The British diet : finding the facts, 1989-1993 / the fortieth report of the Steering Group on Chemical Aspects of Food Surveillance.

MAFF

The British Diet: Finding the Facts 1989 - 1993

The fortieth report of the Steering Group of Chemical Aspects of Food Surveillance

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

THE BRITISH DIET: FINDING THE FACTS 1989–1993

The fortieth report of the Steering Group on Chemical Aspects of Food Surveillance

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Food Surveillance Paper No.	*Title*
1	The surveillance of food contamination in the United Kingdom
2	Survey of vinyl chloride content of polyvinyl chloride for food contact and of foods
3	Survey of vinylidene chloride levels in food contact materials and in foods
4	Survey of mycotoxins in the United Kingdom
5	Survey of copper and zinc in food
6	Survey of acrylonitrile and methacrylonitrile levels in food contact materials and in foods
7	Survey of dieldrin residues in food
8	Survey of arsenic in food
9	Report of the Working Party on Pesticide Residues (1977–1981)
10	Survey of lead in food: second supplementary report
11	Survey of styrene levels in food contact materials and in foods
12	Survey of cadmium in food: first supplementary report
13	Polychlorinated biphenyl (PCB) residues in food and human tissues
14	Steering Group on Food Surveillance progress report 1984
15	Survey of aluminium, antimony, chromium, cobalt, indium, nickel, thallium and tin in food
16	Report of the Working Party on Pesticide Residues (1982 to 1985)
17	Survey of mercury in food: second supplementary report
18	Mycotoxins
19	Survey of colour usage in food
20	Nitrate, nitrite and *N*-nitroso compounds in food
21	Survey of plasticiser levels in food contact materials and in foods
22	Anabolic, anthelmintic and antimicrobial agents
23	The British diet: finding the facts
24	Food Surveillance 1985 to 1988
25	Report of the Working Party on Pesticide Residues: 1985–88
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33	Veterinary residues in animal products 1986 to 1990
34	Report of the Working Party on Pesticide Residues: 1988–90
35	Food chemical surveillance 1989 to 1992
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37	Dietary intake of food additives in the UK: initial surveillance
38	Progress Report of the Working Party on Chemical Contaminants from Food Contact Materials 1988 to 1992
39	Aluminium in food

STEERING GROUP ON CHEMICAL ASPECTS OF FOOD SURVEILLANCE

This report was considered and recommended for publication by the Steering Group on Chemical Aspects of Food Surveillance (formerly the Steering Group on Food Surveillance) whose membership was then as follows:

Dr W H B Denner (Chairman)	BSc, PhD	Ministry of Agriculture, Fisheries and Food
Dr J C Sherlock (Deputy Chairman)	BSc, PhD, CChem, FRSC, FIFST	Ministry of Agriculture, Fisheries and Food
Dr D P Atkins (Secretary)	BSc, PhD	Ministry of Agriculture, Fisheries and Food
Mrs J Hayes (Administrative Secretary)		Ministry of Agriculture, Fisheries and Food
Dr M E McQuillan (Minutes Secretary)	BSc, PhD	Ministry of Agriculture, Fisheries and Food
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Professor B W Bycroft	BSc, PhD, CChem, FRSC	University of Nottingham
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Mr B H B Dickinson		Ministry of Agriculture, Fisheries and Food
Dr G E Diggle	MB, BS, MFPM, AKC	Department of Health
Mr A J Harrison	OBE, MChemA, FRSC, FIFST, FRSH	Public Analyst
Professor S R Jones	BSc, PhD	British Nuclear Fuels plc
Mr C P Kendall		Department of Health
Dr N J King	BSc, PhD	Department of the Environment
Ms S Leather	BA, BPhil, MA, CQSW	Consumer representative
Dr A F MacLeod	LRCP, LRCS, LRFP & S, MFPHMI	The Scottish Office Home and Health Department

Dr C H McMurray	BSc, BAgr, PhD, FRSC, CChem, FIFST	Department of Agriculture for Northern Ireland
Dr P I Stanley	BSc, PhD	Ministry of Agriculture, Fisheries and Food
Mr P W Strachan	MA (Cantab), FIFST	Colmans of Norwich

STEERING GROUP ON CHEMICAL ASPECTS OF FOOD SURVEILLANCE

Terms of Reference

To identify through surveillance the need for action to ensure the chemical safety and nutritional adequacy of food.

This report was prepared by the Working Party on Nutrients in Food and the Working Party on Dietary Surveys.

WORKING PARTY ON NUTRIENTS IN FOOD

At the time of preparation of this report, the membership was as follows:

Dr R Harding (Chairman)	BSc, MSc, PhD, Barrister	Ministry of Agriculture, Fisheries and Food
Ms R Abraham	BSc, SRD	Northwick Park Hospital
Ms S Anderson	BSc, SRD	Freelance dietitian
Dr D H Buss	BSc, PhD, FIFST	Ministry of Agriculture, Fisheries and Food
Dr R Cottrell	PhD, CChem, FRSC, FIFST, FRSH, FRSA	The Sugar Bureau
Mr M J L Day	MA	Ministry of Agriculture, Fisheries and Food
Dr C Hall	MB, BCh, FFPHM(I), DRCOG	DHSS Northern Ireland
Mr B Harrison	BSc, Mags, MIBiol, AIFST	H J Heinz Co Ltd
Ms B Holland	BSc, SRD	Royal Society of Chemistry
Mr M Kipps	BSc, MSc	University of Surrey
Dr A R Leeds	MB, BS, MSc	King's College London
Dr J Ludlow	MCBH, MBChB, MFPhM, PhD	Welsh Office
Mr I Lumley	BSc, MSc, CChem, MRSC	Laboratory of the Government Chemist
Dr R Skinner	MBBS, MSc, MD, MFPHM, PhD	The Scottish Office Home and Health Department
Professor D A T Southgate	BSc, PhD, CBiol, MIBiol	AFRC IFR Norwich (until Aug 1992); now Visiting Professor University Newcastle upon Tyne
Mr R Wenlock	BSc, DipNutr, FRSH	Department of Health

Scientific Secretariat:

Ms J Lewis	BSc, SRD	Ministry of Agriculture, Fisheries and Food
Miss G Smithers	BSc	Ministry of Agriculture, Fisheries and Food

WORKING PARTY ON NUTRIENTS IN FOOD

Terms of Reference

(i) To identify areas in which information on the content and availability of nutrients in foods is required to ensure that the nation's food supplies and diets can be adequately monitored; to review programmes for maintaining *McCance and Widdowson's The Composition of Foods* and the Ministry's nutrient databank; to assess priorities; and to propose means of obtaining information;

(ii) When requested, to advise other committees and departments; and

(iii) To report at intervals to the Steering Group on Chemical Aspects of Food Surveillance and, when appropriate, to request publication of the results in Food Surveillance Papers.

WORKING PARTY ON DIETARY SURVEYS

At the time of preparation of this report, the membership was as follows:

Dr R Harding (Chairman)	BSc, MSc, PhD, Barrister	Ministry of Agriculture, Fisheries and Food
Dr A Anderson	BSc, SRD, PhD	University of Glasgow
Dr S Bingham	BSc, PhD	MRC Dunn Nutrition Unit, Cambridge
Dr M Boyle	MFPHM, PhD	DHSS Northern Ireland
Dr J Cade	BSc, SRD, PhD	University of Leeds
Dr L Davies	BSc, PhD	Royal Free Hospital School of Medicine, London
Mr M J L Day	MA	Ministry of Agriculture, Fisheries and Food
Ms C Hamilton	BA, MSc, FSS	Ministry of Agriculture, Fisheries and Food
Dr J Ludlow	MCBH, MBChB, MFPHM, PhD	Welsh Office
Dr G McNeill	MB, ChB, MSc, PhD	Rowett Research Institute, Aberdeen
Dr M Nelson	BSc, MSc, PhD	King's College London
Dr R Skinner	MBBS, MSc, MD, MFPHM, PhD	The Scottish Office Home and Health Department
Professor D A T Southgate	BSc, PhD, CBiol, MIBiol	AFRC IFR Norwich (until Aug 1992); now Visiting Professor University Newcastle upon Tyne
Dr J J Strain	BSc, BAgr, PhD, DipEd (TAFE)	University of Ulster
Dr D Tennant	BSc, PhD, MIEnvSc	Ministry of Agriculture, Fisheries and Food
Miss M Thomson	SRD, MPhil	Eastern General Hospital, Edinburgh
Dr M Wiseman	MB, MRCP	Department of Health

Scientific Secretariat:

Dr J Hughes	BSc, MSc, PhD	Ministry of Agriculture, Fisheries and Food
Miss S Lee	BSc	Ministry of Agriculture, Fisheries and Food
Ms A Mills	BSc	Ministry of Agriculture, Fisheries and Food

WORKING PARTY ON DIETARY SURVEYS

Terms of Reference

(i) To propose or, when requested, advise on the planning, analysis and interpretation of dietary surveys for the Steering Group on Chemical Aspects of Food Surveillance in order to determine normal and extreme intakes of dietary constituents in groups of the population; and to oversee the Total Diet Study;

(ii) When requested, to advise other committees and departments; and

(iii) To report at intervals to the Steering Group on Chemical Aspects of Food Surveillance and, when appropriate, to request publication of the results in Food Surveillance Papers.

CONTENTS

GLOSSARY OF TERMS, ABBREVIATIONS AND UNITS

Abbreviations used in this report:

ADI	Acceptable Daily Intake
ALSPAC	Avon Longitudinal Study on Pregnancy and Childhood
BCR	Bureau of Community Reference
BMR	Basal metabolic rate
COMA	Committee on Medical Aspects of Food Policy
COT	Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment
CRM	Certified Reference Materials
DH	Department of Health
DRV	Dietary Reference Value
EC	European Community
EFTA	European Free Trade Association
ESRC	Economic and Social Research Council
FAPAS	Food Analysis Performance Assessment Scheme
GLC	Gas–liquid chromatography
HPLC	High performance liquid chromatography
LRNI	Lower Reference Nutrient Intake
MAFF	Ministry of Agriculture, Fisheries and Food
MBA	Microbiological assay
MRC	Medical Research Council
NAMAS	National Measurement Accreditation Service
NDNS	National Diet and Nutrition Survey
NFS	National Food Survey
NSP	Non-starch polysaccharide
OPCS	Office of Population Censuses and Surveys
PABA	Para-amino-benzoic acid
R&D	Research and development
RNI	Reference Nutrient Intake
RSC	Royal Society of Chemistry
RSGB	Research Surveys of Great Britain Ltd
SCPR	Social & Community Planning Research
TDS	Total Diet Study

Summary of units used in this report:

microgram	(µg) one millionth of a gram
milligram	(mg) one thousandth of a gram
kilogram	(kg) one thousand grams
litre	(l) one thousand millilitres

SUMMARY

This report describes surveillance carried out from 1989 to 1993 on the nutrient composition of food and on food consumption by populations and individuals. Previous work was reported in Food Surveillance Paper No. 23.[1]

The programme of monitoring individual foods that make up the UK diet is continuous as the range and type of foods available, their composition, and their relative importance in the diet are constantly changing. Methods of analysis are also improving all the time, thereby enabling more detailed information on the nutrient composition of foods to be obtained. Specifically, work has been undertaken to develop suitable methodologies to determine the main pro-vitamin A carotenoids, the total folate content, components of dietary fibre and individual fatty acids in foodstuffs. Development work on the determination of individual folates, positional and geometric isomers of unsaturated fatty acids, and maltodextrins continues.

A wide range of foods has been studied in detail since 1988. Projects have included the determination of the quantities of individual carotenoids in fruit and vegetables, the measurement of individual fatty acids in many different products, the measurement of iodine in milk and other important sources of iodine in the British diet, and the measurement of vitamin D and its metabolites in meat. The analytical data obtained have been evaluated and, where appropriate, published in food composition tables or scientific papers and incorporated into the Ministry's nutrient databank.

Current analytical studies include a major review of the nutrient content of carcase meats (beef, pork and lamb), and the analysis of a wide range of foods for selenium and for vitamin K content.

Several dietary surveys and allied projects have been carried out since 1988. Dietary surveys are undertaken at two different levels which give information both on details of individuals' diets (The National Diet and Nutrition Survey – NDNS) and household food purchases (The National Food Survey – NFS).

The NDNS programme began in 1991 and comprises four separate surveys each covering a nationally representative sample of a population age group. The fieldwork for the first of these surveys (children aged $1\frac{1}{2}$–$4\frac{1}{2}$ years) was completed in July 1993 and the initial report is expected in autumn 1994. Preparation for the next population group (adults aged 65 years or over) has already begun. These surveys provide detailed quantitative information on intake of different foods, and of nutrient and other food constituents in the whole population.

Data from the 1986/87 Dietary and Nutritional Survey of British Adults, the precursor of the NDNS programme, have been analysed and published. These have been used for assessing the effects of the Government's policies on food and nutrition, developing new dietary reference values for the UK and for the EC and estimating the intakes of food chemicals including pesticides, additives, natural

toxicants and contaminants. The data have since been archived and are available for further analyses.

Results from the national dietary survey of infants aged 6 to 12 months have also been published and the data have been used by other working parties and advisory committees.

Several projects to improve the measurement of food intake have also been carried out during this period. These include the use of biological markers to evaluate the validity of intake data and the development of tools to make measuring and recording easier and more accurate.

