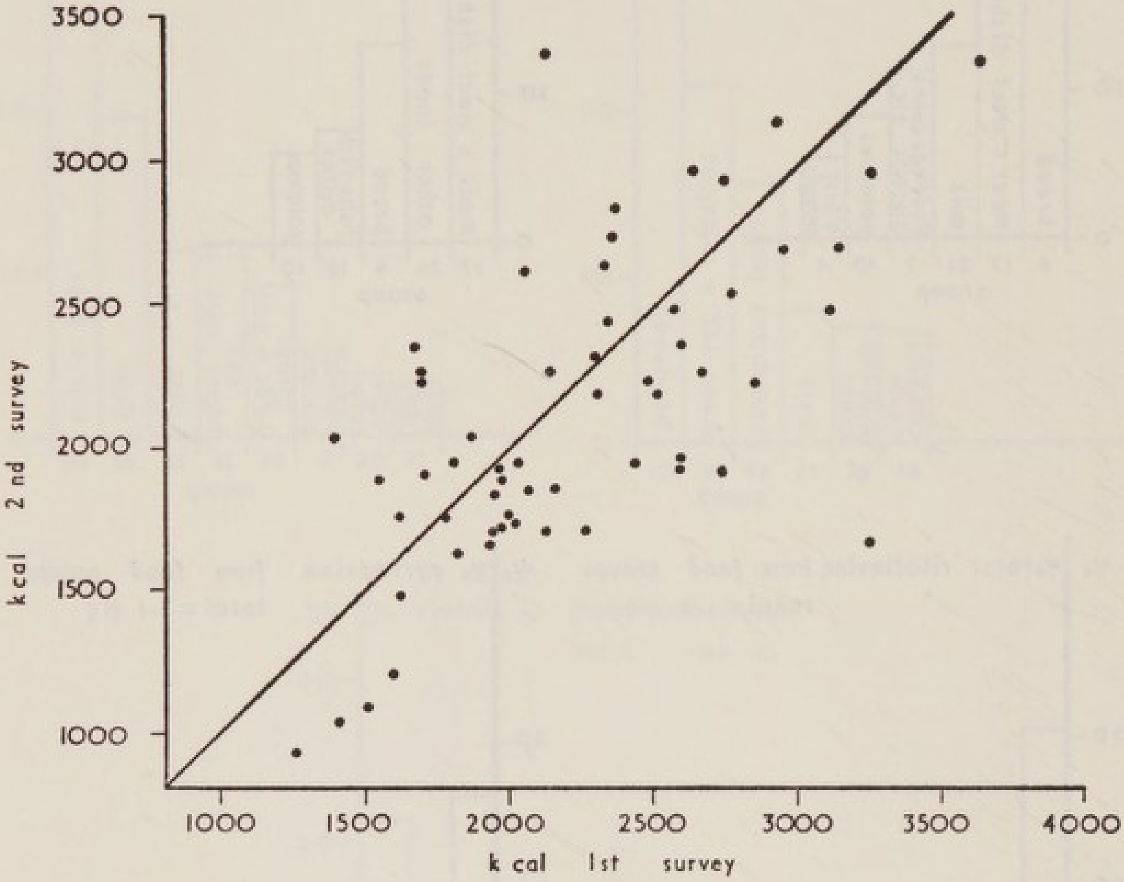

Fig. A12. *Comparison of the daily intakes of energy in two survey periods. The line indicates the hypothetical case of identical intakes on both occasions.*

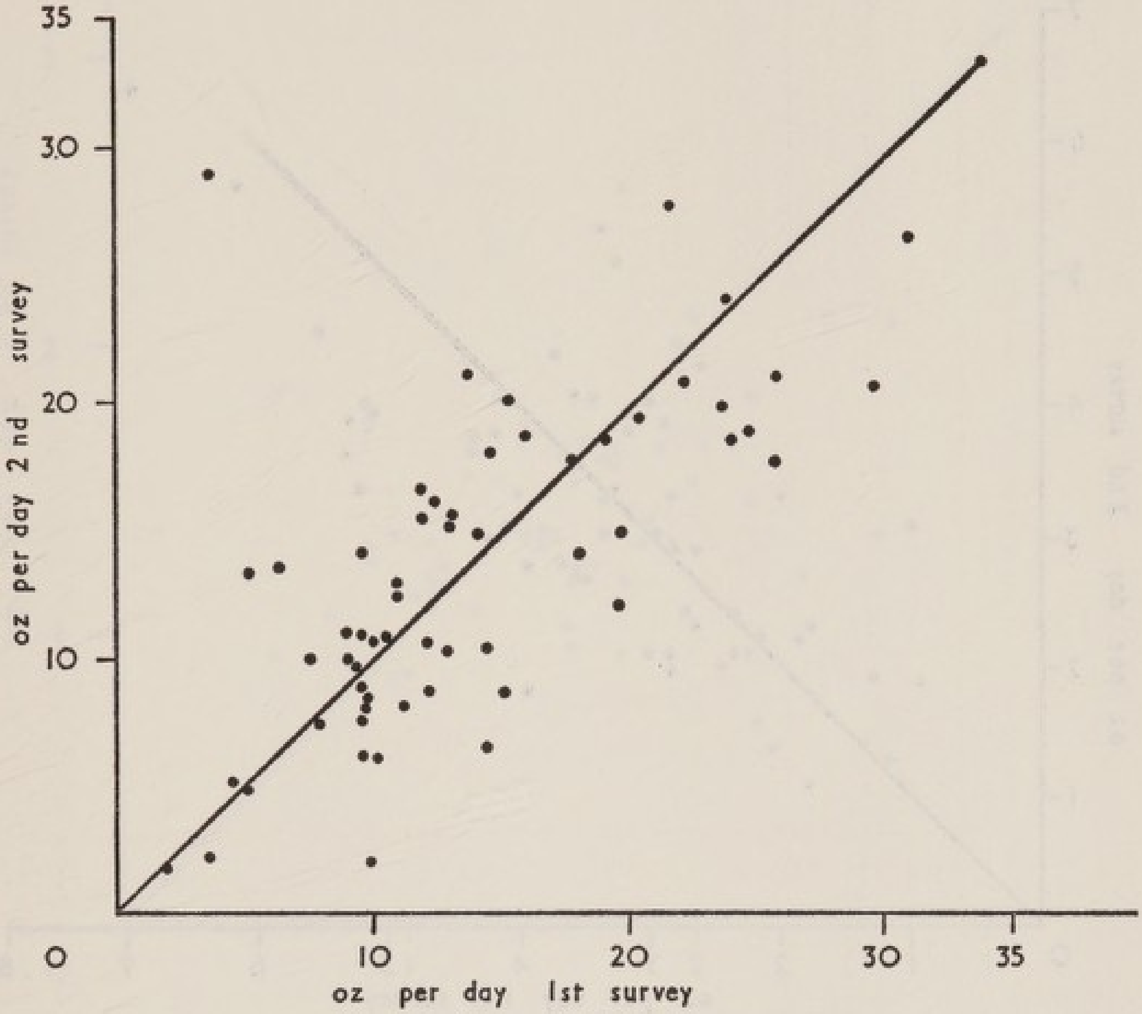

Fig. A13. *Comparison of the daily intakes of milk in two survey periods. The line indicates the hypothetical case of identical intakes on both occasions.*

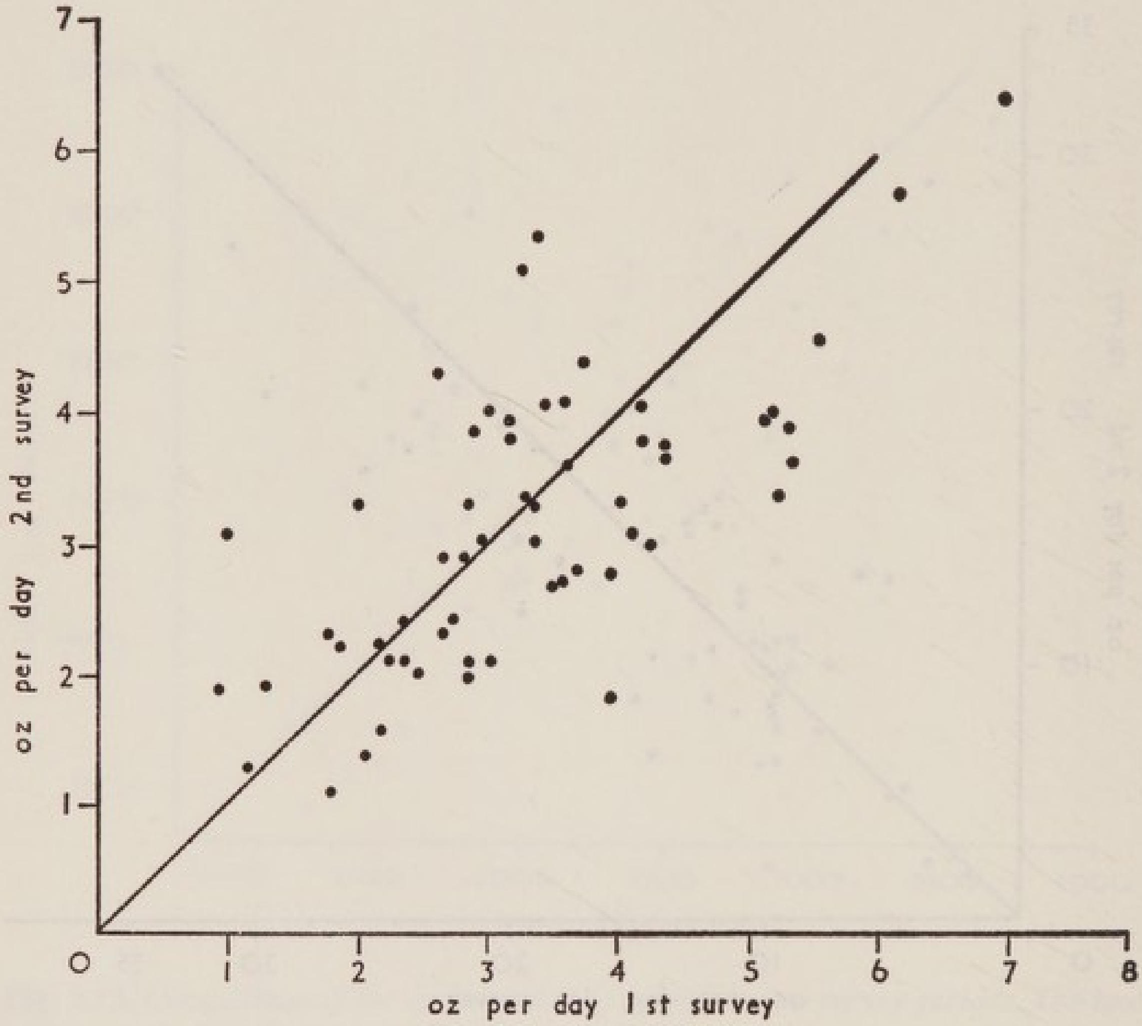

Fig. A14. *Comparison of the daily intakes of meat in two survey periods. The line indicates the hypothetical case of identical intakes on both occasions.*