The continuous NFS provides a wide range of information which has contributed to the analysis of policy and to monitoring the population trends in food intake. A report covering the first 50 years (1940–1990) was published during 1991. Until 1991, only foods (excluding confectionery, soft and alcoholic drinks) entering the home for consumption were recorded. At the beginning of 1992, the survey was extended to include both information on foods consumed outside the home, and data on confectionery, soft and alcoholic drinks purchases and consumption. Data from the NFS are published both quarterly and annually and are used extensively in risk assessment and in the formulation of nutrient recommendations. In the future they will also be used to monitor the extent to which the nutrition targets contained in the 'Health of the Nation' White Paper are being met.

INTRODUCTION

1. The Ministry of Agriculture, Fisheries and Food (MAFF) aims to ensure that an adequate, varied and safe food supply is available at all times so that consumers can choose, with confidence, a healthy and enjoyable diet. The Working Party on Nutrients in Food and the Working Party on Dietary Surveys play a key role in ensuring that up-to-date information is available on the amounts of foods that the British population consume and on the nutrient content of the British diet. Both working parties report to the Steering Group on Chemical Aspects of Food Surveillance, the committee within the advisory system that co-ordinates Government monitoring of chemical food safety and food quality. Its terms of reference are set out on page v.

2. Both working parties were set up in 1991, to replace the Working Party on Nutrients, which provided an expertise predominantly in the area of food composition and to a lesser extent dietary surveys. This change was necessitated by the increasing complexity and volume of work on dietary surveys which was beginning to arise and the recognition of the fact that this situation was likely to continue. The terms of reference of the working parties are set out on pages viii and xi.

3. The primary purpose of the Working Party on Dietary Surveys is to provide reliable and up-to-date information on the foods consumed by the population and by individuals within the population. These data are needed by Government for a number of reasons:

(i) to identify the size and characteristics of populations who may be at risk because of exposure to a non-nutrient food constituent (for example, natural toxicants, contaminants or additives or the inappropriate intake of a nutrient);

(ii) to identify foods that are the main contributors of various food constituents (nutrient or non-nutrient) in the diet of specific groups of people;

(iii) to provide information on the distribution of foods consumed by different age groups to enable appropriate nutritional Dietary Reference Values (DRVs), or Acceptable Daily Intakes (ADIs) of additives or contaminants etc., to be set;

(iv) to measure both the effect and effectiveness of food, agricultural, social and health policies on the nutrient intake of the population.

4. The Working Party on Nutrients in Food, using intake data provided by the Working Party on Dietary Surveys, establishes the intake of nutrients by the population and individuals. These nutrient intake data are required by Government:

(i) to investigate and monitor the nutritional adequacy of the diet, both of the nation as a whole and of particular sections of the population. Historically, these nutritional data were used to estimate the risk of deficiencies arising as a result of food shortages and to help to plan the allocation of available food supplies. Although food shortages are no longer a problem, concern is growing at the increased risk of deficiency of some vitamins and minerals in certain population groups (for example pre-school

children), as a result of restricted or poor choice of foods consumed. In addition, the dietary habits of a population can contribute to the risk of developing chronic diseases, such as heart disease and cancer. The hypotheses which link diet with chronic diseases are continually evolving, and Government must always be in a position to assess their significance;

(ii) to monitor the extent to which the quantitative dietary targets set by Government in the 'Health of the Nation' White Paper[2] are being met;

(iii) to be able to identify the size and characteristics of any population which may be at risk because of an inadequate or excessive intake of a nutrient;

(iv) to identify foods that are the main contributors of nutrients in the diet of specific groups of people;

(v) to provide information on the distribution of nutrient intakes in different age groups for the purpose of setting Dietary Reference Values;

(vi) to measure both the effect and effectiveness of food, agricultural, social and health policies on the nutrient intake of the population;

(vii) to assist with the planning of diets for closed communities such as hospitals, the armed forces and prisons.

5. It is the policy of the Ministry that all such work is made publicly available. The data generated by both working parties and their predecessors have therefore been published both in the scientific literature and in the form of books and reports. In addition much of the raw data is available for inspection on request. The information is particularly useful to a wide range of users including dietitians and clinicians, nutrition educators, the food industry and those involved in scientific or social research.

BACKGROUND

Food composition

6. The fourth edition of *McCance and Widdowson's The Composition of Foods*[3] was published by the Ministry in 1978. In the early 1980s, two supplements were published, one expanding the values for amino acids and fatty acids in foods,[4] and one providing information on the nutrient content of common immigrant foods.[5] In 1986, the Ministry commissioned the Royal Society of Chemistry (RSC) to produce both the book versions of *McCance and Widdowson's The Composition of Foods*, and also the computerised version, known as the National Nutrient Databank. Since 1988, further supplements to the fourth edition have been published covering *Cereals and Cereal Products,*[6] *Milk Products and Eggs*[7] and *Vegetables, Herbs and Spices.*[8]

7. The fifth edition of *McCance and Widdowson's The Composition of Foods*[9] was published in September 1991, since when three supplements have been added

covering *Fruit and Nuts,*[10] *Vegetable Dishes*[11] and *Fish and Fish Products.*[12] A further supplement, *Food Labelling Data for Manufacturers*[13] was published during 1992. Details of the contents of all these publications are given in Appendix I. Future supplements will cover *Beverages, Snacks and Miscellaneous Foods, Fatty Acids* and *Meat and Meat Products.*

8. Work is continuing on the development and computerisation of the National Nutrient Databank. The RSC has recently developed a new database using the PowerHouse data management system. This will hold data from all current RSC/MAFF publications and facilitate the production of future supplements and associated publications.

Dietary surveys

9. Two principal types of survey are carried out, one to provide details of individuals' diets (The National Diet and Nutrition Survey) and the other to gather information about household food purchases (The National Food Survey). These are outlined in paras. 11–18.

10. Both the surveys are used extensively by other surveillance working parties for risk assessment purposes. The continuous NFS does not measure foods consumed by individuals, but its greatest strength is that it allows population trends in food intakes to be monitored. The individual dietary surveys, on the other hand, are carried out less frequently, but allow a closer look to be taken at the intakes of individuals and distribution of intakes throughout the population.

The National Diet and Nutrition Survey (NDNS) programme

11. The Ministry and the Department of Health (DH) have identified the need for detailed information on food consumption and intake of nutrients and non-nutrient food constituents by the general population. They recognised that the value of dietary surveys is enhanced by the inclusion of objective measurements of nutritional status and indicators of health and vice versa. The first joint MAFF/DH survey, the Dietary and Nutritional Survey of British Adults, was undertaken by the Office of Population Censuses and Surveys (OPCS), and the initial analysis was published in 1990.[14] The data from the survey, along with the nutrient databank, have been deposited at the Economic and Social Research Council (ESRC) Data Archive at the University of Essex.

12. Following the successful completion and evaluation of this survey the Ministry and DH decided to establish the National Diet and Nutrition Survey (NDNS) programme to provide detailed quantitative information on the intake of different foods, and of nutrient and other food constituents, in different sectors of the population in order to assist the development of Government nutrition policy. The programme is split into four separate surveys, conducted at approximately two-yearly intervals. It is intended that each survey will examine a nationally representative

sample drawn from four different population age groups: children aged 1½–4½ years, school children aged 5–15 years, adults aged 16–64 years, and older adults aged 65 years or over.

13. Using data generated by the Working Party on Nutrients in Food, the NDNS programme will also help to monitor progress towards the quantitative dietary targets set by the Government in 'The Health of the Nation' White Paper[2] and to compare nutrient intakes with the DRVs set out in the report, Dietary Reference Values for Food Energy and Nutrients for the United Kingdom.[15] At the same time measurements of health status are made for monitoring purposes as well as to examine their relationships with dietary, physiological and social data. These dietary surveys of individuals complement the Ministry's continuous National Food Survey (NFS). A complete list of objectives for the NDNS programme can be found in Appendix II.

The National Food Survey (NFS)

14. The National Food Survey is the longest-running continuous survey of household food consumption and expenditure in the world. Over a period of 50 years, the survey has provided a wide range of information which has contributed to the analysis of nutrition policy and to monitoring the change in the diets of British households. The survey was first carried out in 1940 by the Ministry of Food to monitor the diets of urban working class families, in order to assess the effectiveness of wartime food policies. It became truly representative of Britain in 1950 when it was extended to cover all sections of the population. A report, covering the first 50 years of the survey (1940–1990)[16] was published during 1991. Details of the survey methodology are outlined in Appendix III.

15. Data on the household purchases of food are collected from around 7000 households each year throughout Britain. Until 1991, only foods entering the home for consumption were recorded; data on confectionery, soft and alcoholic drinks were excluded. However, at the beginning of 1992, the survey was extended to include both information on foods consumed outside the home, and data on confectionery, soft and alcoholic drinks purchases and consumption (both inside and outside the home).

16. The organisation of, and responsibility for, the National Food Survey rests with the Ministry, which is advised by the National Food Survey Committee, members of which are listed in Appendix IV. The nutritional databases used by the NFS are constantly updated and draw heavily on the nutritional data generated by the Working Party on Nutrients in Food.

17. National Food Survey results are produced for individual months, quarters and years, enabling trends in consumption to be monitored over time. Quarterly and annual figures are also calculated separately for groups of households classified according to various alternative criteria, including region, composition of family, and income. Results can also be produced by social class, freezer ownership and other

characteristics. The most recently published annual report[17] is for 1992, and the most recent quarterly results are published for the third quarter of 1993.[18] In recent years attempts have been made to extract further information from NFS data. Statistical techniques have been used to estimate food and nutrient consumption by different types of household members.[16,19]

18. Data from the NFS have been used extensively by committees such as the Committee on Medical Aspects of Food Policy (COMA) to help formulate nutrient recommendations. The NFS was also used to help set the dietary targets of the 'Health of the Nation,'[2] and is now being used to monitor progress towards these targets (Appendix V) in conjunction with measurements on representative individuals that are collected from the NDNS programme.

The Total Diet Study

19. The Working Party on Dietary Surveys oversees the Ministry's Total Diet Study. The purpose of this study, which was begun in the early 1960s and is carried out on a continuous annual basis, is to provide, as far as possible, an estimate of the average intake of any food constituent of current concern in Britain. This allows the Ministry to make estimates of the current average of, or background exposure to, any nutrient or non-nutrient in the diet for the population as a whole[20,21] and compare these with exposure data for particular vulnerable groups within the population.

20. The types and quantities of foods which make up the study are largely based on those recorded in the National Food Survey and are outlined in Appendix VI, together with details of the study methodology. The major items of the national diet are combined into 20 groups of similar foods for analysis. Foods are grouped so that commodities known to be susceptible to contamination are kept separate, as are commodities which are consumed in large quantities (such as bread, potatoes and milk). Grouping of foods in this way ensures that analysis of a relatively small number of samples gives a reliable estimate of average exposure in a cost-effective manner. The continuous nature of the Total Diet Study allows trends over time to be established.

21. As well as measuring exposure to nutrients, the study has been used to estimate intakes of a wide range of contaminants, such as heavy metals, dioxins and pesticides. This is especially useful where data may not be available for levels of a substance in individual foods (e.g. fluoride, chromium, dioxins, heavy metals). Recent analyses of the Total Diet Study have included individual fatty acids and a range of minerals and heavy metals.

Other dietary surveys

22. No one survey can provide all the information necessary to carry out adequate nutritional and risk assessment for all types of food or sub-populations. The Ministry has a need to collect information on small sub-population groups from time to time as

these may not be identified in sufficient numbers by the larger nationally representative surveys. For this reason various *ad hoc* dietary surveys are carried out. These include surveys to collect information on nutrient intakes of pregnant women and infants, intake of sweeteners in diabetics and slimmers, and intake of nitrates, pesticides, other contaminants and natural toxicants in populations with higher than average consumption of some foods. All surveys are considered by the Working Party on Dietary Surveys and where relevant in collaboration with those working parties directly involved in the study of each of these additives or contaminants. Surveys of vegetarians, pregnant women and infants have been carried out recently.

CRITERIA FOR SETTING PRIORITIES

23. A number of factors are considered by the working parties in determining priorities for research and surveillance. The criteria used by the Working Party on Nutrients in Food and the Working Party on Dietary Surveys are set out in Tables 1 and 2, respectively.

RECENT AND CURRENT PROGRAMMES OF WORK

Food composition

24. Nutritional data need to be regularly updated because foods themselves are constantly changing. Not only are new products constantly being developed and old ones reformulated, but also traditional foods change. Changes in food composition may result from the introduction of new plant varieties, imports from different countries, altered storage practices, processing techniques, fortification practices and packaging.

Table 1: The Working Party on Nutrients in Food: criteria for setting priorities.

1. Is the quality of the science good?
2. To what extent will the project achieve the stated objectives?
3. Does the project offer value for money?
4. Will the project help improve the methods of analysis available for nutrients in food?
5. Are the foods to be analysed important sources of nutrients in the diet of the population as a whole or specific nutritionally vulnerable groups within the population?
6. Is the study important for updating or extending currently available data?
7. Is there reason to believe that a health or nutritional problem may exist or arise in some sector of the community which needs investigation by composition studies (in conjunction with dietary studies)?
8. Is the project required to assist with a proper assessment of the diet, bearing in mind the current requirements of Government policy, or to help other Government committees?

Table 2: The Working Party on Dietary Surveys: criteria for setting priorities.

1. Is the quality of the science good?
2. To what extent will the project achieve the stated objectives?
3. Does the project offer good value for money?
4. Will the project generate novel data or will it repeat work in progress or already available?
5. Is there reason to believe that a health or nutrition problem may exist or arise in some sector of the community which needs investigation by dietary studies, e.g. pregnant women, adolescent girls and vegetarians?
6. Is the project needed to assess the intake of foods, additives, contaminants or naturally occurring toxicants, in order to assess food safety in the population?
7. Will the project help to improve dietary survey methodology?
8. Is the project needed by the Government to assess the intake of foods, nutrients, or changes in the diet of the population?

25. The range and types of foods available have steadily increased, and there are now several thousand available in the UK. With the advent of the Single Market, and changing lifestyles within the UK (e.g. more foreign travel, more working women, changing meal patterns, increased use of microwave ovens and ready meals) it is likely that the diet will continue to change.

26. The relative importance of different foods in the diet also continues to change. For example, since the early 1980s, there has been an increased consumption of skimmed and semi-skimmed milks in place of whole milk, increased consumption of low-fat spreads, polyunsaturated margarine and vegetable oils in place of butter, hard margarine and lard, increased consumption of wholemeal bread and fruit juice and a decreased consumption of carcase meat, sugar and eggs.[17,22,23] Details of these and other changes are given in Table 3. Table 4 shows how intakes of selected nutrients have changed over the same period.

27. As the composition of foods and their relative importance in the diet may be expected to continue to change, the Working Party *recommends* that the programme of monitoring of the individual foods that make up the UK diet be maintained.

Sampling of foods for nutritional analysis

28. The aim of nutritional composition studies is to gain nutrient information on foods which are representative of those available to the consumer, and to provide information on the variation in composition of foods consumed.[24]

29. Foods are biological materials, and as such will show considerable variation in composition. A number of questions need to be posed when assessing likely causes of variation:

Table 3: Consumption of selected foods, 1980, 1985 and 1992.

Food	Consumption (oz/person/week)[a]		
	1980	1985	1992
Milk, whole (pt)	4.2	3.3	1.7
Milk, skimmed (pt)	tr	0.4	1.7
Yoghurt (pt)	0.1	0.1	0.2
Cream (pt)	0.03	0.02	0.03
Cheese	3.9	3.9	4.0
Carcase meat	16.8	13.2	10.0
Other meats and products	23.4	23.5	23.5
Eggs (no.)	3.7	3.1	2.1
Total fats of which:	11.2	10.1	8.7
Butter	4.1	2.8	1.4
Margarine	3.8	3.8	2.8
Low-fat and dairy spreads	–	0.5	1.8
Lard	1.8	1.4	0.6
Vegetable oil	1.1	1.0	1.7
Total cereals of which:	55.4	53.8	51.6
Wholemeal bread	1.5	3.6	3.9
White and other bread	29.6	27.4	22.8
Buns, cakes and pastries	3.7	3.5	4.1
Biscuits	5.4	5.2	5.1
Sugar	11.2	8.4	5.5
Total vegetables	85.4	84.9	77.4
Total fruit	28.1	27.1	32.8

[a] Except where stated.
Note: tr = Trace
Source: National Food Survey

- In what form is the food available (e.g. fresh, frozen, chilled, canned, etc.)?
- What are the major brands for each food to be analysed? (And will they differ significantly in composition?)
- Is there any reason to believe there will be regional or seasonal differences?
- Is there reason to believe that different methods of preparation/cooking will lead to differences? (What are the most common methods?)
- Is the composition of the food known to be naturally variable, or are nutrient levels likely to be quite consistent?

30. Considerable effort is made to ensure that a representative selection of foods is analysed, taking into account such factors as relative importance in the diet, market share information, processing and cooking methods, fortification practices, and variation between samples, as appropriate.

Table 4: Daily intake of selected nutrients in Britain, 1980–1992.

Year	Food energy (kcal)	Fat (g)	Fat % food energy	Saturated fat (g)	Saturated fat % food energy	Fibre[a] (g)	Sodium (g)	NMES[b] (g)
1980	2230	106	42.6	46.8	18.9	12.0	2.6	
1981	2210	104	42.2	45.6	18.6			
1982	2180	103	42.6	44.4	18.3			
1983	2140	101	42.6	44.5	18.7			
1984	2060	97	42.3	41.9	18.3			
1985	2020	96	42.8	40.6	18.1	12.0	2.6	
1986	2070	98	42.6	40.6	17.7	13.0	2.7	
1987	2040	96	42.4	39.4	17.4	12.7	2.6	
1988	2000	93	41.9	38.3	17.2	12.5	2.6	62
1989	1940	90	41.8	36.9	17.1	12.4	2.6	59
1990	1870	86	41.4	34.6	16.7	12.1	2.5	57
1991	1840	85	41.4	33.7	16.4	12.0	2.5	58
1992	1860	86	41.7	33.6	16.3	12.0	2.5	53

Source: National Food Survey

[a] Fibre = non-starch polysaccharides (NSP).

[b] NMES = non-milk extrinsic sugars (includes table sugars, fruit juice, honey and sugars added during the manufacture of foods).

31. The cost involved in analysing single food samples for a range of nutrients is high. In order to gain representative data at a cost-effective price, composite (or bulk) samples are normally analysed. Occasionally, where variation in composition is thought to be large, for example, the fat content of minced beef (Table 5), a number of single samples are analysed. The usual number of samples collected is 10. This is considered to be large enough to reflect the variability in composition for most foods. In some cases, where variation is thought to be small, 6–8 samples may be purchased.

32. Working Party members agree that the current method of designing sampling schemes, although pragmatic, is likely to give representative nutrient values for individual foods analysed. The Working Party, however, *recommends* that wherever possible, statistical principles should be incorporated into the sampling plans.

Methods of analysis

33. The measured nutrient content of a food depends on the method of analysis being used. Reliable results depend on careful application of appropriate and accurate analytical techniques. Improved methods of analysis are being developed at an increasing pace and application of such methods often provides more detailed information on the nutrient composition of foods. The introduction of quality assurance systems in analytical laboratories is an important factor in assuring the quality of data obtained.

Table 5: Variation in fat and moisture content of (a) minced beef and (b) extra-lean minced beef.

Sample number	Moisture (%)	Fat (%)
(a) Minced beef		
1	61.5	17.0
2	64.6	15.7
3	57.3	26.5
4	66.6	14.9
5	64.7	15.9
6	70.0	7.8
7	59.8	20.5
8	68.7	11.5
9	61.8	19.4
10	64.5	17.0
Mean	63.9	16.6
SD	3.9	5.0
(b) Extra-lean minced beef		
1	70.2	8.3
2	71.4	7.6
3	63.8	16.9
4	72.1	7.7
5	70.1	6.3
6	67.5	9.4
7	70.4	6.4
8	71.2	3.9
9	67.0	10.6
10	72.6	5.5
Mean	69.6	8.3
SD	2.7	3.6

34. High performance liquid chromatographic (HPLC) methods are now used for the determination of fat-soluble vitamins and pro-vitamins as they have considerable advantages over classical chromatographic and spectrometric methods.

35. HPLC allows, for example, all-*trans*-retinol and 13-*cis*-retinol to be individually determined relatively easily. It is important to differentiate between these two retinols as 13-*cis* has only about 75 per cent of the biological activity of all-*trans*-retinol. Classical spectrometric procedures could not make this distinction, were susceptible to interference from the sample matrix and were of limited sensitivity.

36. Work has been undertaken to develop a suitable methodology to determine the main pro-vitamin A carotenoids in foods. About 50 carotenoids are predicted to have pro-vitamin A activity, but those commonly found in the UK diet are β-carotene, α-carotene and α- and β-cryptoxanthin. Whereas 6 μg of β-carotene have a vitamin A potency of 1 μg of all-*trans*-retinol, α-carotene and α- and β-cryptoxanthin have only about 50 per cent of this activity. HPLC allows the separation of these different carotenoids, and allows a more accurate calculation of total vitamin A activity in foods. Diode array detection allows inspection of the spectral characteristics of

carotenoids separated from samples, thus enabling positive identification. This analytical approach has obvious advantages over classical open column chromatographic and spectrometric procedures which were non-specific and insensitive.

37. The analysis of carotenoids is technically exacting. The separation and analysis of the many carotenoids, both the pro-vitamin A and the non pro-vitamin A forms, are increasingly of importance for assessing the role of carotenoids as antioxidants and the Working Party *recommends* that continued development of HPLC methods for measuring the major components is needed. The Working Party further *recommends* that work to determine more accurately the bioavailability and biological activity of different carotenoid fractions should be undertaken.

38. The determination of folates in foodstuffs is a subject which has attracted considerable attention in the last few years and the Working Party has overseen much work in this area. The term 'folates' refers to a group of compounds which are derivatives of folic acid. These occur in foodstuffs conjugated to one or more gamma-glutamyl residue. Owing to the very low levels of folates found in most foodstuffs, reliable determination is difficult, and determination of individual compounds is often not possible. Microbiological assay (MBA) is used to determine the total folate content of foodstuffs because of the sensitivity of the technique. However, this sensitivity also has associated problems. Assays are subject to a range of sample matrix effects, e.g. inhibition or stimulation of test organism growth and differential growth effects depending on the various forms of folate present in samples.

39. The various forms of folate present as polyglutamates are extracted from foodstuffs under conditions which prevent degradation, but prior to MBA these polyglutamates must be hydrolysed to mono- or di- glutamates. The most commonly used source of the enzyme capable of performing this hydrolysis, or de-conjugation, is dried chicken pancreas powder. Unfortunately, a range of problems associated with the quality of commercial preparations of this powder during 1990–1992 has delayed the production of folate data of sufficient reliability for inclusion into food composition tables. Alternative sources of the enzyme, such as pig kidney and human plasma, have been investigated but more method validation is required before consistency of performance can be guaranteed. Problems with the MBA of folates have also been reported by other European countries and Australia.

40. A group of analysts from the European Community (EC) and Economic Free Trade Area (EFTA) working under the umbrella of the Bureau of Community Reference (BCR) have been investigating the various critical steps in the MBA of folates, and the results of these studies will be of future benefit.[25]

41. The Working Party recognises that there is a need to be able to identify and quantify the individual forms of folate in foodstuffs because of differing biological activities. Currently the only realistic means of achieving this is by the use of HPLC. Work is currently underway with the aim of developing procedures for the selective

concentration of folates from sample digests and the removal of interferences prior to HPLC separation, identification and quantification of individual compounds. The Working Party *recommends* that this work be continued.

42. The definition and determination of the dietary fibre content of foods have been the subject of much debate in recent years. Methods of analysis continue to be modified and compared by inter-laboratory study. Dietary fibre values in the fourth edition of *McCance and Widdowson's The Composition of Foods*[3] were determined using the method of Southgate[26] which involves removal of starch from the food by enzymatic hydrolysis, separation of the residue into cellulose, non-cellulosic polysaccharide and lignin, and acid hydrolysis and colorimetric determination of the component sugars. The fifth edition of *McCance and Widdowson's The Composition of Foods*[9] contains dietary fibre results obtained both by the Southgate method and the non-starch polysaccharide (NSP) procedure developed by Englyst.[27] The Working Party *recommends* that further studies are required to relate the analytical values of component NSP fractions to their physiological effect.

43. As with the Southgate method, the Englyst procedure involves the removal of starch but additional steps in the protocol of the latter allows the determination of total dietary fibre as non-starch polysaccharide (NSP) and differentiation of soluble and insoluble NSP, cellulose and non-cellulosic polysaccharides. Sugars are determined by gas-liquid chromatography (GLC) and colorimetry, thereby supplying further information on component monosaccharides and uronic acids. The Englyst procedure has been subject to collaborative trials in the UK[28] and has been adopted by the Ministry, in the absence of an EC definition,[29] as the recommended method for food labelling purposes.[30] Slight variations to the Englyst procedure continue to be made, and the resulting protocols subjected to inter-laboratory study. The relationship between the various forms and fractions of dietary fibre are shown in Table 6. A wide range of fruits and vegetables has been analysed for dietary fibre using this procedure in recent years. These data complement existing information on the NSP content of cereals and cereal products, which were obtained in the mid-1980s.

Table 6: Relationship between the dietary fibre fractions.

Cellulose	Insoluble fibre[a]	Englyst fibre[b]	Southgate fibre[c]
Insoluble non-cellulosic polysaccharides			
Soluble non-cellulosic polysaccharides	Soluble fibre		
Resistant starch			
Lignin			

[a] Some methods of analysis include lignin.
[b] Non-starch polysaccharide.
[c] Unavailable carbohydrate. Fibre determined by this method may vary from the sum of the fractions shown because it can include starch which is not necessarily the same as resistant starch measured by the Englyst method.

44. Individual common sugars and starch can be reliably determined if appropriate methods of analysis are used. However, problems can arise if foods contain significant amounts of maltodextrins, other oligosaccharides and/or gums, as these components will not all be accounted for. A similar problem may occur with foods that contain significant amounts of emulsifiers which may not be fully accounted for using standard methods of analysis for the determination of fat. The Working Party *recommends* that when foods to be analysed are known to contain high levels of such components, care is taken to ensure that analytical protocols are used which are capable of determining all major constituents.

45. To ensure that analytical data are always as accurate and reliable as possible, the Working Party *recommends* that laboratories producing nutritional composition data use validated and recognised analytical methods, where they are available, have analytical quality assurance systems in place, and use Certified Reference Materials (CRM) where appropriate or in-house quality control materials. The Working Party *recommends* that laboratories should, where appropriate, participate in the current Food Analysis Performance Assessment Scheme (FAPAS) as part of their quality assurance system, and be accredited by the National Measurement Accreditation Service (NAMAS). The Working Party further *recommends* that active encouragement be given to the development of CRMs for nutrients in foods, representing a range of food matrices.