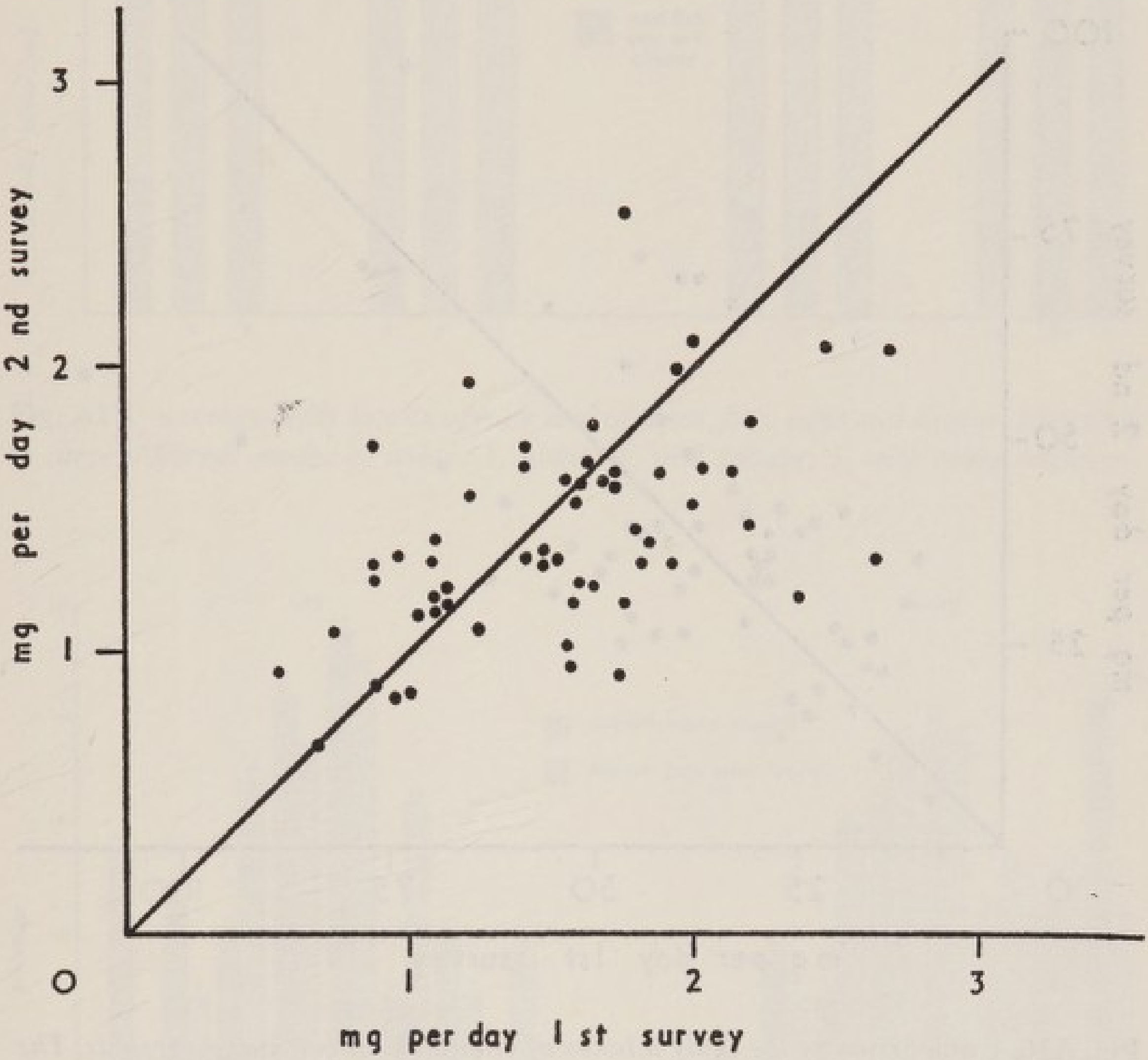

Fig. A15. *Comparison of the daily intakes of riboflavine in two survey periods. The line indicates the hypothetical case of identical intakes on both occasions.*

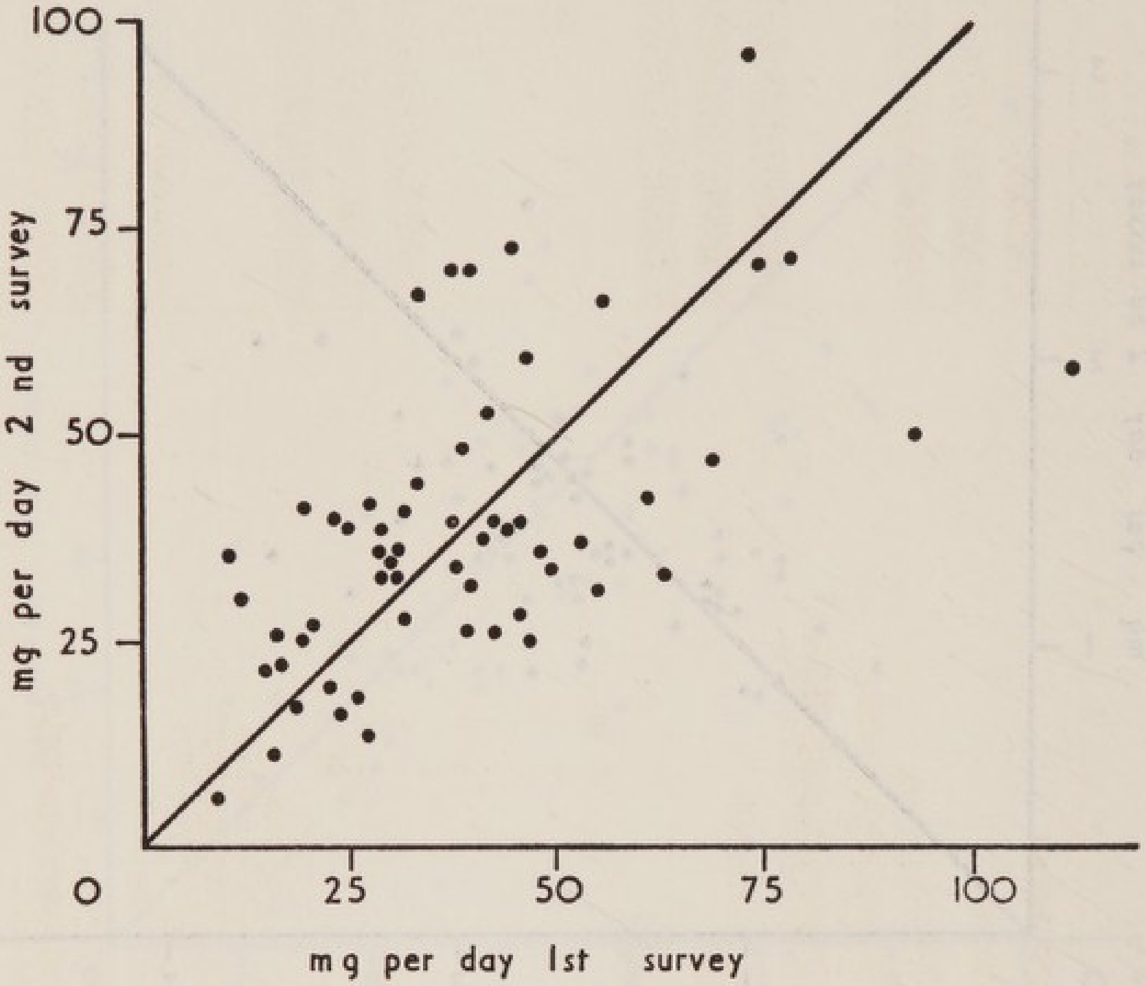

Fig. A16. *Comparison of the daily intakes of vitamin C in two survey periods. The line indicates the hypothetical case of identical intakes on both occasions.*

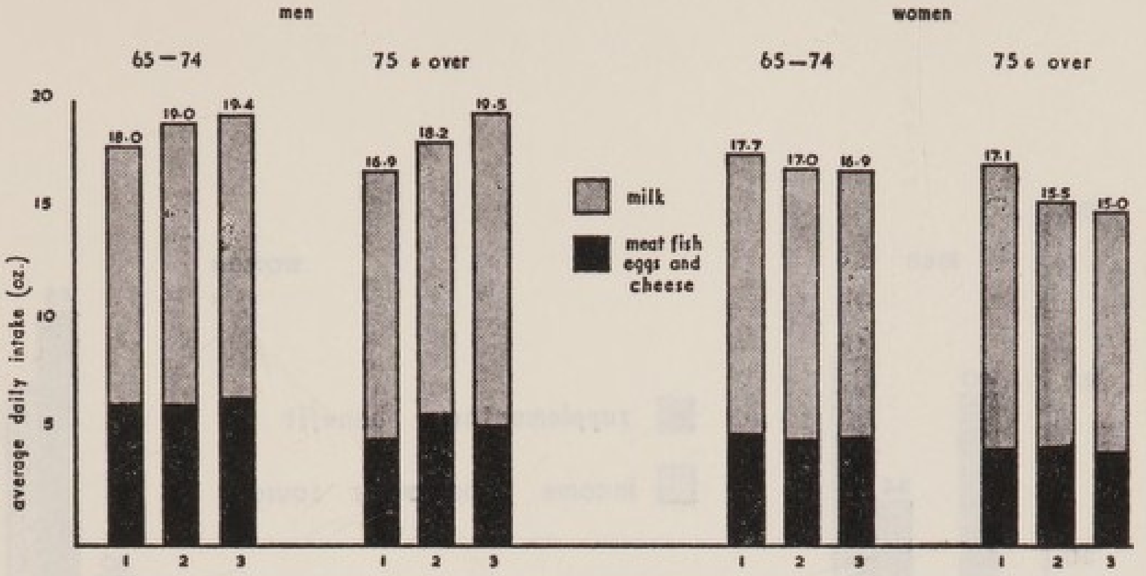

Fig. A17. *Average daily intake of milk and of meat, fish, eggs and cheese according to three different modes of living:* 1, *alone;* 2, *with spouse;* 3, *with other relatives.*

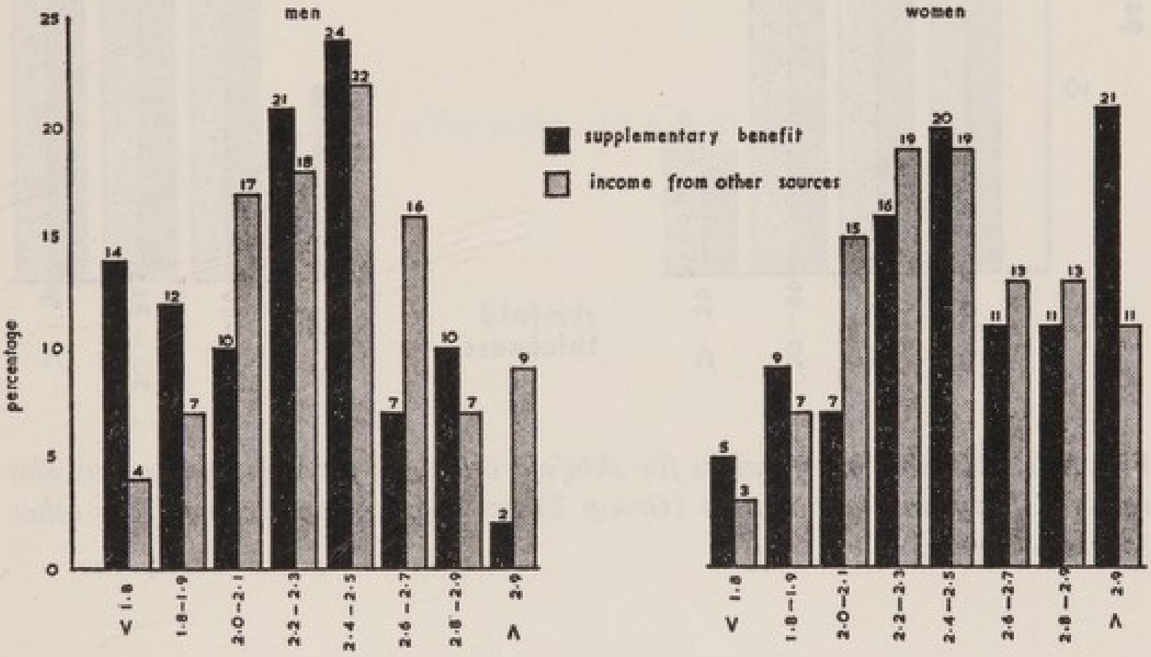

Fig. A18. *Distribution of values for Quetelet's index for men and women who received Supplementary Benefit* (*Group* 2) *or whose income came from other sources* (*Group* 3).