Areas of work since 1988

46. Several nutrients and a wide range of foods have been studied in detail since 1988. When analytical data are obtained, they are evaluated and, where appropriate, incorporated into the Ministry's nutrient databank,[31] which is used in the National Diet and Nutrition Survey programme (Appendix VII). Table 7 gives details of all analytical work recently completed and Table 8 gives details of the current work programme. Details of selected studies are outlined below.

Individual carotenoids in foods

47. In conjunction with the development of suitable methodology, work has been carried out to determine the amounts of individual carotenoids in key foods such as fruits and vegetables. The main pro-vitamin A carotenoids found were β-carotene, α-carotene and β-cryptoxanthin. A selection of these data have been published in the supplements to *McCance and Widdowson's The Composition of Foods* on *Fruit and Nuts*[10] and *Vegetables, Herbs and Spices*.[8] The effect of season and cooking was also determined, and results obtained for seasonal variations in the levels of β-carotene in carrots are presented in Table 9.

48. Spectral data from the HPLC determination of carotenoids have indicated that *cis*-isomers of β-carotene and β-cryptoxanthin are present in some vegetable extracts. The formation of *cis*-isomers during processing may be of nutritional significance because they have 50 per cent or less of the pro-vitamin activity of the all-*trans* form.

Current HPLC procedures do not physically separate *cis*- and *trans*-carotenoid isomers and this may lead to an overestimate of total vitamin A activity of some food products which have undergone processing. Work is underway to develop a reliable and robust HPLC method capable of overcoming this problem. The non pro-vitamin A carotenoids such as lutene and lycopene have active antioxidant free radical scavenging properties and may also be nutritionally important. Consideration is therefore being given to the development of methods of analysis for these compounds as well.

Table 7: Recently completed analytical projects.

Project	Details	Published references[a]
Dairy products and eggs	53 foods analysed for a range of nutrients. Foods included speciality cheeses, a range of speciality yoghurts, dairy desserts, boiled and scrambled eggs.	7, 9
Micronutrient retention in foods cooked and reheated by microwave and conventional methods	A small number of ready-prepared meals (both frozen and cook chill) were regenerated using both methods and nutrient retention was measured.	45
Savoury snacks and nuts	54 samples analysed for a range of nutrients. Foods included potato crisps and other savoury snacks, and a range of nuts.	9
Foods commonly consumed by children aged 1½–4½ years	35 foods analysed for a wide range of nutrients. Foods included biscuits, confectionery, chilled desserts and ice cream.	9
Meat products	55 samples analysed for a range of nutrients. Samples included burgers, sausages, reformed products and selected meat dishes.	9
Soft drinks	35 samples, including juice drinks, baby juice, carbonated drinks, low-alcohol drinks and flavoured milks, were analysed for a range of nutrients. Vitamin A, C and B_{12} analyses were carried out on supplemented products.	9
Miscellaneous foods	77 samples analysed for a range of nutrients. Foods included soups, pickles, salad dressings, sauces, gravy products, stuffing, honey, chocolate spread and reduced-sugar jams.	9
Organic fruit and vegetables	Paired samples of 'organic' and 'conventional' apple, carrot, green cabbage, potato and tomato were analysed for a range of nutrients, to establish whether produce sold as 'organic' differed in composition from that sold as 'conventional'.	46
Fish and fish products	83 samples analysed for a large range of nutrients.	
Analysis of Total Diet Study	The 1991 TDS samples were analysed for total fat, fatty acids, and a range of minerals including iodine and selenium.	

Table 7 *continued*

Project	Details	Published references[a]
Analysis of retail cuts of carcase pork	To provide reliable nutrient data on the composition of retail cuts of carcase pork. 75 samples (a range of popular retail cuts) analysed for a wide range of nutrients.	
Analysis of retail cuts of carcase beef	To provide reliable nutrient data on the composition of retail cuts of carcase beef. 75 samples (a range of popular retail cuts) analysed for a wide range of nutrients.	
Carotenoids in vegetables	20 foods analysed for individual carotenes. Foods included carrots (seasonal analysis), cabbages, broccoli, spinach, peppers, tomatoes, apricots and mango.	8, 10
Fatty acids and vitamin E in ready meals	17 ready meals were analysed for total fat, individual fatty acids and vitamin E content.	29
Fat, fatty acids and vitamin E	A selection of biscuits, cakes, desserts, ice creams, animal fats and dressings were analysed (65 samples).	
Fatty acids in foods	64 samples analysed for total fat, individual fatty acids and sterols. Samples included fat spreads, confectionery, cooked meat products, savoury snacks and milk products.	
Measurement of food folates and their bioavailability in humans	The objective of this project was to refine chemical and biochemical methods of determining folate levels in foods; to determine changes caused by oxidants; and to measure (in rats and humans) folate-binding proteins, blood and urinary folate over time. Levels of food folates in the Total Diet Study were also determined.	47
Iodine content of dietary supplements and milk	76 dietary supplements analysed. Whole and skimmed milks from 13 regional dairies were collected at intervals for iodine analysis.	
Vitamin D in meat	This project was designed to establish if meat had vitamin D activity.	

[a] Work without published reference is currently being prepared for publication.

Table 8: Current analytical projects.

Project	Objective
Analysis of retail cuts of carcase lamb	To provide reliable nutrient data on the composition of retail cuts of carcase lamb. 65 samples (a range of popular retail cuts) are being analysed for a wide range of nutrients.
The effects of domestic cooking and preparation techniques on the nutritional composition of vegetables	A range of fresh and frozen vegetables important in the British diet will be prepared by several different domestic techniques and the resultant nutrient losses assessed. Cooking methods will include boiling, microwaving, steaming, pressure cooking, stir-frying and baking.
Selective isolation and concentration of individual folates from food digests	To develop a simple, robust and reproducible procedure for the concentration of folates from food digests and subsequent removal of interferences. This procedure would allow the determination of individual forms of folate present in foodstuffs by HPLC procedures.
Determination of the selenium content of a wide range of British foods	To provide reliable data on the selenium content of a range of British foods. 210 composite food samples, including a wide range of cereal products, will be analysed for their selenium content.
Determination of the chemical forms of selenium in key foods	To develop methods for isolating and identifying selenium species in key foods.
Determination of *cis*-carotenoids in foods	To develop a HPLC procedure to separate and quantify the *cis*- and *trans*-isomers of the major pro-vitamin A carotenoids found in foods.
Determination of dietary vitamin K intake and food sources	To provide a database of the key food sources of vitamin K in the British diet, and provide an estimate of daily intake of vitamin K by different groups within the population.

Table 9: Seasonal variation in β-carotene levels of carrots: raw, cooked and frozen (μg/100 g).

Sample number	Carrots, new summer, raw	Carrots, old summer, raw	Carrots, new winter, raw	Carrots, old winter, raw	Carrots, old winter, cooked	Carrots, frozen
1	4020	5660	4530	4210	3290	3190
2	3640	5780	5120	3260	2370	2470
3	4230	6880	4580	3410	2290	3530
4	3570	5940	3940	4060	4120	4010
5	3470	7350	2610	4460	2900	3050
6	3040	5190	2350	3510	1640	2630
7	4220	4640	4210	3760	2590	3530
8	3230	5800	5270	3010	2420	2930
9	3040	6980	4050	4540	2370	5360
10	4280	4980	2320	2720	1720	4910
Mean	3480	5920	3900	3690	2570	3560
SD	610	900	1100	620	730	950

Individual fatty acids in foods

49. The data available on individual fatty acids in foods have been updated and extended considerably. Interest in the various positional and geometric isomers of mono-, di- and tri-unsaturated fatty acids present in foodstuffs has led to the development of ever-more elegant means of separating them by capillary gas-liquid chromatography using non- or mid-polar or highly polar columns.

50. The range of foods analysed include meat products, offal, game, margarines, low- and reduced-fat spreads, eggs, milk products, cakes and biscuits, desserts, ice creams and ready meals. Data on ready meals have recently been published,[32] and Table 10 shows some selected results for other foods. These data are currently being prepared for publication. The Ministry's Total Diet Study samples have also been analysed for these acids.

Vitamin D in meat

51. Work has also been undertaken to obtain accurate measurements of vitamin D and its metabolites in meat using physicochemical and immunoassay methods. The results of these analyses are presented in Table 11. No parent vitamin D was detected, but the more active metabolite 25(OH)D was present in most samples in variable amounts. The metabolite $1,25(OH)_2D_3$ was present in much higher quantities in chicken meat than in beef. These vitamin D metabolites are currently being determined as part of the nutritional studies on carcase meats and although there is no consensus on their respective levels of biological activity, the findings are still of much interest. This work is currently being prepared for publication.

Table 10: Fatty acid composition of selected foods (g/100 g food).

Food	Moisture	Total fat	Saturates	Mono-unsaturates	Polyunsaturates	*Trans*
Goats' milk, full fat	88.0	3.7	2.2	0.8	0.1	0.1
Sheeps' milk, full fat	83.2	5.8	3.3	1.1	0.3	0.3
Cheese spread, processed	53.5	23.0	13.7	5.3	0.6	1.1
Thick and creamy yoghurt	74.4	2.7	1.6	0.6	0.1	0.1
Vegetable ghee	tr	99.4	45.8	34.4	8.8	1.0
Venison, raw	73.7	2.2	0.9	0.4	0.4	0.1
Duckling, meat only, raw	74.8	6.5	1.9	3.0	0.9	0.1
Pig heart, raw	76.6	3.8	1.4	1.0	0.5	0
Lamb heart, raw	77.3	6.8	2.9	1.6	0.5	0.5
Salami	33.6	40.3	15.3	18.3	4.7	0.2
Meat paste	65.8	13.7	4.2	5.4	2.1	0.4
Saveloy	58.5	27.9	8.7	10.8	4.1	0.5
Cheese and tomato pizza	54.8	6.5	2.3	2.1	1.0	0.2
Potato waffles, baked	48.4	12.9	5.4	5.1	1.4	0.3
Chips, microwaved	46.2	10.2	3.8	3.3	2.1	0.1

Note: tr = Trace

Table 11: Vitamin D and its metabolites in chicken and beef meat.

	Vitamin D_3 (µg/100 g)		$25(OH)D_3$ (µg/100 g)		$1,25(OH)_2D_3$ (µg/100 g)	
	raw	cooked	raw	cooked	raw	cooked
Chicken						
Breast, butcher (4 samples)	0	0	0.09–0.27	0.00–0.25	0.001–0.003	0.001–0.005
Breast, supermarket (3 samples)	0	0	0.42–0.72	0.17–0.88	0.002–0.003	0.003–0.004
Breast, free range (2 samples)	0	0	0.00–0.18	0.06–0.14	0.002–0.005	0.002–0.005
Leg, butcher (4 samples)	0	0	0.14–1.04	0.20–0.42	0.002–0.003	0.003–0.005
Leg, supermarket (4 samples)	0	0	0.00–1.49	0.00–1.60	0.002–0.004	0.002–0.007
Mean			0.41	0.34	0.003	0.004
SD			0.40	0.46	0.001	0.001
Beef						
Rump steak, butcher (1 sample)	0	0	0.25	0.48	<0.001	<0.001
Rump steak, supermarket (1 sample)	0	0	0.36	0.46	<0.001	<0.001
T-bone steak, butcher (1 sample)	0	0	0.51	0.72	<0.001	0.001
Braising steak, supermarket (1 sample)	0	0	0.15	0.36	<0.001	<0.001
Mean			0.32	0.51		
SD			0.15	0.15		

52. The Working Party *recommends* that more work is done to establish if meat and meat products can be considered to be a significant source of dietary vitamin D. The Working Party also *recommends* that further work be carried out on the biological activity of vitamin D metabolites.

Iodine content of cows' milk

53. As part of a survey of the iodine content of the diet, a project determining the levels of iodine in milk was commissioned. Milk samples were collected at intervals over a period of one year (1990–1991) from 13 dairies throughout the UK. Table 12 summarises the results obtained. These confirm the difference expected between summer and winter milk. Very little difference was observed, however, between the levels in skimmed and full fat milk. Some regional variation was found with average values being highest in Devon, Mid-Glamorgan and Berkshire and lower levels being found in Liverpool, Leeds and Glasgow. Some of this may be attributed to different feeding patterns, for example animals may be put out to pasture earlier in some parts of the country than in others. Although iodine levels in milk seem to have stabilised in

Table 12: Iodine content of milk 1990–91: summary of results.

Sample	Iodine content (µg/kg)	
	Mean	Range
All samples	154	40–310
All whole milk	153	50–310
All skimmed milk	154	40–290
Nov/Dec 1990		
all	226	150–290
whole	223	150–290
skimmed	202	110–290
March 1991		
all	203	110–310
whole	204	130–310
skimmed	202	110–290
May/June 1991		
all	97	40–140
whole	92	50–120
skimmed	101	40–140
July 1991		
all	90	40–170
whole	94	60–170
skimmed	85	40–170
Winter (Nov/Dec and March)		
all	214	110–310
whole	213	130–310
skimmed	215	110–290
Summer (May/June and July)		
all	93	40–170
whole	93	50–170
skimmed	93	40–170

recent years they remain higher than those reported in 1965, and there is still considerable sample variation. Full details of this study, together with further information on the iodine content of the diet, are being prepared for publication.

54. Owing to recent concern expressed about potential high intakes of iodine in the British diet, these results were presented to the Committee on the Toxicity of Chemicals in Food, Consumer Products and the Environment (COT) in September 1992. The COT was reassured that average iodine intakes for adults did not give rise to any toxicological concern but recommended that monitoring of iodine levels in milk should continue.[33] The Working Party *endorses* this recommendation, and further *recommends* that such monitoring should also continue to include other important sources of iodine in the British diet.