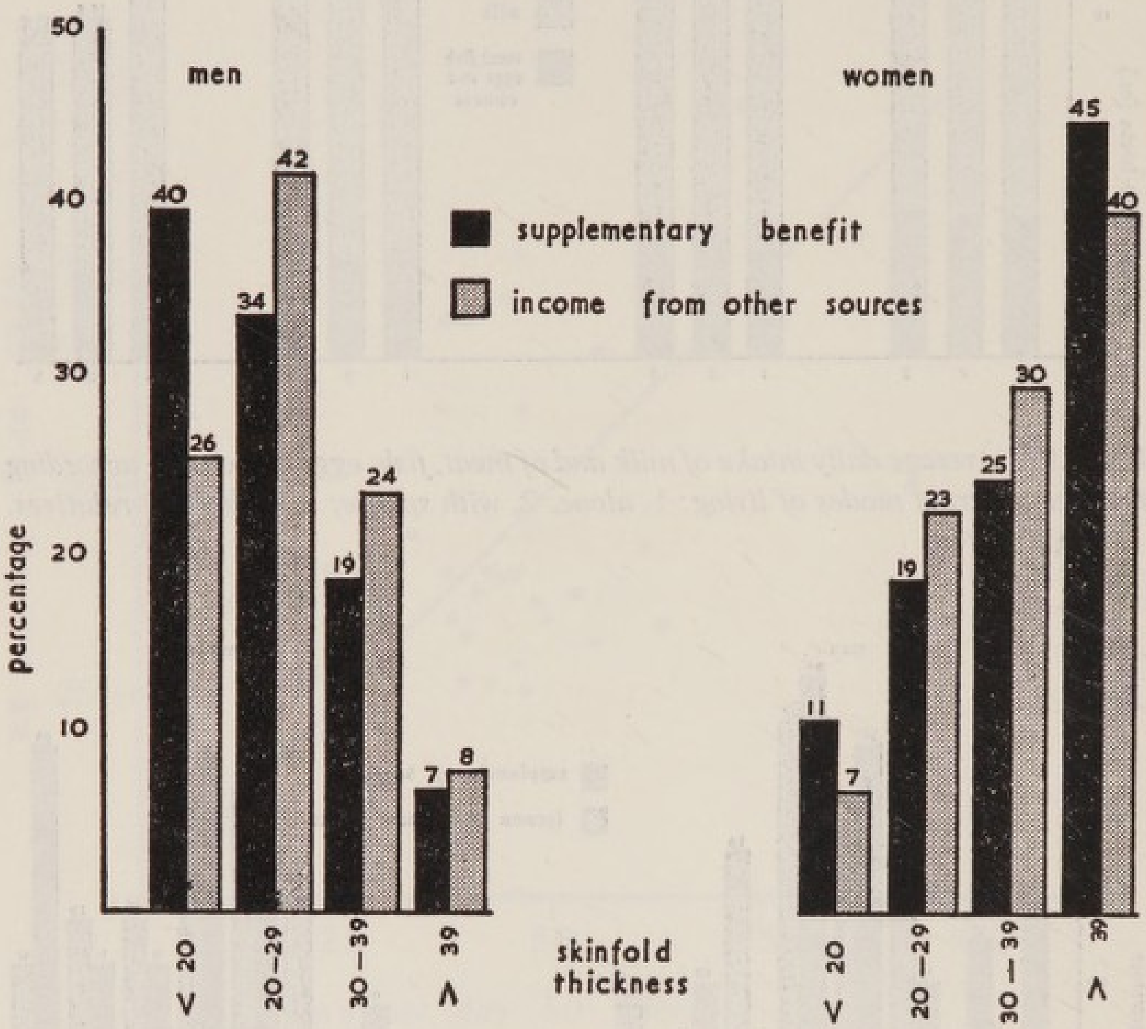

Fig. A19. *Distribution of values for skinfold thickness for men and women who received Supplementary Benefit* (*Group* 2) *or whose income came from other sources* (*Group* 3).

Appendix B

Forms used in the Survey

(For index, see p. viii)

NUTRITION SURVEY OF THE ELDERLY

Dietary History and Meal Pattern Questionnaire

Area ....

Dietary investigator's name ....

Serial number of case...

Surname of subject...

Forenames ....

Address ....

....

....

Record of calls (date and time)

....

....

....

....

....

---

1. If you had anything to eat or drink at these times yesterday, will you tell me what kind of things you had.

BEFORE OR ON RISING

BREAKFAST

MID-MORNING

MID-DAY

MID-AFTERNOON

EVENING

BEFORE RETIRING OR IN BED

---

2. (a) Is this your normal pattern? Yes/No

   (b) If not, what are the principal ways in which it varies?

3. (a) Is the pattern about the same at the weekends? Yes/No

(b) If not, what are the principal ways in which it varies

4. (a) Do the amounts vary very much from day to day? Yes/No

(b) If yes, in what ways do they vary?

5. Are you on a special diet? Yes/No

If yes, please give details

6. About how much of the following foods do you buy each week?
In any instance where you buy none or very little, can you tell me why (e.g. dislike, health reason, religious belief, cost, difficult to get or prepare, no teeth).

Would you like to have more of them?

	How much	*If little or none bought—reason*	*Like more of (tick items)*
Bread			
Butter			
Margarine			
Cheese			
Eggs			
Milk			
Fresh fruit			
Vegetables			
Cereals			
Meat			
Fish			
Tinned foods			
Sweets			
Sugar			
Alcohol			

7. Are there any other particular foods you do not eat for the reasons given at question 6 or other reasons

Foods	*Reasons for not eating*

8. How many slices of bread did you eat yesterday? If none, state

	Large loaf	*Small loaf*
Average slice	....	....
Extra thin	....	....
Extra thick	....	....
Rolls	....	

9. (a) How many cups of tea did you drink yesterday? ....

(b) How much sugar did you have in each cup of tea

None

Levelled teaspoons ....

Heaped teaspoons ....

(c) Do you take milk in your tea Yes/No

10. (a) How many cups of coffee did you drink yesterday? ....

(b) How much sugar did you have in each cup of coffee

None

Levelled teaspoons ....

Heaped teaspoons ....

(c) How much milk did you have in each cup of coffee

None

$\frac{1}{8}$ cup

$\frac{1}{4}$ cup

$\frac{1}{2}$ cup

$\frac{3}{4}$ cup

All

11. (a) How many cups of any other beverage that contains milk and/or sugar did you drink yesterday..................

(b) How much sugar did you have in each cup of this beverage

None

Levelled teaspoons ....

Heaped teaspoons ....

(c) How much milk did you have in each cup of this beverage

None

$\frac{1}{8}$ cup

$\frac{1}{4}$ cup

$\frac{1}{2}$ cup

$\frac{3}{4}$ cup

All

12. How many glasses or cups of milk did you drink yesterday..................

13. If you had a breakfast cereal yesterday (a) how much milk did you add

None

$\frac{1}{4}$ pint

$\frac{1}{2}$ pint or more

(b) How much sugar did you add

None

Teaspoons ....

Dessertspoons ....

14. Do you take any vitamin supplements, medicinal foods or medicines Yes/No

If yes, please give details
(Interviewer to explain what kind of preparations this covers)

NUTRITION SURVEY OF THE ELDERLY

Medical examination

For office use

Area...

Name of examining clinician ....

Name and address of patient ....

....

....

....

Age (years) ....

Sex ....

Clinician's own reference number for patient...........

....

Date of medical examination...............................

If any part of the examination is refused, state presumptive reason

COMPLETION OF FORM

1. When completing the rest of this form, column 2 should be ticked if a subject refuses to answer a question or be examined. If an answer or examination is not obtained for other reasons, column 3 should be ticked.
2. Where questions have alternative answers, delete those which do not apply. Otherwise, answer in the space provided as indicated or by ticks in column 1.
3. **Column 4 should not be used.**

	(1)	Answer or exam refused (2)	Answer or exam not obtained (3)	For office use (4)
Mobility				
1. (a) Bedfast —unable* to get out of bed				
(b) Bedfast —able to get in and out of bed with help				
(c) Housefast —unable* to cook				
(d) Housefast —able to cook				
(e) Not housefast —unable* to shop				
(f) Not housefast —able to shop				
2. Unless answer to question 1 is (f), indicate whether cause of immobility is due to disease of				
Joints				
Bones				
Feet				
C.V.S.				
Lungs				
Eyes				
Ears				
C.N.S.				
Genito-urinary system				
Other site				
Medication (Unless none, consult patient's G.P.)				
3. None				
Barbiturates				
Tranquillisers				
Aspirin (or aspirin containing analgesics)				

* Unable = physical or mental impairment, not disinclination.

	(1)	Answer or exam refused (2)	Answer or exam not obtained (3)	For office use (4)
Vitamins				
Iron				
Other (specify)				
Alcohol and tobacco 4. Addictive alcohol Yes/No				
5. Smoker Yes/No If yes—cigarettes, number per week.................. —pipe, ounces tobacco per week...............				
Medical history 6. Tick if positive Gastrointestinal trouble				
Malabsorption				
Diarrhoea				
Constipation				
Bleeding piles				
Operation (scars)				
7. Back pain (none/constant/intermittent/on movement				
8. If female, number of pregnancies...............				
9. Patient's own assessment of health Good/fair/poor				
10. Patient's own assessment of weight Gaining/steady/losing				
11. Is patient slow moving Yes/No				
Anthropometric PLEASE GIVE IN CM. AND KG. IF POSSIBLE 12. Height ....in. or..............cm.				
13. Leg length ....in. or..............cm.				
14. Ask patient—height in youth (if known) ....in. or..............cm.				