Current food composition projects

55. Details of current analytical studies are shown in Table 8. Three main areas of work are the nutrient analysis of carcase meats (beef, pork and lamb), the analysis of foods for selenium content, and the analysis of foods for vitamin K content.

Carcase meats

56. Information on the nutritional value of a wide range of cuts of meat in the UK is reported in the fifth edition of *McCance and Widdowson's The Composition of Foods*,[9] but these analyses were performed on cuts of meat available to the consumer in the early 1970s. At that time, data were obtained on both raw and cooked samples, and analysis of lean and separable fat was performed. The cooking procedures were restricted to the then more traditional methods such as roasting, stewing, grilling, frying and boiling.

57. Since the early 1970s carcase meats are likely to have undergone changes in composition, due to changes in breeds of animals (for example, continental breeds of cattle, which have become more popular, tend to have less fat marbling than the more traditional crossbreeds), husbandry and butchering practices and cooking procedures. Many methods for the determination of nutrients have also been improved.

58. As a result, a major review of the nutrient composition of retail cuts of carcase meats is now underway. Of this, the analytical work on carcase beef and carcase pork has almost been completed and the data are currently being evaluated for incorporation into the Ministry's nutrient databank and the NFS nutrient databanks. These data will also be published as a further supplement to the fifth edition of *McCance and Widdowson's The Composition of Foods*.[9] A project on carcase lamb is due to be completed in mid-1994.

Selenium content of foods

59. Since the early 1980s, interest in the role of selenium in human health has increased. In addition to being an essential element in the diet, it also has antioxidant properties. Selenium has therefore been included in the fifth edition of *McCance and Widdowson's The Composition of Foods*,[9] but values for many foods are either unavailable, or very old. Over the years there has been considerable change in the levels in such traditional sources as flour for bread making, and in the amounts obtained by dairy cattle and poultry from animal feed.[34] The Working Party therefore identified the need to update and extend information on key sources of this element in the UK diet and analysis of a wide range of foods, including flours, breads, breakfast cereals, other cereal products, milks, shellfish, game and selected vegetables, is now being carried out. Regional samples are also being analysed, where important differences in selenium content are known to exist. Work is also ongoing to develop a method to isolate and separate different selenium species (selenomethionine, selenocystine, selinite and selenate), each of which is known to have differing bioavailability in humans.

Vitamin K in foods

60. There is also limited quantitative information available on the vitamin K content of foods, or on vitamin K requirements. A project is therefore underway to provide information on the levels of this vitamin in foods commonly consumed in the UK. These data will be used to determine the relationship between vitamin K intake and biochemical status, to investigate any possible antioxidant activity, and to identify key food sources and the potential risk of deficiency for different groups of the population.

Dietary surveys

61. A number of techniques are employed and evaluated in surveys endorsed by the Working Party on Dietary Surveys and commissioned by the Ministry. These include duplicate diet studies, weighed diary records, semi-quantitative diary records, and food frequency questionnaires. These methods are described in Appendix VIII and summarised where appropriate in the section on recent surveys (paras. 73–92).

62. A number of factors are considered by the Working Party when deciding the most appropriate methodology to apply. These include:

(i) the group to be studied – different methods are required, for example, for infants and for elderly people;

(ii) the detail needed in order to study the problem effectively; and

(iii) the limitations of the scientific and financial resources available.

63. Some surveys include more than one methodology, for example, a four-day weighed diary record and a food frequency questionnaire have been included in the methodology for the NDNS of children aged $1\frac{1}{2}$–$4\frac{1}{2}$ years. This both provides for the collection of information on the actual foods eaten over the study period and enables unusual diets and foods of particular interest to this and other working parties to be identified and assessed for nutrient and non-nutrient intakes.

64. The Ministry requires reliable quantitative data on food consumption to make good estimates of both nutrient and non-nutrient consumption. Much risk assessment for non-nutrients is based on the data collected for individuals in surveys such as the Dietary and Nutritional Survey of British Adults[14] and of other surveys of specific groups, for example, infants.[35] There are, however, a number of potential sources of imprecision in dietary assessment methods such as the choice of foods for inclusion in the code list, the choice of the food composition information used and, more importantly, the process of recording by the individual. For foods eaten outside the home there is also possible error due to estimation of portion sizes. The impact of many of these difficulties can be lessened by the progressive refinement of the survey methodology employed, for example, the development of a set of validated food photographs for estimating food portion weights may greatly improve the accuracy of the data recorded.

65. The Working Party recognises the importance of developing improved methods for collecting quantitative data on habitual food consumption and *recommends* that further work be carried out in this area.

Validation of dietary studies

66. The major concerns in dietary assessment are that the dietary consumption of the subject may alter during the assessment period and that such studies have a potential bias towards under-recording. The Working Party considers the accurate validation of energy and nutrient intake data collected in dietary surveys to be extremely important and *recommends* that methods applicable to specific population groups are continuously developed and refined.

67. The average daily energy intake for individuals can be validated against the measured energy expenditure, for example, using the doubly labelled water technique, or against the measured or estimated basal metabolic rate (BMR). Unfortunately the use of doubly labelled water is limited by its availability and cost to studies of relatively small numbers of people, for example, to the NDNS feasibility study of children aged $1\frac{1}{2}$–$4\frac{1}{2}$ years. Measurement of BMR is generally restricted to clinical studies but equations for estimating BMR for older children, adolescents, adults and elderly people have been developed[15] based on weight, age and sex. Such equations do not, however, exist for children under five years of age.

68. Other means of validating food and nutrient intake data include the use of biomarkers such as 24-hour urine nitrogen output in individuals in nitrogen balance. Although specific biomarkers already exist for some macronutrients, vitamins and minerals, several important nutrients remain to be covered. The Working Party therefore *recommends* that the search for additional biomarkers be continued.

Evaluation of dietary studies

69. The energy and nutrient intake data collected from dietary surveys have to be evaluated and interpreted before conclusions can be drawn. The usual standards for nutrients are the Dietary Reference Values (DRVs).[15] However, these can give no more than a guide to the adequacy of diets. The DRVs for any one nutrient presuppose that requirements for energy and all other nutrients are met. To determine the extent of the risk of deficiency within a specific population group, the average group intakes for nutrients must therefore be compared with the Reference Nutrient Intakes (RNI). Intakes above the RNI will almost certainly be adequate and intakes below the Lower Reference Nutrient Intake (LRNI) are almost certainly inadequate for most individuals. However, it is impossible to say for certain whether an individual's nutrient intake, if it lies between the LRNI and the RNI, is or is not adequate, without some additional measurements of nutritional status, for example blood and urine analytes and anthropometric measurements (body weight, height, waist, hip and mid-upper-arm circumferences and skin fold thicknesses), being made.

The Working Party therefore *recommends* that serious consideration be given to the inclusion of measures of nutritional status in dietary surveys wherever possible.

70. Minimum plausible levels of energy expenditure expressed as a multiple of BMR can be used as cut-off limits to evaluate energy intake data. Results falling below these limits are likely to be incompatible with long-term maintenance of energy balance. The Working Party therefore *recommends* that BMR should be measured or estimated wherever possible and that caution should be taken in interpreting data for subjects with measured energy intake below measured or estimated expenditure.

71. In addition to analyses and evaluation of the NDNS and NFS, the Working Party *recommends* that analyses or further analyses of data collected in other dietary surveys of specific population groups, for example single parent families, also be undertaken. The results from such additional surveys contribute to the knowledge of food and nutrient consumption of individuals and populations who may be at risk but who are under-represented in the NDNS and NFS because they only represent a small percentage of the total population.

Recent dietary surveys

72. Several dietary surveys and allied projects have been carried out since 1988. These are listed together with information on the outcome in Table 13. Further details of specific projects are outlined on pp. 27–36.

Table 13: Dietary surveys and allied projects carried out since 1988.

Study	Objectives	Outcome
Dietary surveys		
Food consumption outside the home; collation and evaluation of available data	To establish what surveys have been conducted in the past 8–10 years and what surveys are projected to start. To assess the value of such surveys to the Ministry in its attempt to fill the gap between food consumption as reported by the NFS and total food consumption.	Report produced Dec. 1989 and presented to Working Party. Information used to extend NFS to include food and drink purchased and consumed outside the home.
The Dietary and Nutritional Survey of British Adults	To provide detailed information on the current dietary behaviour and nutritional status of the adult population living in private households in Great Britain.	Report published in 1990.[13] Further analysis continuing for additional publications.
Food and nutrient intakes of British infants aged 6–12 months	To determine the type and quantities of food eaten by infants and the extent of variation between individuals according to such factors as the infant's age and the family's socio-economic background.	Report published Dec. 1992.[34]

Table 13 *continued*

Study	Objectives	Outcome
Dietary survey of vegetarians (demi-vegetarians, lacto-ovo-vegetarians and vegans)	To estimate the grouped energy and nutrient intakes of the whole vegetarian sample and each sub-sample, to make possible the assessment of the nutritional adequacy of their respective diets.	Report submitted in 1989. Publication of three scientific papers.[38, 39, 40]
Pilot and developmental work for National Diet and Nutrition Survey: children aged 1½–4½ years	To test the proposed questionnaire and establish whether the suggested design and methods are suitable for a main survey to provide reliable data on the diets of pre-school children.	Information used in preparation for main NDNS: children aged 1½–4½ years. A report was submitted and two papers have been prepared for publication in scientific journals.[41]
Survey to investigate changes in food consumption over time within the same group of people	To identify characteristics of individuals more at risk of exceeding the Acceptable Daily Intake (ADI) for food additives and contaminants and as an aid in assessing the validity of assumptions made when estimating consumption of various foods from short-term dietary surveys.	Data used by Risk Assessment and Management Branch.
Avon Longitudinal Study on Pregnancy and Childhood	To determine if the consumption of caffeine in pregnancy can be related to the outcome of pregnancy and to determine how children's diets change from birth to school age in terms of consumption of foods containing caffeine and other pharmacologically active principles including food additives.	Report submitted on caffeine intake in pregnancy with pregnancy outcome, Dec. 1992.
National Diet and Nutrition Survey: children aged 1½–4½ years (main survey, OPCS)	To provide detailed quantitative information on the food and nutrient intake, sources of nutrients and nutritional status of pre-school children. See also Appendix II.	Survey fieldwork was completed in July 1993. The first published report is due in 1994.
Asian diet study	To collect information on the types of foods and recipes eaten and the frequency of consumption of foods by South Asian groups in the UK. To analyse and calculate the nutrient content of the main ethnic foods.	The pilot work is complete and the main study is underway. Some analyses have been passed to the Ministry.
Development of survey methodology		
Integrated dietary analysis – electronic recording of the descriptions and weights of food and drink consumed	To develop software and modify the necessary hardware to allow a hand-held computer to record and code foods eaten in a dietary survey and to link this with a PC for nutrient analysis.	Report received. Development and evaluation continuing.

Table 13 *continued*

Study	Objectives	Outcome
Validation of weighed food intake records and other dietary assessment techniques for women (aged 50–65 years) and men (over 60 years) with doubly labelled water and urinary nitrogen	To compare total energy expenditure (as measured by the doubly labelled water technique) and 24-hour urinary nitrogen excretion as biomarkers for testing the validity of reported food intake.	The report on the results from the women has been received and a scientific paper is being prepared for publication.
Development of standard food photographs for use in dietary surveys – phase I	To determine if people can identify portion weights using photographs, and the type of biases in perception which may exist, to determine if the style of photograph (i.e. size, black-and-white or colour) affects the ability of subjects to estimate portion size.	The work is currently underway and phase I is due to be completed in 1994. A scientific paper on the initial results has been prepared for publication.
Analysis of survey data		
Diet, nutrition and health interrelationships in the Dietary and Nutritional Survey of British Adults	To examine the interrelation between various aspects of diet and clinical, biochemical, anthropometric and behavioural characteristics of individuals studied in the Adult Survey.	Analysis currently underway.
Analysis of dietary data from Whitehall II study of Civil Servants	To carry out two types of investigation: (i) surveillance of what a stratum of the British working population is eating, and the relationship of eating patterns to other factors; (ii) to increase the information on the relationships between nutrition and a variety of health measures; also to relate nutritional patterns to other health behaviour, such as smoking, drinking and exercise, as well as to health status.	Analyses of food intake records and food frequency questionnaires are being completed. Further analyses to look at relationships are being carried out. A report is expected in 1994.

The Dietary and Nutritional Survey of British Adults

73. This survey was commissioned jointly by the Ministry and DH and conducted by the Social Survey Division of the Office of Population Censuses and Surveys (OPCS). Dietary and nutritional evaluations were carried out by the Ministry and DH. Nearly 2200 (2197) people representative of the population aged between 16 and 64 years (but excluding pregnant women) kept a detailed weighed record of all food and drink that they consumed for seven consecutive days. Selected anthropometric measurements (for example, height, weight) and blood pressure were determined. Blood and urine (24 hour) samples were taken and extensively analysed. Details of lifestyle characteristics (for example, smoking, slimming, dietary supplement use) and socio-economic factors were also collected.

74. The initial results from this survey have been published.[14] A selection of the most significant findings is presented in Table 14. So far they have been used for assessing the effects of the Government's policies on food and nutrition, for developing new dietary reference values for the UK and for the EC, and to estimate the intakes of food chemicals including pesticides, additives and contaminants.

Table 14: Selected results from the Dietary and Nutritional Survey of British Adults.

1. More women than men ate wholemeal bread, reduced-fat milks, salad vegetables, fresh fruit and sweets; more men ate fried white fish, sausages, meat pies and chips.
2. Fat provided, on average, 40.4% and 40.3% of food energy (excluding alcohol) for men and women, respectively.
3. Men and women in social classes I and II had higher fibre intakes than those in lower social classes.
4. A total of 12% of women and 8% of men were obese (i.e. body mass index was greater than 30) compared with 8% and 6% in 1980.
5. One-third of all women and 45% of those under 50 years, had low iron stores.
6. Those who took food supplements had higher nutrient intakes from food alone than those who did not take supplements.
7. Levels of total serum cholesterol were higher in those consuming a large proportion of energy as saturated fatty acids, and those with higher body mass index.
8. Men obtained about one-third and women about one-quarter of their total energy intake from food eaten out of the home.

Dietary survey of British infants

75. Until recently little quantitative information was available on the range of foods fed to infants or the nutrient intake of older infants. To correct this deficiency, the Ministry commissioned a national dietary survey of infants aged 6 to 12 months. The survey was conducted by Research Surveys of Great Britain (RSGB) Ltd. The sample of 488 infants (81 per cent response rate) was recruited from a nationally representative commercial baby panel. Each mother completed a seven-day quantitative record of all the food and drink given to and consumed by her infant. Additional information on past and present feeding habits was obtained via a personal interview after the mother had completed the diary record.

76. Intakes of 38 nutrients together with total energy were calculated from the records of food consumption using a specially developed nutrient databank and were compared with the DRVs set out in the report, Dietary Reference Values for Food Energy and Nutrients for the United Kingdom.[15]

77. Selected results of the study have been published and presented at scientific meetings.[36,37] A report, Food and Nutrient Intakes of British Infants Aged 6–12 Months,[35] was published in 1992 which draws all the information together. This showed that milks continue to be important sources of nutrients, providing over 40 per cent of protein and energy, and over half the average intake of fat, calcium, riboflavin and iodine. With the exception of vitamin D, zinc and iron, average intakes

of nutrients from food were well above the RNIs. Iron intakes were marginal and require further investigation particularly as the major sources, fortified commercial infant foods and infant formulas, tend to be replaced by cows' milk (which is low in iron) and 'family foods' in the second year of life. The percentage contributions of foods to iron intake for infants aged 6–9 months and for infants aged 9–12 months are shown in Fig. 1.

78. The food consumption data have been used to provide details of the distribution of intakes. This has been used internally by other working parties to estimate the dietary intake of pesticides, radioactivity doses and additives in this age group. The data from the survey have also been used in EC negotiations, e.g. the draft Directive on processed cereal-based foods and baby foods for infants and young children, and as background information to the DH COMA Working Group on Weaning.

Other recent surveys

79. The Ministry has commissioned various *ad hoc* surveys to assess the intakes of foods and nutrients of potentially nutritionally vulnerable groups. Details of those completed since 1988 or currently underway are summarised below.

Dietary survey of vegetarians

80. A survey of 127 vegetarians (37 demi-vegetarians; 52 lacto-ovo-vegetarians; 38 vegans) from Greater London was conducted in 1987 and the data analysed from 1988 onwards.

81. Informants kept a weighed record of all food and drink consumed for three days. In addition a food frequency questionnaire was completed and an extensive interview on attitudes to diet, food preparation practices, health and lifestyle carried out.

82. The findings of this survey, which have been published in the scientific literature,[38,39,40] have shown that demi-vegetarians, lacto-ovo-vegetarians and vegans have on average adequate energy and protein intakes compared to the DRVs. However, only vegans have fat intakes close to current recommendations. Average intakes of all the micronutrients studied for demi- and lacto-ovo-vegetarians met the UK RNI but intakes of iodine, riboflavin and vitamin B_{12} for vegans were below the RNI. About 25 per cent of the subjects took some type of dietary supplement during the time of the survey.

Avon Longitudinal Study on Pregnancy and Childhood

83. The Avon Longitudinal Study on Pregnancy and Childhood (ALSPAC) is a research initiative of the University of Bristol designed to identify features which are important in the development, well being and health of a geographical cohort of

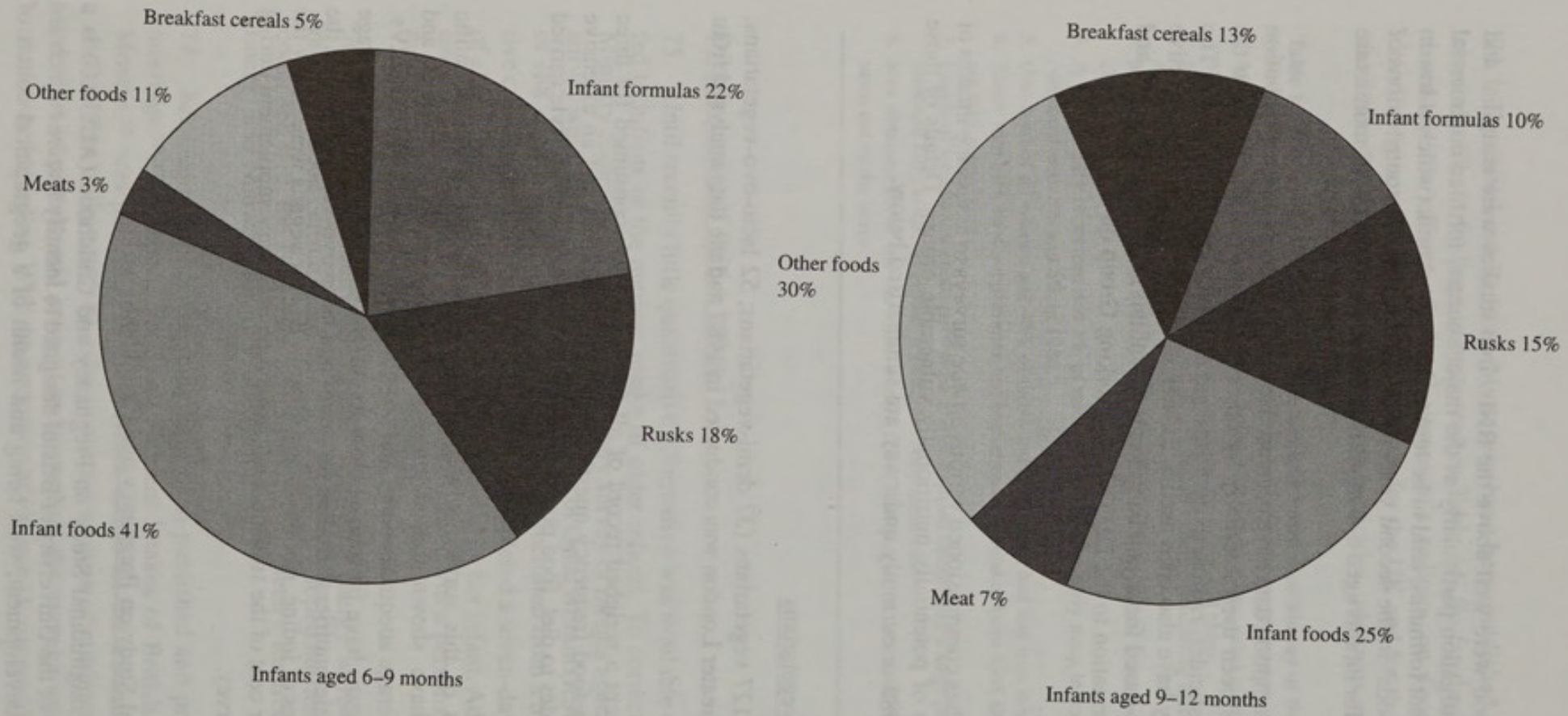

Fig. 1: Percentage contribution of foods to iron intake

children born in Avon. The study is being funded by a number of organisations, including the Ministry.

84. It is a postal survey of some 15,000 participants. From the 20th week of pregnancy until the child is seven years old, subjects will receive about 20 questionnaires collecting information on diet, environment, health, etc. Data on frequency consumption for particular foods of interest will be collected until the end of the survey. A detailed study of iron status in a sub-sample of mothers and infants up to two years of age has begun.

85. One of the more important aspects of the survey from the Ministry's point of view is the determination of how children's diets change from birth to school age, particularly in respect of foods containing food additives or pharmacologically active principles such as caffeine. Consumption of caffeine in pregnancy has also been monitored and the information related to pregnancy outcome.

86. A report was submitted to the Ministry on caffeine intake in pregnancy and pregnancy outcome in 1992. There is no evidence from this study to suggest that caffeine has a detrimental effect on the outcome of pregnancy.

Food consumption outside the home

87. This project consisted of a review (collation and evaluation) of available information on the consumption of food outside the home. The reviewers concluded that detailed quantitative data on food purchased and consumed outside the home were not available at that time. As a result it was decided to extend the NFS to include food and drink purchased and consumed outside the home as recommended by the Working Party on Nutrients in 1988.

Taylor Nelson Longitudinal Survey of Eating Habits

88. This survey investigates changes in food consumption over time within the same group of people. Every six months a two-week diary of consumption of a predefined group of foods has been collected from 2100 nationally representative households (5500 individuals). Although a comparison of the results with those obtained from the Dietary and Nutritional Survey of British Adults suggests that the Taylor Nelson survey tends to underestimate food intakes, it can nevertheless provide a valuable source of information about dietary trends.

Current dietary surveys

89. The fieldwork for the first survey in the NDNS programme, a study of 1700 children aged $1\frac{1}{2}$–$4\frac{1}{2}$ years, was conducted by the Social Survey Division of the Office of Population Censuses and Surveys (OPCS) and the Medical Research Council's (MRC) Dunn Nutrition Unit, Cambridge, and completed in June 1993. Parents and carers were asked to keep a detailed weighed record of all food and drink consumed

by the study child over a period of four consecutive days including a Saturday and Sunday. From these records, information on intakes of 55 nutrients including total fat, fatty acids, fibre, vitamins, minerals and individual sugars will be obtained.

90. Anthropometric measurements (standing height or supine length, mid-upper arm circumference, head circumference and weight) were also made as part of the study, and where consent had been given, blood samples were taken in addition. The latter was analysed for a number of analytes including haemoglobin, ferritin, vitamins, trace elements, fat, albumin and markers of immune function. The initial results of the survey should be available in a published report in 1994. The Department of Health also commissioned a separate dental survey which was conducted after completion of the dietary survey. This comprised an interview and a full dental examination.

91. The next population group to be surveyed in the NDNS programme will be elderly people, i.e. adults aged 65 years or over. This survey will include both those living in communal establishments (approximately 400) and those living in their own homes (approximately 1250). The survey will be conducted by Social & Community Planning Research (SCPR) in conjunction with the Department of Epidemiology and Public Health, University College London and the MRC Dunn Nutrition Unit, Cambridge. Pilot work is due to begin in February 1994. The method for collecting quantitative dietary information will be tested and the completeness of the dietary record will be validated for each subject by comparing their urinary and dietary nitrogen. Para-amino-benzoic acid (PABA) will be used as a check for completeness of the 24-hour urine sample. After the results of the pilot survey have been carefully evaluated and appropriate amendments made to the methodology, the mainstage survey will start in October 1994 and continue for 12 months. Information will be collected on food and nutrient intakes, anthropometric characteristics, a range of blood and urine analytes, as well as socio-economic, demographic, health and lifestyle factors.

Survey of commonly consumed foods by groups of South Asian origin

92. This project is collecting information on commonly consumed foods and dishes by groups of South Asian origin in the UK (Gujerati, Punjabi, Pakistani, Bengali and Ismaili). The foods and dishes are also being analysed for their nutrient content. Pilot work is complete and the main study is underway. The nutrient composition of a small number of recipes has already been used in *Vegetable Dishes*, the second supplement to *McCance and Widdowson's The Composition of Foods*.[11] A comparison will be made of the nutrient content calculated from food composition tables with the results of laboratory analysis of common dishes made in the home and obtained from retail outlets. Information about the frequency of consumption of traditional foods in the diets of different generations within the study groups will also be obtained and used as a basis for devising health education strategies as required.

Projects on survey methodology

93. A number of projects allied to dietary surveys have been undertaken by the Ministry since the 1988 report. These are summarised below.

Validation of the dietary recording procedure used for the NDNS of children aged 1½–4½ years

94. A feasibility study for the National Diet and Nutrition Survey of children aged 1½–4½ years was completed in 1989. The doubly labelled water technique was used to validate the energy intake calculated from a four-day weighed food intake record. Ninety-three children fully co-operated with all aspects of the survey and measurements of energy intake and energy expenditure were successfully achieved for 81 children (39 females, 42 males). Table 15 shows that mean total energy intakes and total energy expenditures are similar in both the entire cohort and in the three age groups. The average difference of only 3 per cent provided sufficient confidence in the weighed intake methodology for this method to be used in the mainstage of the NDNS of children 1½–4½ years. These results have been included in a scientific paper which is in press.[41]

95. The data from this study were also used to look at inter- and intra-individual variation in nutrient intakes to determine the criteria for selection of the number and type of days of the week when food intake recording should take place. Significant differences in average nutrient intake for certain nutrients between weekdays and weekend days were found resulting in the decision to use a four-day record which included two week days and both weekend days. A paper has been prepared for publication.

96. A report on the method developed from this study and a subsequent pilot study will be published in the OPCS Survey Methodology series early in 1994.

Validation of dietary intake records using doubly labelled water and urinary nitrogen

97. This is a study of simultaneous validation of reported dietary intake (measured by five techniques: weighed records, food frequency questionnaire, 24-hour recall by

Table 15: Mean total energy intakes and energy expenditures of children aged 1½–4½ years.