	(1)	Answer or exam refused (2)	Answer or exam not obtained (3)	For office use (4)
15. Weight...............lb. or...............kg. (Broadly indicate clothing worn)				
16. Skinfold thickness (mean of 3 tests) —triceps.......................mm. —subscapular....................mm.				
17. Arm circumference at mid-point of upper arm ....in. or...............cm.				
18. Grip Right ....lb. Left ....lb. Is patient right handed Yes/No				
19. Kyphosis O/+/++				
Medical and nutritional findings 20. E.C.G. number abnormal findings				
21. Pulse rate More than 90/60–90/less than 60				
22. Rhythm—regular				
—irregular, auricular fibrillation				
—irregular, extrasystoles				
23. Radial vessel wall Normal/thickened				
24. Blood pressure................. / ....mm.				
25. Oedema None/generalised/local (specify)				
26. Clinician's assessment of general condition (allowing for age of patient) Much better than average				
Better than average				
Worse than average				
Much worse than average				

		Answer or exam refused	Answer or exam not obtained	For office use
	(1)	(2)	(3)	(4)
27. Wasted (i.e. cachectic or undernourished) Yes/No				
28. Tongue surface normal Yes/No If no, complete *each* of the following (i) Papillae filiform —Normal				
White, thick, furry				
Partial loss				
Total loss				
(ii) Papillae fungiform —Normal				
White, small				
Intermediate				
Some large red				
Many large red				
(iii) Fissuring Absent/longitudinal/longitudinal and transverse (iv) Raw inflamed tongue Yes/No (v) Geographical tongue Yes/No (vi) Smooth atrophic tongue Yes/No				
29. (i) Sublingual haemorrhages O/+/++ (ii) Sublingual varicosities Present/Absent				
30. Gums—gingivitis Present/Absent scurvy Present/Absent				
31. Teeth or dentures Mastication efficient/inefficient				
32. Mouth —angular stomatitis Present/Absent —cheilosis Present/Absent —salivation Present/Absent				
33. Nasolabialfold Normal/red/red and seborrhoeic				
34. Eyes —palpebritis Yes/No —blepharitis Yes/No —conjunctivitis Yes/No —arcus senilis Yes/No —Snellens $\frac{6}{24}$ with glasses Yes/No				

	(1)	Answer or exam refused (2)	Answer or exam not obtained (3)	For office use (4)
35. Hearing (with aid if worn) —can/cannot hear normal speech at one yard				
36. Tremor—hands Yes/No —lips Yes/No —jaw Yes/No				
37. Sheet haemorrhages into skin Yes/No				
38. Petechiae arms or legs Yes/No				
39. Pupura (senile) Yes/No				
40. Skin (exposed) Normal/pigmented/probable pellagra				
41. Transparent skin on dorsum of hand Yes/doubtful/No				
42. Royston's sign legs or arms Yes/No				
43. Skin —Rheumatoid nodules				
—Gouty tophi				
—Xanthomata				
—Redundant skin folds				
—Hyperkeratosis				
—Osteoarthritis				
—Eczema				
—Ulceration				
—Erythema ab igne				
—Varicose veins				
—Peripheral vascular insufficiency				
44. Hands—flat nails Yes/No — clubbing Yes/No				
45. Peripheral neuritis Yes/No				

	(1)	Answer or exam refused (2)	Answer or exam not obtained (3)	For office use (4)
46. Mental state—(a) very alert for age				
(b) normal				
(c) abnormal				
If (c), complete each of the following Agitated Yes/No Depressed Yes/No Obviously forgetful Yes/No Wandering Yes/No Demented Yes/No				
47. Millard's index of deterioration Association score .... Vocabulary score				
48. Speech Intelligible/not intelligible				
49. Malnutrition Present/Absent If present, specify (i) Type (e.g. scurvy, pellagra) .... (ii) Precipitating factors Medical diagnosis....................................... .... Social and/or economic..............................				
50. Important medical conditions affecting health—specify				

	(1)	Answer or exam refused (2)	Answer or exam not obtained (3)	For office use (4)
51. Chest clinically clear Yes/No If no, give details of X-ray findings				
52. Lymphatic system—lymph nodes Enlarged/not enlarged				
53. Diagnosis				
54. X-ray of hands for bone density) (cortical thickness of metacarpal) Right...............................mm. Left ....mm.				

If no blood/urine taken, complete page 1 of STAT. NS/10 PART B and attach

If blood/urine taken.

Blood/urine and form STAT. NS/10 PART B sent to biochemist on

....

....

Form STAT. NS/10 PART B returned on..............................and attached.

....
signature of clinician

....
date

NUTRITION SURVEY OF THE ELDERLY

Social and economic questionnaire

Area ....

Dietary investigator's name..

Serial number of case.......................

Surname of subject...

Forenames...

Address ....

....

....

FOR OFFICE USE

Information to be obtained about subject

1. Age (years) ....
2. Sex ....
3. Marital status
   Single
   Married
   Widowed/divorced—within last 6 months
   —6 months but under 12 months
   —1 year but under 2
   —2 years but under 3
   —3 years but under 4
   —4 years but under 5
   —5 years but under 10
   —10 years or more
4. If spouse living, age of spouse.......................................
5. Number of children still living......................................
6. (i) Occupation or previous occupation (In the case of women who are or have been married, their husband's occupation)

   ....

   (ii) Self-employed Yes/No

   (iii) If no, by what type of organisation employed (e.g. private firm, local government, civil service)

   ....

   (iv) Grade or type of position (manager, foreman, etc.)

   ....

FOR OFFICE USE

7. Are you working
   Full time/part-time (less than 30 hours per week/not at all)

8. Year of retirement (subject or husband as in question 6)

   ....

9. Household—living alone
   —with spouse only
   —with spouse and other relatives*
   —without spouse, with other relatives*
   —boarding with people other than relatives and paying for meals and room
   —other

   (* approximate ages of other relatives to be given)

10. Do you receive regular visits from
    —relatives
    —friends or neighbours
    —local authority officers
    —welfare or voluntary helpers
    —privately employed helpers
    —others

11. Do you regularly *receive* any gifts of food Yes/No
    If so, how often and what kind of things

12. Do you regularly *give* any gifts of food Yes/No
    If so, how often and what kind of things

13. Whether or not you actually do it, have you any interest in preparing and cooking meals

14. Do you get any cooked meals from the "meals-on-wheels" service Yes/No

    If *Yes*—how often ....
    —how long have you been having them.................
    —what do they cost...
    —what sort of meals are they usually....................
    —do you think they are very good/good/fair/poor

    If *No* —would you like to have them if they were available Yes/No

FOR OFFICE USE

15. Who usually does most of the shopping
    —yourself
    —spouse
    —other relatives
    —welfare or voluntary helpers
    —privately employed helpers
    —others

16. Who usually prepares *most* of your meals
    —yourself
    —spouse
    —other relatives
    —welfare or voluntary helpers
    —privately employed helpers
    —others

17. Who usually does *most* of the housework
    —yourself
    —spouse
    —other relatives
    —welfare or voluntary helpers
    —privately employed helpers
    —others

18. Do you have meals away from home Yes/No
    If *Yes*, where—club
    —restaurant
    —friends and relatives
    —other places

    If so—how often
    —how long have you been having them
    —what do they cost (if applicable)
    —what travelling is involved (time and cost)

19. What pets do you keep (say if none)

20. The last time you were ill, who came to attend to you (and how did you get in touch)

    ....
    ....
    ....
    ....
    ....
    ....

FOR OFFICE USE

21. Do you (or your spouse) receive
    —State Pension (i.e. retirement or O.A.P.) Yes/No
    —Supplementary allowance Yes/No
    —Employer's pension Yes/No
    —*Regular* income from any other source Yes/No

22. What is your total income minus expenditure on housing (i.e. rent and rates and mortgages)

    £.......................

23. (a) How much do you usually spend a week on food

    £.................s.................

    (b) How many people are fed from this.......................

Interviewer's general assessment

24. Into which of the following categories does the subject appear to fall (Tick only one in each case)

    (i) *Competence:* *Mental* (a) fully alert
    (b) adequate
    (c) confused

    (ii) *Physical* (a) fully mobile and competent
    (b) limited
    (c) helpless

    (iii) Overall dependency (a) independent
    (b) partially dependent on others
    (c) wholly dependent on others

25. *Case History*

    Please give general description of the subject and the living conditions, amplifying where necessary the answers given to specific questions. (Use next page for this.)

INSTRUCTIONS FOR COLLECTION AND DISTRIBUTION OF BLOOD SPECIMENS

1. Using a 30 ml disposable plastic syringe take as much blood as possible (35 ml or more). Dispense:
   2 ml into one sequestrene tube for *HAEMATOLOGY*
   2 ml into one sequestrene tube for *WHOLE BLOOD FOLATE*, B_{12} and B_6
   7 ml into sequestrene for *LEUCOCYTE ASCORBIC ACID.*
   The rest into a Stayne's Universal capped bottle which must be *wrapped in silver foil.*

2. From the sequestrene tube set aside for haematology measure the haemoglobin and PCV, and make three films:
   One film is fixed:
   One stained—May-Grunwald-Giemsa (see, Dacie and Lewis, "Practical Haematology"): and
   One fixed and sent to Professor Mollin by post.
   A break-off capillary tube may be used for measuring Hb and PCV (see Lewis, S. M. and Benjamin, H. (1965) *J. clin. Path.*, **18**, 689).

3. The Stayne's Universal capped bottle should stand at room temperature to allow the clot to retract fully.
   Put it in the *centrifuge* (making sure it is standing on a rubber bung to prevent cracking of the plastic). *Spin* at top speed for 10 minutes.
   Take off the serum carefully with a Pasteur pipette into 2 plastic centrifuge tubes making sure all serum is removed, even if some is bloodstained.
   Then centrifuge the 2 tubes to spin down any red cells so as *to get off all the serum possible.*
   Then transfer the serum from the two tubes into another Stayne's Universal sterilised capped bottle, also wrapped in silver foil.
   If blood has to be sent to more than 1 laboratory it will be necessary to use more than 1 Stayne's Universal bottle as serum will be divided.

4. Mix well the 2 ml sequestrene sample set aside for whole blood folate, B_{12} and B_6:
   (a) Pipette 0·3 ml of blood into a Bijou bottle containing 2·7 ml of distilled water containing 1 g% of ascorbic acid. The ascorbic acid solution should be made up fresh for each batch of haemolysates using the specially provided distilled water and ascorbic acid. This specimen should be labelled—"*Whole Blood Folate*".
   (b) Pipette 1 ml of blood into a Stayne's Universal plastic bottle, also wrapped in silver foil, containing 9 ml of the specially provided distilled water (*without* ascorbic acid) and label—"*Whole blood* B_{12} *&* B_6".

5. The haemolysates and sera are then put in cardboard boxes and packed in dry ice in a Jablo type of container for transport.

Appendix C

Detailed Tables C1–C7
and Figures C1–C11
relating to Special Studies

(For index, see pp. viii and ix)

Table C1

Numbers of subjects with normal and abnormal values[1] for some haematological measurements

Measurement	Range	All persons	Men 65–74	Men 75 and over	All men	Women 65–74	Women 75 and over	All women
Haemoglobin	Normal Men > 13 g/100 ml	620	175	148	323			
	Women > 12 g/100 ml					164	133	297
	Subnormal Men < 13 g/100 ml	49	12	16	28			
	Women < 12 g/100 ml					14	7	21
	Total	669	187	164	351	178	140	318
Serum iron	Normal > 60 μg/100 ml	543	155	136	291	142	110	252
	Subnormal < 60 μg/100 ml	135	32	28	60	37	38	75
	Total	678	187	164	351	179	148	327
Total iron binding capacity	Normal 300–400 μg/100 ml	391	116	100	216	97	78	175
	Lower than normal < 300 μg/100 ml	103	28	40	68	19	16	35
	Higher than normal > 400 μg/100 ml	184	43	24	67	63	54	117
	Total	678	187	164	351	179	148	327
Serum folate	Normal > 6 ng/ml	257	70	55	125	70	62	132
	Borderline 3–6 ng/ml	323	89	81	170	90	63	153
	Subnormal < 3 ng/ml	99	29	26	55	18	26	44
	Total	679	188	162	350	178	151	329
Red cell folate	Normal > 150 ng/ml	547	156	126	282	145	120	265
	Borderline 100–150 ng/ml	81	20	22	42	21	18	39
	Subnormal < 100 ng/ml	24	5	7	12	4	8	12
	Total	652	181	155	336	170	146	316
Vitamin B_{12}	Normal > 200 pg/ml	605	171	138	309	163	133	296
	Borderline 100–200 pg/ml	69	16	22	38	14	17	31
	Subnormal < 100 pg/ml	8	1	4	5	2	1	3
	Total	682	188	164	352	179	151	330
Vitamin B_6	Normal > 3 ng/ml	447	119	104	223	122	102	224
	Borderline 2–3 ng/ml	165	48	40	88	40	37	77
	Subnormal < 2 ng/ml	71	22	19	41	18	12	30
	Total	683	189	163	352	180	151	331

NOTE: [1] See paragraph 1.2, p. 57.