Ages (years)	*N*	Energy intake (kJ/day)		Energy expenditure (kJ/day)	
		Mean	SD	Mean	SD
1½–4½	81	4773	828	4928	987
1½–2½	23	4204	631	4472	1062
2½–3½	31	4635	740	4874	828
3½–4½	27	5418	635	5380	916

post and by interview, and semi-quantitative food diary) against total energy expenditure measured by the doubly labelled water technique and 24-hour urinary nitrogen excretion in 18 women aged 50–65 years and 30 men aged 60 years and over.

98. A report containing the outcome of the study on the women has been received and has been presented at a scientific meeting. The work on the men is not yet complete but the results should be available in time to be used in planning the NDNS of elderly people.

Standard food photographs for use in dietary surveys

99. Little previous work has been carried out to assess the value of using photographs to determine portion size or weight in dietary surveys, despite the fact that photographs are being used more frequently. The first phase of a project which will determine if people can identify portion weights by this means and the type of biases in perception which may exist is now complete. The effects of the size and colour of the photograph or range of photographs depicting different serving size (or as a fraction or multiple of a standard portion photograph) on the ability of the subjects to estimate portion size has also been examined. A paper has been prepared for publication.

100. The need to weigh foods when using diary recording methods may reduce the response rate and/or alter the habitual intake. Further work will determine if photographs are helpful in improving the estimate of food consumption and nutrient intake based on '24-hour recalls' of known food consumption. Following the outcome of this work it is proposed to extend the project to identify exactly which foods and portion sizes should be represented in a set of standard food photographs and to evaluate the use of them in the assessment of food and nutrient intakes.

Integrated dietary analysis

101. The development of a program for a hand-held computer for electronically recording the descriptions and weights of foods and drink consumed by individuals was commissioned in 1989. The program allows the user to enter food consumption data by a menu system. Day, date and time are also entered. Weight is recorded either via electronic weighing scales attached via a serial port or by a portion size facility. Entry of personal data is possible. The data from the hand-held computer can be transferred to a personal computer (PC). The PC program has additional functions which are currently being developed and include recipe handling, the addition of single foods or nutrients to the database by the fieldworker, analysis of derived variables, basic nutritional analysis, editing, and creation of lists. The acceptability of the package by survey subjects and by nutrition scientists engaged in research will be assessed.

Analysis of survey data

102. The Dietary and Nutritional Survey of British Adults has produced an enormous volume of data on the food and nutrient intake, nutritional status, and anthropometric measurements of the British population, aged between 16 and 64 years. The report published in 1990 presents only the initial findings of the survey.

103. Since then the Ministry has undertaken, in addition to other researchers, further analyses of the dietary data to provide information on the contribution that foods make to intakes of minor nutrients not covered in the initial report, to compare nutrient intake data with the DRVs and to compare dietary patterns of sub-groups of the population who achieve specific population DRV targets with those that do not.

The Dietary and Nutritional Survey of British Adults: NHS Central Register flagging of respondents

104. Subjects participating in the above survey have been identified on the NHS Central Register to enable information on the eventual cause of death to be passed back in an anonymised manner to the Ministry and DH. Possible relationships between cause of death and nutritional and dietary parameters will then be explored.

Diet, nutrition and health interrelationships in the Dietary and Nutritional Survey of British Adults (Adults Survey)

105. Interrelationships between various aspects of diet and clinical, biochemical, anthropometric and behavioural characteristics of individuals studied in the Adults Survey are being investigated by multivariate analysis. For example, associations between serum cholesterol and a number of factors including percentage of energy from fat and fatty acids, will be examined with and without allowance for age, body mass index, slimming and smoking habit. The hypothesis that a list of dietary variables can be identified to differentiate individuals with multiple risk factors from those at 'low risk' will also be examined.

106. A user group has been formed to stimulate discussion on the use of the data from the Adults Survey, to help people get the best from these data (and data from present and future surveys) for their own special needs, and to minimise duplication of research.

107. A newsletter, *Survey News*, for users of the data and other interested people, is also being produced. This free publication, which is issued twice a year, includes information on the raw data, including how they can be, and are being used, as well as updating readers on other surveys being carried out by the Government. It also aims to provide a discussion forum on issues related to survey data.

Whitehall II study: dietary assessment project

108. Analysis of food frequency questionnaires and seven-day weighed food diaries completed by 1000 Civil Servants is underway and will provide information on the eating patterns of a stratum of the British working population. Relationships between nutrition and dietary patterns and other health behaviour (e.g. smoking, drinking, exercise), health beliefs, health status and biochemical measures will be investigated.

Norwich survey of elderly people: further analyses

109. The data from a diet and health survey of 145 elderly people (68–90 years) resident in Norwich is being analysed to provide information on variations in daily nutrient intake. In addition two-year follow-up data are being investigated to determine variation in anthropometric and biochemical markers of nutritional status over time.

110. Information on variations in daily nutrient intake will be used in the development of the dietary record for the NDNS of elderly people.

FUTURE PRIORITIES

111. The Ministry is an important source of funding for strategic food research. Nutrition research has received increased funding in recent years, and expenditure has now risen to almost £4 million. Each year the Ministry identifies its strategic objectives and requirements for research in a published document.[42,43]

Food composition

Nutritive values of food

112. Continuous monitoring is needed to determine the nutritive value of important foods in the UK diet, with particular reference to those arising from the application of new technologies in agriculture, the food industry, the catering industry and the home. The Working Party on Nutrients in Food *recommends* that the Ministry's continuous programme of nutrient analysis continues, taking into account changing dietary habits of the UK population, and changing food industry practices.

Compounds of newly recognised nutritional significance

113. Developments in nutritional science concerning the relationship between diet and disease require an expansion of the range of constituents measured in foods and the diet. These include values for non-nutritive substances which are biologically active such as glucosinolates (free radical scavengers), polyphenolic materials (tannins, etc.) and phyto-oestrogens. Many of these have been formally considered as natural toxicants but it is clear that the boundary between nutrients and non-nutrients

is an arbitrary one. Other nutrients for which information is likely to be required in the future include long-chain polyunsaturated fatty acids, non pro-vitamin A carotenoids and other elements such as chromium. The Working Party *recommends* that consideration should be given to the inclusion of these substances in future work programmes. Work on emerging methodologies or technologies which would assist in the analysis of these compounds should be supported.

New and modified food products

114. It is likely that, in order to help achieve the nutritional targets set out by the Government's White Paper the 'Health of the Nation,'[2] the food industry will, over the next few years, modify the nutrient composition of a large number of existing food products, as well as produce a number of new ones. The number of novel foods and foods produced by novel processes appearing on the market will also increase. The Working Party *recommends* that such foods be considered for inclusion in future food composition work programmes.

Foods consumed outside the home

115. Information on foods consumed outside the home has been collected as part of the National Food Survey since January 1992. In recent years, there have been marked changes in patterns of eating out. The Dietary and Nutritional Survey of British Adults[14] found that 90 per cent of informants recorded the consumption of some food outside the home during the seven-day recording period.

116. The composition and nutritional value of foods purchased from catering establishments will often be different from the equivalent product prepared in the home. The Working Party *recommends* that in future food composition work, priority should be given to those foods that are identified by the National Food Survey as most commonly consumed outside the home. Consideration should be given, where possible, to regional variations in consumption patterns.

Methods of analysis

117. The Working Party *recommends* that methodological studies be carried out for the separation and measurement of different food folates, the carotenoids, vitamin D and its metabolites, *trans*-polyunsaturated fatty acids, maltodextrins and oligosaccharides in foods. Further work on the measurement of dietary fibre – non-starch polysaccharides – is also needed to improve precision and inter-laboratory agreement.

Bioavailability

118. The availability to humans of nutrients in foods is influenced by a number of factors, including the form of nutrient in the food, the presence of enhancing or inhibitory factors in the food or in other parts of the meal, and even the nutritional

status and age of the individual. The Working Party *recommends* that more work on bioavailability, particularly of vitamins and minerals, is undertaken, recognising that bioavailability is an attribute of the diet, not of the individual foods themselves. Studies are needed for calcium, iron, zinc, selenium, folates, carotenoids, tocopherols and vitamin D metabolites.

Biological activity

119. In addition to studies on bioavailability, the Working Party also *recommends* that studies of the biological activity of different folates, tocopherols, carotenoids, selenium and vitamin D metabolites should be carried out.

Dietary surveys

Diet and nutrition surveys

120. The Working Party strongly endorses the NDNS programme. Ministerial approval has been given for elderly people (adults aged 65 years or over) to be the next population group in this programme. Further details are provided in para. 91. The contractors for this survey have been appointed and work on finalising the methodology has begun. The Working Party has advised on the components of the survey and the methods to be tested in the feasibility work. The pilot survey is expected to be completed in spring 1994 and the 12-month fieldwork for the main stage is due to begin in October 1994.

121. It is intended that the next population group to be surveyed in this programme will be school children aged 5–15 years. The Working Party *recommends* that planning for this survey should begin in 1994.

122. The need for long-term prospective dietary studies to investigate the health implications of diet has been identified. The 'flagging' of subjects in dietary surveys for future follow-up requires the subjects' consent. The Working Party *recommends* that a longitudinal element should be considered for each dietary survey for future follow-up.

123. The need for more information on the diets of nutritionally 'at risk' sub-groups of the population (for example, low-income families and individuals) has been identified. The Working Party *recommends* that dietary surveys for such sub-groups should be considered.

124. Information on the use of sweeteners both in the general population and in those groups likely to consume large amounts of food containing sweetening agents, such as diabetics and children, has been requested by the Food Advisory Committee and the Committee on the Toxicity of Chemicals in Food, Consumer Products and the Environment (COT). This information is required in order to inform a review of the use of these substances and to determine if there are groups of the population who exceed the Acceptable Daily Intakes (ADI). The intake of sweeteners in young

children can be determined from the NDNS of children aged $1\frac{1}{2}$–$4\frac{1}{2}$ years. However, diabetics are not represented in sufficient numbers in this survey to provide a statistically representative study population. The Working Party is in agreement with the *recommendation* that a dietary survey of a representative sample of the UK diabetic population be carried out to furnish the required data. The Working Party also *endorses the recommendation* that the need to collect similar data for slimmers and reduced-weight maintainers be investigated.

125. Foods which are prime dietary sources of nitrates, pesticides and natural toxicants are of particular interest to the relevant working parties who monitor their intakes. Such foods include fruits, vegetables, pulses and herbal teas, with the result that vegetarians are potentially a population group with higher than average intakes of these classes of chemicals. The Working Party *endorses the recommendation* that a survey of nationally representative vegetarians (non-consumers of meat, poultry and fish) be carried out in order to collect information on food consumption via a diary record and to enable estimations of mean and extreme intakes of chemicals to be made. Such a survey should also include a duplicate diet study in a sub-sample of the population so that the levels of nitrates and natural toxicants ingested can be accurately determined. This work requires the development of a compositional database giving values for these constituents in representative samples of foods. The data from this survey would also be used to formulate a food sampling scheme for pesticide analysis.

126. Some foods designated as 'rarely consumed foods', e.g. eels, duck eggs, herbal teas, figs, nut butters (excluding peanut), veal and venison, may contribute significantly to the intake of particular contaminants. For such foods the traditional estimates of consumption are less accurate and the confidence limits around the mean and median are likely to be very large. The Working Party *endorses the recommendation* that methods of achieving accurate estimates of the consumption of these foods be considered.

127. There is a continual need for estimates to be made of the average intake of any food constituent (nutrient or non-nutrient) of current interest or concern in Britain. Data from existing food composition tables can be related to food consumption data for the purpose of estimating the average intakes of most nutrients. However, not all food constituents have up-to-date values. The Total Diet Study (TDS) supplies food samples representative of average consumption for analysis of any food constituent. The Working Party therefore *recommends* that the Total Diet Study be continued.

Projects on survey methodology

128. The measurement of food consumption is a major cause of uncertainty in estimating nutrient intakes and the improvement of methodologies in this area requires the development of concurrent use of a variety of methods based on different principles in order to avoid systematic bias.

129. There is a continual need to improve the techniques used to collect quantitative information on habitual dietary intakes. Projects which develop techniques to improve the quality of data collected and/or simplify the recording process for subjects and thus reduce recording fatigue are required. In addition the Working Party has identified the need for improved methods of food coding which would increase the product detail and reduce coding errors. The Working Party *recommends* that proposals for such projects are sought.

130. There is a need for more and improved measures for determining indices of nutritional status and for validating the consumption of food. The Working Party *recommends* that research be carried out to identify suitable biomarkers for these purposes and to determine the relationship between them and intake levels (i.e. the dose response relationship between serum levels and intake).

Analysis of survey data

131. Initial analysis of the data collected in the NDNS of children aged 1½–4½ years will be carried out by the survey contractor and prepared for publication. It is intended that the data will then be archived at the ESRC Data Archive at the University of Essex where it will be made publicly available. The Working Party will advise on requirements for any further analyses and list these in order of priority. It *recommends* that these analyses be undertaken as soon as resources allow.

132. It is likely that the Nutrition Task Force, set up to help achieve the targets outlined in the Government's White Paper the 'Health of the Nation', will require further analyses of the data from the Dietary and Nutritional Survey of British Adults. Such information is required to assist in the planning of dietary initiatives. In addition the Ministry also has a need for further analyses to assist with policy decisions. The Working Party *recommends* that analyses of these data should continue as long as it is relevant.

133. The Ministry's Risk Assessment and Management Branch has a need for estimating chemical intakes in children's diets. It is intended that data from the report, The Diets of British School Children,[44] will be used until data from the NDNS of school children become available.