Table C2

Factors examined for statistically significant relationships

Factor 1	Factor 2	Result of test
Hb concentration	Social class	—[1]
	Summarised social class	—
	Mode of living	P = 0·01 for all persons
	Flat nails	—
	Gastrointestinal troubles	NS[2]
	Taking of extra iron	—
	Serum iron	P = 0·01 for all persons
	Serum folate	—
	Red cell folate	—
	Serum vitamin B_{12}	—
	Serum vitamin B_6	—
	Serum albumin	—
	Leucocyte ascorbic acid	—
	Source of income	—
Mode of living	Serum vitamin B_{12}	P = 0·1 for women over 75 (NS all persons)
	Serum folate	NS
	Red cell folate	NS
	Serum iron	NS
Mental state	Serum vitamin B_{12}	NS
	Serum folate	NS
	Red cell folate	NS
	Serum iron	P = 0·05 for all women and for all persons
Taking of tranquillisers and and barbiturates	Serum folate	P = 0·10 for all men P = 0·05 for women over 75 and for all persons
	Red cell folate	—
Efficiency of mastication	Serum vitamin B_{12}	—
Smoking habits	Red cell folate	NS
Clinician's assessment	Serum folate	NS
Tongue papillae (fungiform)	Serum folate	NS
Millard's Index[3]	Serum folate	—
	Red cell folate	—

Factor 1	Factor 2	Result of test
Serum folate	Red cell folate	P = 0·01 for all men, all women and all persons
Serum albumin	Total iron-binding capacity	—

NOTES: [1] — signifies that results were grouped in such a way that small numbers precluded the use of statistical tests.

[2] NS, not significant.

[3] Millard's Index, see p. 139.

NOTE: The totals given by the numbers of persons in the following histograms do not correspond exactly to those in Table C1, p. 149.

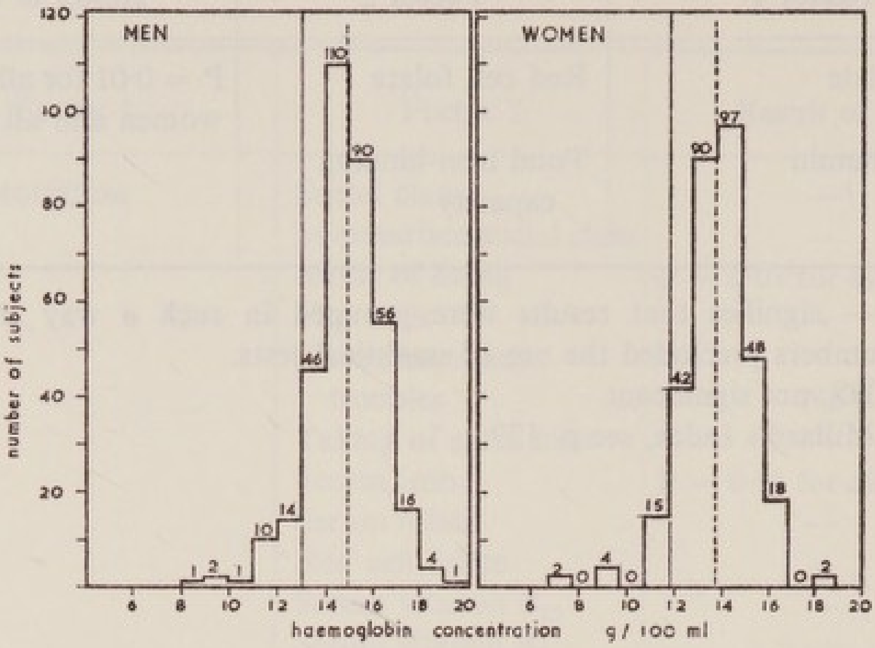

Fig. C1. *Frequency distribution of haemoglobin concentration for men and women. Subnormal and normal ranges are to the left and right respectively of the continuous vertical line. The mean haemoglobin concentration is represented by the broken line.*

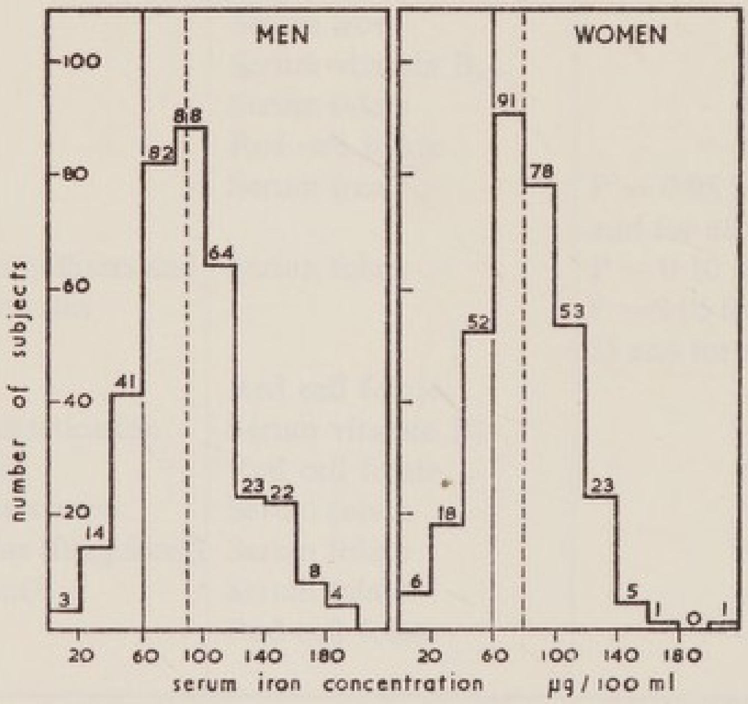

Fig. C2. *Frequency distribution of serum iron concentration for men and women. Subnormal and normal ranges are to the left and right respectively of the continuous vertical line. The mean serum iron concentration is represented by the broken line.*

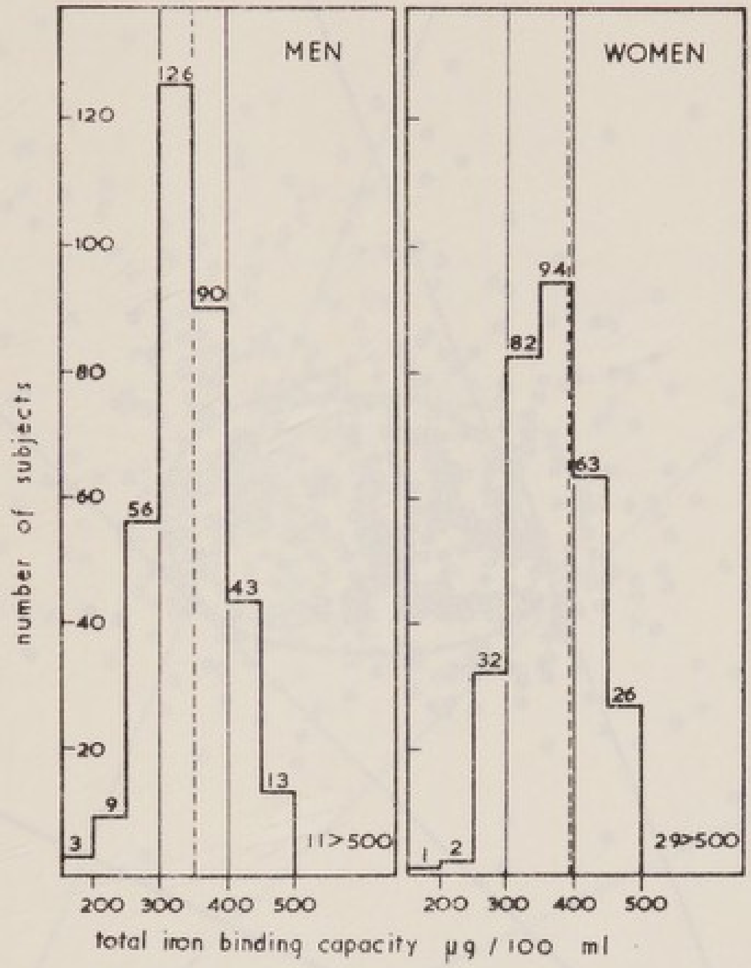

Fig. C3. *Frequency distribution of total iron binding capacity of serum for men and women. The normal range is within the continuous vertical lines. The mean total iron binding capacity is represented by the broken line.*

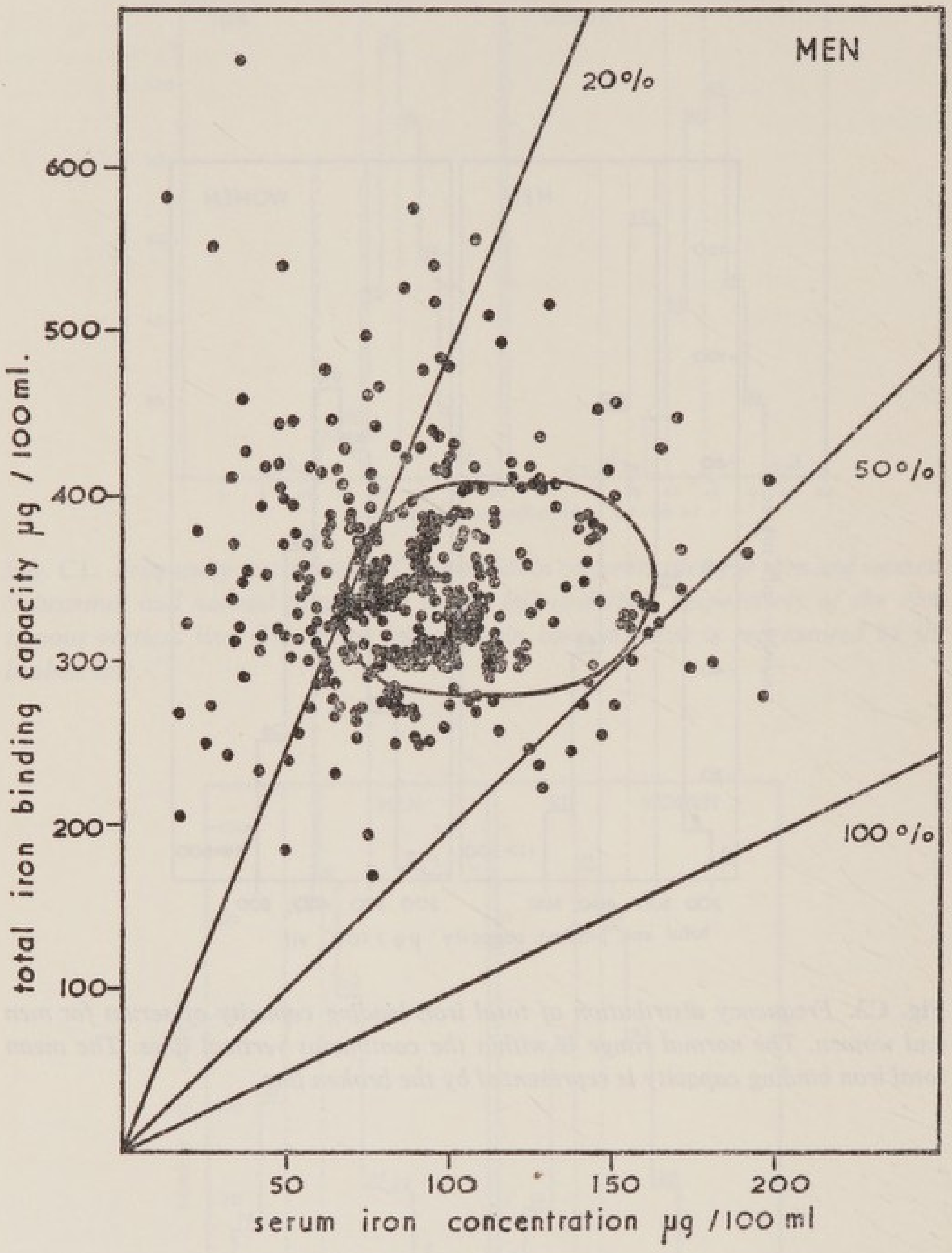

Fig. C4. *Relationship between the serum iron concentration, total iron binding capacity and transferrin saturation in men. The normal range for serum iron and total iron binding capacity is encircled. The lines* 20%, 50% *and* 100% *represent transferrin saturation.*

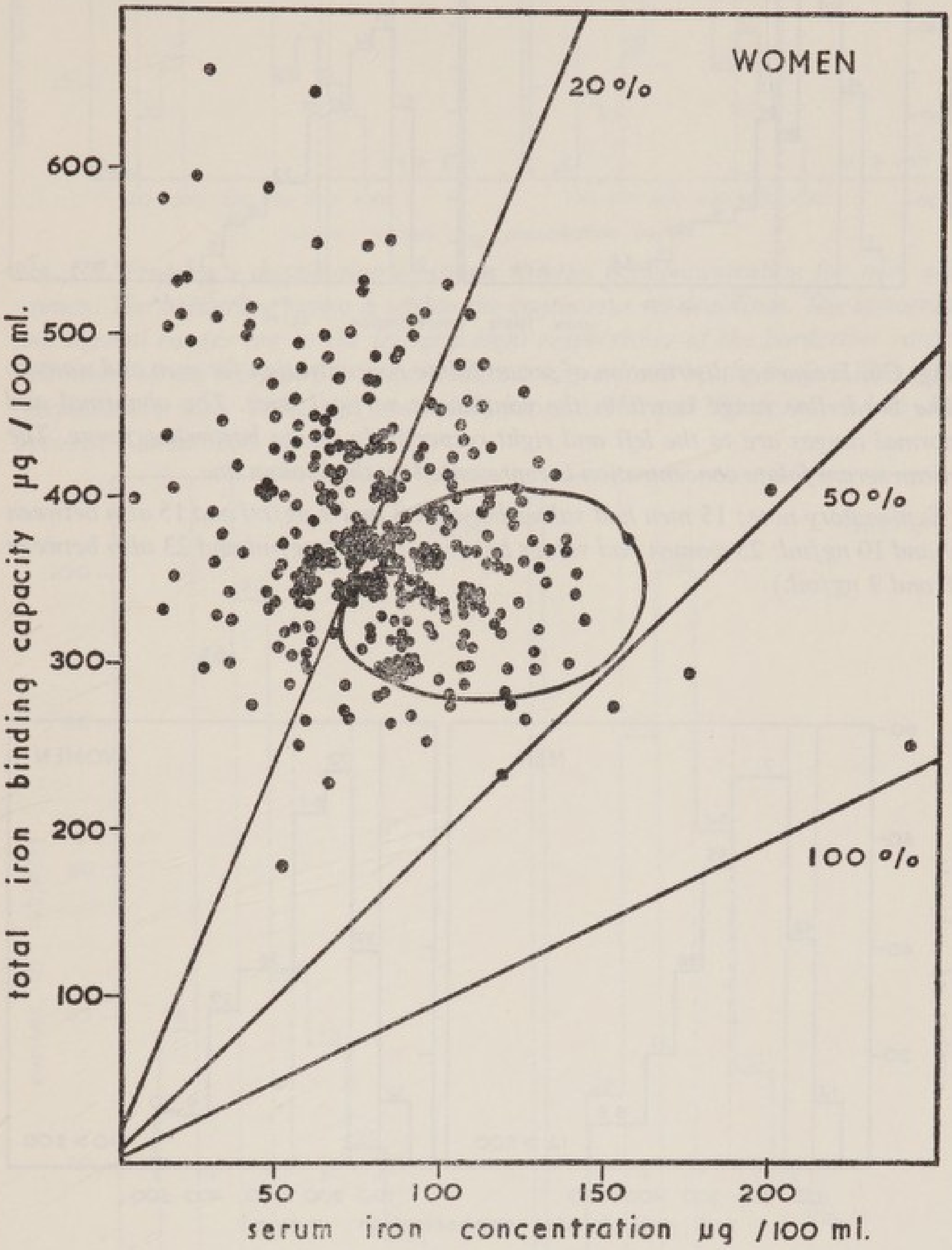

Fig. C5. *Relationship between the serum iron concentration, total iron binding capacity and transferrin saturation in women. The normal range for serum iron and total iron binding capacity is encircled. The lines 20%, 50% and 100% represent transferrin saturation.*

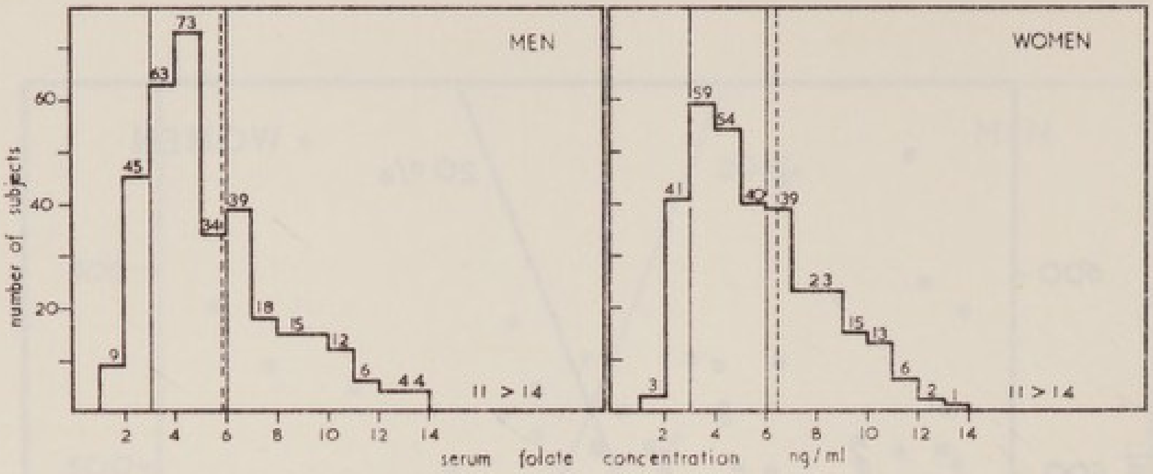

Fig. C6. *Frequency distribution of serum folate concentration for men and women. The borderline range is within the continuous vertical lines. The abnormal and normal ranges are to the left and right respectively of the borderline range. The mean serum folate concentration is represented by the broken line.*

(*Explanatory note:* 15 *men had values between* 8 *and* 9 *ng/ml and* 15 *also between* 9 *and* 10 *ng/ml;* 23 *women had values between* 7 *and* 8 *ng/ml and* 23 *also between* 8 *and* 9 *ng/ml.*)

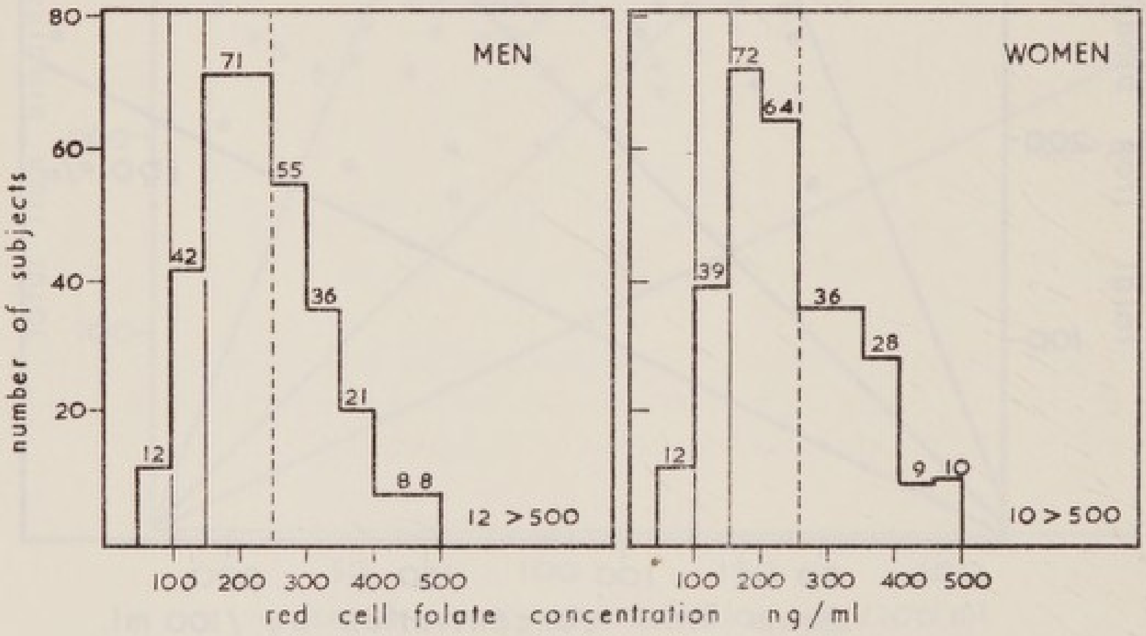

Fig. C7. *Frequency distribution of red cell folate concentration for men and women. The borderline range is within the continuous vertical lines. The abnormal and normal ranges are to the left and right respectively of the borderline range. The mean red cell folate concentration is represented by the broken line.*

(*Explanatory note:* 71 *men had values between* 150 *and* 200 *ng/ml and* 71 *also between* 200 *and* 250 *ng/ml;* 36 *women had values between* 250 *and* 300 *ng/ml and* 36 *also between* 300 *and* 350 *ng/ml.*)

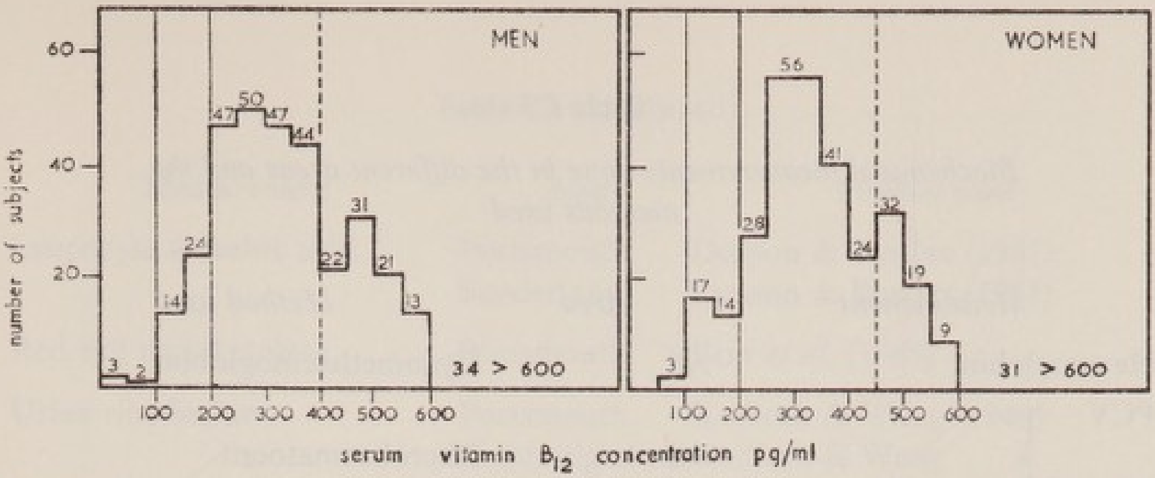

Fig. C8. *Frequency distribution of serum vitamin* B_{12} *concentration for men and women. The borderline range is within the continuous vertical lines. The abnormal and normal ranges are to the left and right respectively of the borderline range. The mean serum vitamin* B_{12} *concentration is represented by the broken line. (Explanatory note: 56 women had values between 250 and 300 pg/ml and 56 also between 300 and 350 pg/ml.).*

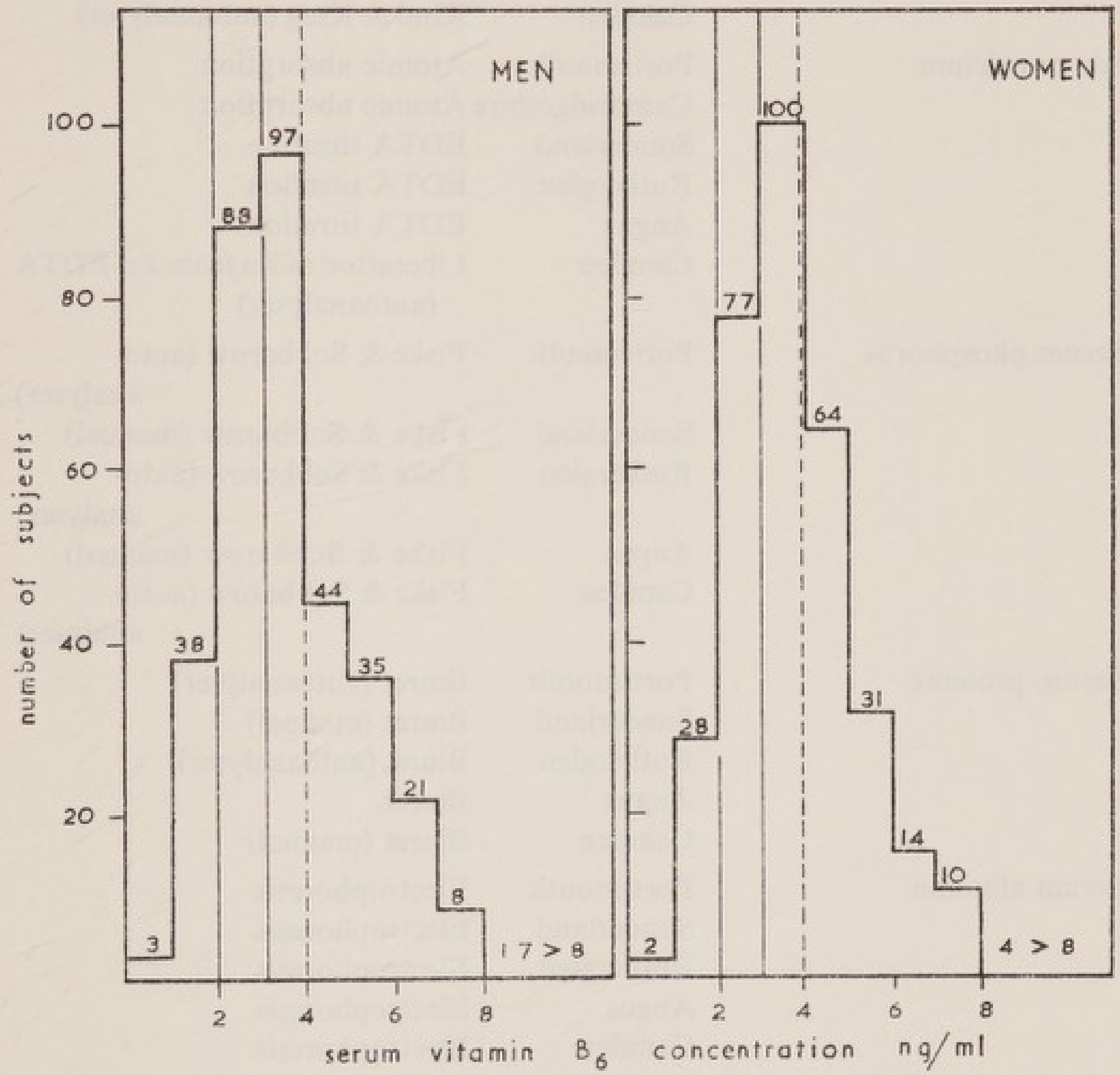

Fig. C9. *Frequency distribution of serum vitamin* B_6 *concentration for men and women. The borderline range is within the continuous vertical lines. The abnormal and normal ranges are to the left and right respectively of the borderline range. The mean serum vitamin* B_6 *concentration is represented by the broken line.*

Table C3

Biochemical measurements done in the different areas and the methods used

Measurement	*Area*	*Method used*
Haemoglobin	All	Cyanmethaemoglobin
PCV, MCHC	All	Microhaematocrit
Serum alkaline phosphatase	Portsmouth	Kind & King (autoanalyser)
	Cambridgeshire	
	Sunderland	King Armstrong (manual)
	Rutherglen	Kind & King (manual)
	Angus	King Armstrong (manual)
	Camden	Kind & King (autoanalyser)
Serum calcium	Portsmouth	Atomic absorption
	Cambridgeshire	Atomic absorption
	Sunderland	EDTA titration
	Rutherglen	EDTA titration
	Angus	EDTA titration
	Camden	Liberation of Zn from Zn-EDTA (autoanalyser)
Serum phosphorus	Portsmouth	Fiske & Subbarow (autoanalyser)
	Sunderland	Fiske & Subbarow (manual)
	Rutherglen	Fiske & Subbarow (autoanalyser)
	Angus	Fiske & Subbarow (manual)
	Camden	Fiske & Subbarow (autoanalyser)
Serum proteins	Portsmouth	Biuret (autoanalyser)
	Sunderland	Biuret (manual)
	Rutherglen	Biuret (autoanalyser)
	Angus	Biuret
	Camden	Biuret (manual)
Serum albumin	Portsmouth	Electrophoresis
	Sunderland	Electrophoresis
	Rutherglen	Electrophoresis
	Angus	Electrophoresis
	Camden	Electrophoresis
Serum pseudocholinesterase	Portsmouth	Biggs *et al.* (1958)
	Sunderland	de la Huerga *et al.* (1952)
	Rutherglen	de la Huerga *et al.* (1952)
	Angus	de la Huerga *et al.* (1952)

Table C3 (continued)

Measurement	*Area*	*Method used*
Leucocyte ascorbic acid	Portsmouth	Denson & Bowers (1961)
	Sunderland	Denson & Bowers (1961)
Red cell transketolase	Portsmouth	Brin *et al.* (1965)
Urine riboflavine	Portsmouth	Kodicek & Wang (1949)
	Cambridgeshire	Kodicek & Wang after load dose

Table C4

Comparison of results on standards sent to areas 1, 3, 4 *and* 5[1] *for haemoglobin measurements*

Sample	Date sent	Haemoglobin (g/100 ml)					P.C.V.					M.C.H.C.				
		1	3	4	5	Barts	1	3	4	5	Barts	1	3	4	5	Barts
A	14 xi 67	15·1	16·2	15·0		14·6	42	45	47		44	36	36	32		33
B		14·0	14·5	14·0		13·7	42	42	45		41	33	35	31		33
C	21 xi 67	13·8	13·9	15·3		12·1	44	42	48		44	31	33	32		27
D		12·7	13·5	13·3		11·2	40	41	43		40	32	33	31		28
E	5 xii 67	16·1	17·1	16·6		15·0	49	49	51		47	33	35	33		32
F		13·8	14·9	14·5		15·0	43	44	46		43	32	34	32		35
G	12 ii 68	16·4	17·3	15·2		14·9		48	46		45		36	33		33
H		14·8	16·2	14·8		14·9		46	44		45		35	34		33
I	12 iii 68	11·5	11·4	11·2	11·0		37	38	37	35		31	30	30	31·5	
J		10·9	10·7	10·6	11·0		35	37	35	34		31	29	30	32·5	
K	30 iv 68	13·0	13·6	13·3	12·8	13·4	42	42·5	42	43	42	31	32	32	30	32
L		14·6	14·6	14·2	13·8	14·0	44	46·0	44	44	45	33	31·7	32	31·5	31
M	11 vi 68	13·7	13·6	13·9	13·4	13·4	42	42·5	42	41	41	33	32	33	32·5	33
N		14·4	15·0	14·4	13·8	14·0	44	46	43	43	43	33	32·6	33	32	33
O	13 viii 68	14·7	14·9	14·5	14·6	13·4	45	44·5	44	44·5	43	33	33·5	33	33	31
P		14·7	14·9	14·5	13·6	14·9	48	46	44	41	43	31	32·4	33	33	35

NOTE: [1] Key to areas: 1 Portsmouth; 3 Sunderland; 4 Rutherglen; 5 Angus; Barts, Haematology Department, St. Bartholomews Hospital, London.

Table C5

Comparison of results on standards sent to areas 1, 3, 4 *and* 5[1] *for protein measurements*

Sample	Date sent	Total protein (g/100 ml)				Albumin (g/100 ml)				Globulin (g/100 ml)				A/G ratio			
		1	3	4	5	1	3	4	5	1	3	4	5	1	3	4	5
1	14 xi 67	7·1	6·6	6·7	7·7	2·8	4·4	4·7	3·5	4·3	2·2	2·0	4·2	0·65	2·0	2·4	0·84
2		7·1	6·5	6·8	7·1	2·7	4·0	4·1	3·3	4·4	2·5	2·7	3·8	0·61	1·6	1·5	0·87
3	21 xi 67	6·5	6·1	6·0	6·1	2·8	4·4	3·7	3·4	3·7	1·7	2·3	2·7	0·76	2·55	1·6	1·26
4		6·8	6·4	6·4	6·7	3·5	4·5	3·3	3·8	3·3	1·8	3·1	2·9	1·06	2·5	1·06	1·31
5	5 xii 67	8·0	7·6	7·4		3·8	4·6	3·8		4·2	3·0	3·6		0·9	1·5	1·07	
6		8·5	8·3	8·4		3·9	4·8	4·3		4·6	3·55	4·1		0·85	1·35	1·05	
7	12 ii 68	7·7	7·8	7·4	5·6	3·2	4·4	3·4	3·0	4·5	3·4	4·0	2·6	0·7	1·3	0·86	1·15
8		7·1	7·5	7·0	5·4	3·5	4·3	4·4	2·9	3·6	1·5	2·6	2·5	1·0	2·9	1·65	1·15
			(5·8)								(3·2)				(1·35)		
9	12 iii 68	6·6	5·8	5·9		3·6	4·4	3·6		3·0	1·4	2·3		1·2	3·24	1·54	
10		6·8	6·2	6·7		3·2	4·8	3·9		3·6	1·5	2·75		0·89	3·3	1·43	
11	7 v 68	6·1	6·0	5·9	7·0	2·9	3·8	3·8	3·7	3·2	2·15	2·1	3·3	0·93	1·78	1·76	1·12
12		5·9	6·2	5·9	6·4	2·5	4·0	3·6	3·4	3·4	2·15	2·3	3·0	0·73	1·87	1·53	1·13
13	11 vi 68	6·7	6·6	6·8	6·6	2·9	4·6	4·1	3·9	3·9	2·0	2·7	2·7	0·71	2·31	1·5	1·45
14		6·9	6·8	7·3	6·8	3·5	5·2	4·9	4·5	3·4	1·6	2·4	2·3	1·04	3·22	2·08	1·95
15	13 viii 68	7·1	6·9	6·8	6·2	3·9	3·6	3·0	4·3	3·2	3·3	3·6	1·8	1·22	1·08	0·78	2·39
16		7·1	7·2	6·9	6·6	3·9	4·5	4·0	4·0	3·2	2·7	2·9	2·6	1·22	1·66	1·35	1·54

NOTE: [1] Areas: 1 Portsmouth; 3 Sunderland; 4 Rutherglen; 5 Angus.

Table C6

Comparison of results on standards sent to areas 1, 3, 4 and 5[1]

Sample	Date sent	Alkaline phosphatase (K.A. units)				Pseudocholinesterase[2]				Calcium (g/100 ml)			Phosphorus (g/100 ml)			
		1	3	4	5	1	3	4	5	1	4	Hammersmith	1	3	4	5
1	14 xi 67	5	6·2	5·0	4·5	111	224	233	226	9·0	9·0	9·3	3·5	3·4	2·9	3·4
2		9	10·0	10·4	8·0	114	227	207	110	9·7	9·8	10·0	3·2	3·0	2·7	3·0
3	21 xi 67	5	6·7	7·0	2·5	120	221	180		9·2	8·8	10·1	3·3	3·7	3·1	3·8
4		4	4·9	5·3	4·5	97	171	102		9·4	9·2	10·4	3·4	3·8	3·5	3·8
5	5 xii 67	7	6·8	5·9		125	196	175		9·5	9·0	9·8	2·5	2·7	2·4	
6		7	6·8	5·2		140	244	255		9·6	9·5	10·8	1·9	1·9	1·8	
7	12 ii 68	6	7·8	8·0	7·5	102	184	189	201	8·9	8·0	9·1	3·4	4·05	3·1	3·2
8		5	5·2	6·0	5·0	102	195	198	169	9·0	9·1	9·3	3·0	3·3	3·0	2·9
9	12 iii 68	3	4·8	2·8		75	128	72		9·3	10·2	9·7	3·8	3·9	3·4	
10		2	3·6	2·0		120	263	185		8·7	10·0	9·7	4·2	4·3	3·7	
11	7 v 68	5	5·4	5·6	3·5	83	196	186	203	8·7	9·7	9·3	3·4	3·1	2·7	3·1
12		5	5·8	5·1	4·5	90	202	189	300	8·7	9·6	9·4	3·5	2·9	3·0	3·2
13	11 vi 68	6	7·7	5·5	6·5	123	288	184	214	9·5	9·8	10·0	3·6	3·6	3·2	3·7
14		5	5·6	4·8	5·0	100	203	168	200	9·0	9·5	10·0	2·4	2·4	2·2	2·8
15	13 viii 68	4	7·3	5·2	4·5	88	171	42	135	8·5	9·1	9·2	3·2	2·9	3·3	
16		2	4·3	4·0	3·0	103	204	144	181	8·6	9·0	9·9	3·7	3·8	3·7	

NOTES: [1] Areas: 1 Portsmouth; 3 Sunderland; 4 Rutherglen; 5 Angus.
[2] Done in Area 1 by Biggs, Carey, Morrison method which gives results approximately half those of the others.

Table C7

Some biochemical and dietary information on twelve subjects in one area who had been diagnosed as being protein-calorie malnourished

Sex and age of subjects		Serum albumin (g/100 ml)	Serum pseudo-cholinesterase	Dietary protein (g/day)	Energy (kcal/day)
M	74	4·3	292	33·8	945
M	83	3·1	156	60·0	1,870
M	82	3·7	146	66·1	2,430
M	77	3·9	164	81·0	1,785
F	66	5·2	213	92·6	2,002
F	68	3·8	212	57·0	1,534
F	71	3·6	67	82·3	2,907
F	83	3·2	139	69·1	1,845
F	89	3·3	198	30·7	1,068
F	79	3·8	177	33·6	954
F	77	4·1	162	52·8	1,936
F	78	4·8	191	65·5	1,686

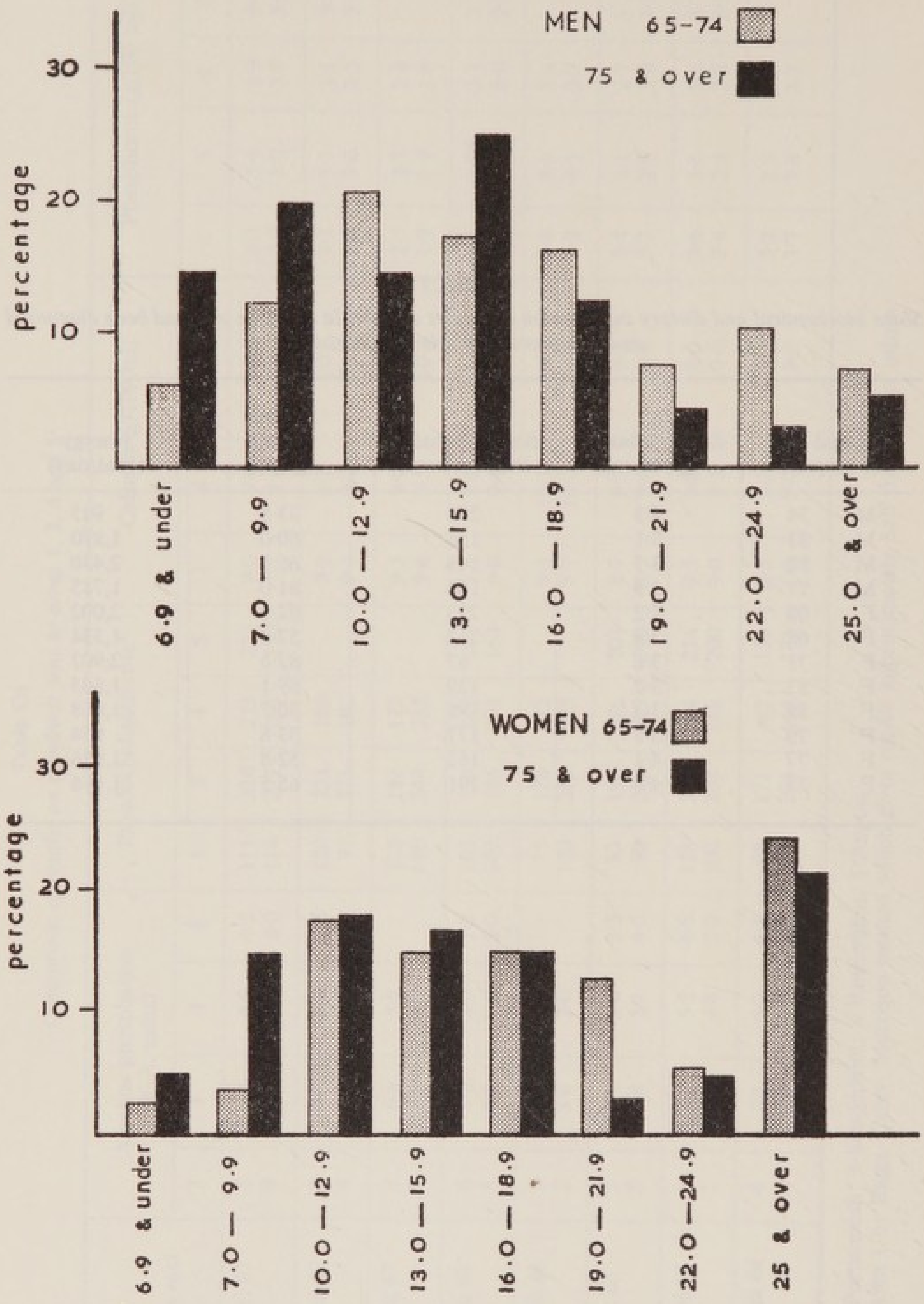

Fig. C10. *Frequency distribution of leucocyte ascorbic acid concentrations* ($\mu g/10^8$ *cells*).

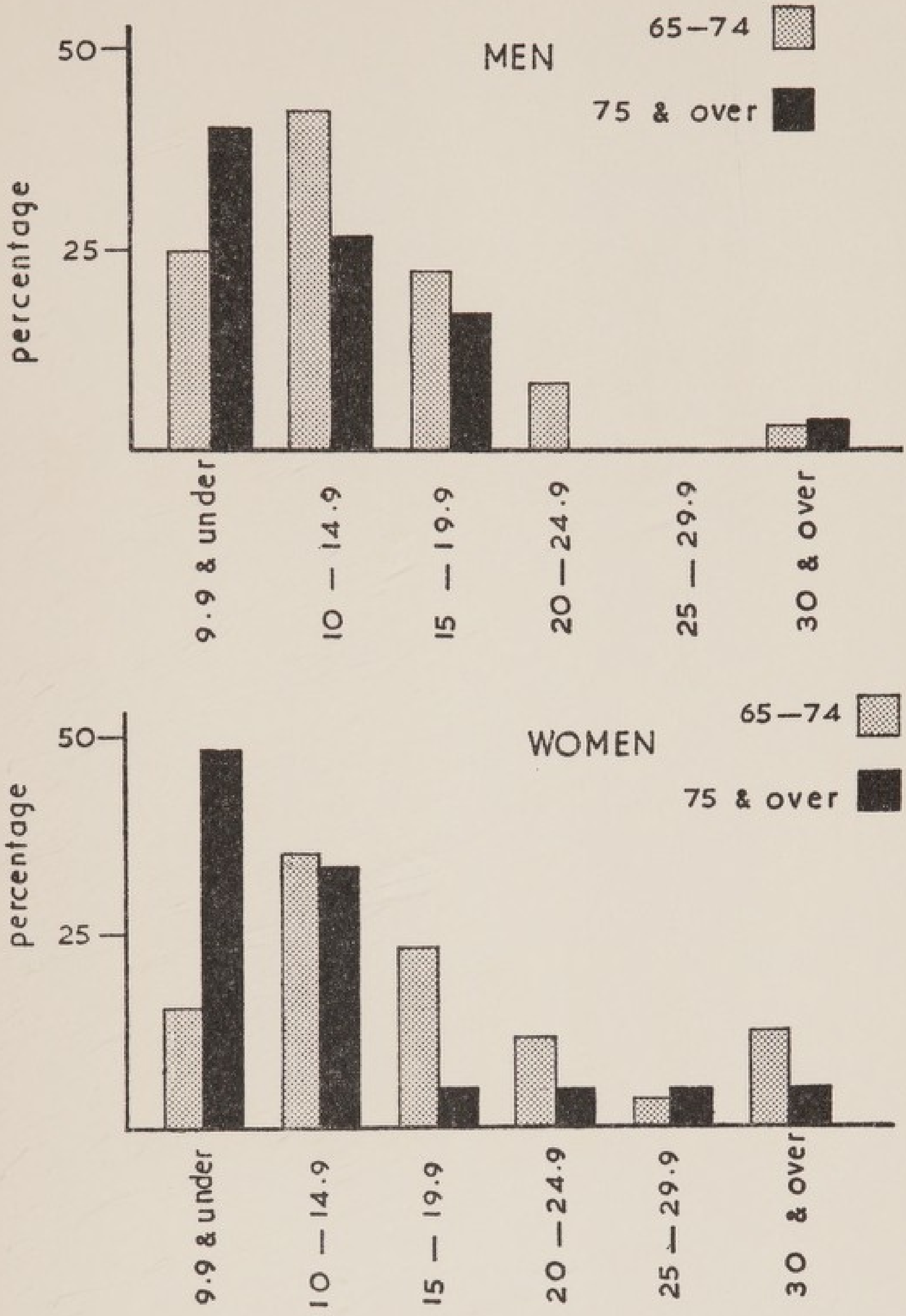

Fig. C11. *Frequency distribution of TPP effect (%).*

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