134. The Working Party considers that there is a need for more information on the diets of low-income families and individuals. A few surveys of such populations have been carried out by other researchers but the data collected have not been fully analysed. The Working Party *recommends* that consideration be given to carrying out further analyses on good-quality data from such surveys.

CONCLUSIONS AND SUMMARY OF RECOMMENDATIONS

135. Since its formation in 1991, the Working Party on Nutrients in Food has recommended a programme of work which aims to ensure that up-to-date and

reliable information on the composition of foods is available so that the nation's diet can be adequately assessed. The Working Party on Dietary Surveys has recommended and advised on the National Diet and Nutrition Survey programme, *ad hoc* dietary surveys, and developments in dietary survey methodology. Both working parties will continue to scrutinise the results obtained from such surveys and allied projects, encourage their publication and recommend appropriate future work. Particular recommendations are that:

Food composition

(i) The programme of monitoring the individual foods that make up the UK diet should continue (paras. 27, 112).

(ii) Wherever possible, statistical principles should be incorporated into the sampling plans of analytical studies (para. 32).

(iii) Methodological studies should be carried out into the separation and measurement of different food folates using HPLC, the carotenoids, vitamin D and its metabolites, *trans*-polyunsaturated fatty acids, maltodextrins and oligosaccharides in foods. Further work on the measurement of dietary fibre – non-starch polysaccharides – is required to improve precision and inter-laboratory agreement (paras. 37, 41, 44, 117).

(iv) Further studies to relate the analytical values of component non-starch polysaccharide (NSP) fractions to their physiological effect should be undertaken (para. 42).

(v) Appropriate methodologies should be used when foods that contain high levels of maltodextrins and other oligosaccharides or emulsifiers are analysed (para. 44).

(vi) Laboratories carrying out nutritional analyses should use validated and recognised analytical methods where they are available; should have analytical quality assurance systems in place; and use Certified Reference Materials (CRMs) where appropriate (para. 45).

(vii) Laboratories carrying out nutritional analyses should participate in the Food Analysis Performance Assessment Scheme (FAPAS) and be accredited by the National Measurement Accreditation Scheme (NAMAS) (para. 45).

(viii) Active encouragement should be given for the development of a range of Certified Reference Materials (CRMs) representing a wide range of food matrices (para. 45).

(ix) More work should be done to establish if meat and meat products are a valuable source of dietary vitamin D and to establish the biological activity of vitamin D metabolites (paras. 52, 119).

(x) Monitoring of iodine levels in milk (and other important sources of iodine in the British diet) should continue (para. 54).

(xi) Analysis of important newly recognised nutritionally related substances, such as glucosinolates (free radical scavengers), polyphenolic materials (tannins, etc.) and

phyto-oestrogens, should be considered in future work programmes. Work on emerging methodologies or technologies which would assist in the analysis of these compounds should be supported (para. 113).

(xii) Investigations of important nutritionally modified foods in the UK diet should be considered for inclusion in future work programmes (para. 114).

(xiii) Investigations of novel foods and foods produced by novel processes should be considered for inclusion in future work programmes (para. 114).

(xiv) Important foods consumed outside the home, as identified by the National Food Survey, should be analysed for their nutrient content (para. 116).

(xv) More work on bioavailability, particularly of vitamins and minerals (carotenoids, tocopherols, folates, vitamin D metabolites, calcium, iron, selenium and zinc), should be carried out (paras. 37, 118).

(xvi) Work on the biological activity of carotenoids, folates, tocopherols, selenium and vitamin D metabolites should be undertaken (paras. 37, 41, 52, 119).

Dietary surveys

(xvii) Further studies should be carried out to develop improved methods for collecting reliable quantitative data on habitual food consumption including the concurrent use of a variety of methods based on different principles in order to avoid systematic bias, simplification of the recording process for subjects and improved methods of food coding (paras. 65, 129).

(xviii) Further methods of validating the energy and nutrient intake data collected in dietary surveys including appropriate biomarkers should be identified and developed (paras. 66, 68, 130).

(xix) Measures of nutritional status, e.g. blood and urine analytes and anthropometric measurements made at the same time as measuring nutrient intake, should be considered for inclusion in dietary surveys (para. 69).

(xx) Basal metabolic rate should be measured or estimated for subjects in dietary surveys wherever possible. However, care should be taken in interpreting the data for those with measured energy intake below the measured or estimated energy expenditure (para. 70).

(xxi) Planning for the National Diet and Nutrition Survey (NDNS) of school children aged 5–15 years should begin in 1994 (paras. 121, 133).

(xxii) A longitudinal element should be considered for inclusion in each dietary survey to allow an investigation of the health implications of the diet (para. 122).

(xxiii) Consideration should be given to carrying out dietary surveys of nutritionally 'at risk' sub-groups of the population and to performing relevant analyses of data from dietary surveys of low-income families and individuals undertaken by other researchers (paras. 71, 123, 134).

(xxiv) A dietary survey of a representative sample of the UK diabetic population should be carried out to provide information on food and nutrient consumption and the use of sweeteners to determine if some diabetics exceed the Acceptable Daily Intake (ADI) for sweeteners. The need for similar information for slimmers and reduced-weight maintainers should also be investigated (para. 124).

(xxv) A dietary survey of vegetarians should be carried out in order to collect information on food and nutrient consumption to enable estimation of mean and extreme intakes of nitrates, pesticides and natural toxicants in this population (para. 125).

(xxvi) Methods of achieving accurate estimates of the consumption of 'rarely consumed foods' which may contribute significantly to the intake of particular contaminants should be considered (para. 126).

(xxvii) The Total Diet Study should continue so that estimates may be made of the average intake of any food constituent (nutrient and non-nutrient) of current concern in Britain (para. 127).

(xxviii) Research should be carried out to establish additional indices of nutritional status. The use of biological markers requires knowledge of the relationship between the markers and intake (i.e. the dose response relationships between serum levels and intake) and in conjunction with population studies provides another approach to validating intake measurements (para. 130).

(xxix) The initial report of the NDNS of children aged $1\frac{1}{2}$–$4\frac{1}{2}$ years should be published by the end of 1994 and further analyses of the data should be undertaken as quickly as possible for follow-up publications and use by policy divisions and other working parties (para. 131).

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APPENDIX I PUBLICATION OF RESULTS IN *McCANCE AND WIDDOWSON'S THE COMPOSITION OF FOODS* AND ITS SUPPLEMENTS

Most of the nutritional data have been published in the fifth edition of *McCance and Widdowson's The Composition of Foods*[1] or the various supplements to this publication.

Cereals and Cereal Products[2]

The *Cereals and Cereal Products* supplement was published in May 1988 and it extended the cereal section in the fourth edition of *McCance and Widdowson's The Composition of Foods*[3] from 120 to 360 foods. Foods analysed as part of the MAFF study on cereal-based food such as cakes were included, together with data from the National Bread Study[4] in the mid-1980s and the last years of the Voluntary Flour Sampling Scheme.[5]

Nutrient coverage was extended to include data for individual sugars, total non-starch polysaccharides and its fractions, manganese, selenium and iodine in the main tables. In addition, values for cholesterol and phytic acid were included as supplementary tables. Recipes for dishes using both white and wholemeal flour were included.

Milk Products and Eggs[6]

This supplement was published in June 1989 and revised the data for milk, milk products and eggs. It extended the number of foods included in both sections from 33 to 300 in the milk and milk product group and 17 to 30 in the eggs section. Data from the large analytical studies[7,8,9,10,11,12] from the mid-1980s on milks, cheeses, creams and yoghurts formed a significant proportion of the new data.

Nutrients covered were similar to those in *Cereals and Cereal Products*, except that fatty acids as total saturates, mono-unsaturates and polyunsaturates, and cholesterol values were included in the main tables. Fibre fractions where relevant, and data for retinol fractions, were included as supplementary tables. Recipes were calculated using whole, semi-skimmed and skimmed milks.

Vegetables, Herbs and Spices[13]

This supplement was published in March 1991 and includes data for over 400 foods compared to 125 in the fourth edition of *McCance and Widdowson's The Composition of Foods.*[3] The majority of data was taken from MAFF analytical studies on fresh, canned and frozen vegetables. A further analytical study provided data for legumes and 'exotic' vegetables, such as taro and seaweeds.

More data than usual were included (following thorough evaluation) from foreign food composition tables and literature reports. Recipes were not included in this

supplement. Nutrients were similar to those in earlier supplements, but supplementary tables included data for carotenoid fractions.

The Composition of Foods: fifth edition[1]

The fifth edition of *McCance and Widdowson's The Composition of Foods* was published in September 1991 and included data for approximately 1200 foods. Data were incorporated from the above-mentioned supplements together with data from the unrevised sections of the fourth edition. In addition, previously unpublished data for around 50 popular food items, such as low-fat sausages and Kit-Kat, were included. Data were also presented for foods fried in a variety of fats.

The coverage of nutrients was essentially the same as for the fourth edition but with fatty acids (as total saturates, mono-unsaturates and polyunsaturates), cholesterol, non-starch polysaccharides, manganese, selenium and iodine in the main tables.

Fruit and Nuts[14]

This supplement was published in 1992 and extends the fruit and nut sections in the fifth edition of *McCance and Widdowson's The Composition of Foods*,[1] considerably increasing the number of foods and nutrients covered. The main tables provide information on individual sugars and individual fibre fractions. Supplementary tables provide information on fatty acids, individual carotenoids and individual tocopherols, where appropriate.

Vegetable Dishes[15]

This is the second supplement to the fifth edition of *McCance and Widdowson's The Composition of Foods*,[1] also published in 1992. It contains data especially collected for the supplement for over 340 foods. For most dishes, nutrient content has been calculated from recipe data. In addition, for the first time, information has been presented on 53 nutrients.

Fish and Fish Products[16]

This supplement was published in 1993 and is the third supplement to the fifth edition of *McCance and Widdowson's The Composition of Foods*.[1] It revises and greatly extends the information in the fifth edition, increasing the number of foods by 308. Data are included on a wide range of fresh and cooked fish and fish products. It also includes information on a wider range of nutrients than presented in the fifth edition, including the individual fatty acids which are of particular importance in certain fish, and the main fractions of vitamin A and vitamin E. All the data have been thoroughly reviewed and almost every value has been updated. This was necessary because most of the data on fish in the fifth edition were taken directly from the third and fourth editions, and had thus not been reassessed or revised for many years.

Food Labelling Data for Manufacturers[17]

This publication gives information on the nutrients of most importance for nutrition labelling for nearly 1200 foods. All the values have been taken from the fifth edition of *McCance and Widdowson's The Composition of Foods*,[1] but have been recalculated in the form required by the 1990 EC Directive on nutrition labelling of foodstuffs.[18]

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APPENDIX II OBJECTIVES OF THE NATIONAL DIET AND NUTRITION SURVEY PROGRAMME

(i) To provide detailed quantitative information on the food and nutrient intake, sources of nutrients and nutritional status of populations as a basis for Government policy;

(ii) To describe the characteristics of individuals with intakes of specific nutrients which are above and below the national average;

(iii) To provide a database to enable the calculation of likely dietary intakes of natural toxicants, contaminants and additives for risk assessment;

(iv) To measure blood and urine indices which give evidence of nutritional status and to relate these to dietary, physiological and social data;

(v) To provide height, weight and other measurements of body size on a representative sample of individuals and to examine their relationship with social, dietary, health and anthropometric data as well as with data from blood analyses;

(vi) To monitor the diet of the population (divided into four age groups) to establish the extent to which it is adequately nutritious and varied;

(vii) To monitor the extent to which the quantitative dietary targets set by Government are met;

(viii) To help determine possible relationships between morbidity, cause of death and diet.

APPENDIX III THE NATIONAL FOOD SURVEY

The National Food Survey (NFS) is a continuous inquiry into the amounts and costs of foods obtained by private households in Britain and of their nutrient content. The survey has provided information on trends in people's purchasing and eating habits in Britain for over 50 years. Over 7000 households per year participate in the NFS, each household participating for one week only. The householder keeps a seven-day record of the description, quantity and cost of all food entering the home for human consumption.

Information on confectionery, alcohol and meals purchased outside the home has been collected since January 1992. Also since this time, important food groups within the NFS have been desegregated (to enable more accurate nutritional analysis). For example, 'breakfast cereals' has now become separated into 'muesli', 'other high fibre', 'sweetened' and 'other'. The number of nutrients analysed has been extended to include more trace nutrients.

As well as details of foods entering the households, the 'housewife' (i.e. the person specified within the household to collect data) notes which persons (including visitors) are present at each meal together with a description of the type of food served. On a separate questionnaire, details are entered of socio-economic characteristics of the family and its members.

Since 1992, approximately 50 per cent of the NFS sample has been approached to take part in the eating-out part of the survey. All household members of 11 years of age or over participating in the Eating Out Survey are supplied with a compact pocket-size diary. Respondents are asked to record all food, soft drinks, alcoholic drinks and confectionery items which have been purchased and consumed away from the home. Respondents are asked to provide a precise description of the item, some indication of portion size and information on where purchased.

Any foods that are made from home food stocks (e.g. packed lunches) but consumed away from home do not fall within the definition of eating out for the purposes of the NFS. Initial data from the Eating Out Survey are still being evaluated, and have not therefore been included in the main analysis for the 1992 Annual Report.

The energy value and nutrient content of the food obtained for consumption are evaluated using special tables of food composition which are reviewed each year for two reasons. The first is to reflect changes in nutrient values resulting from new methods of food production and handling, and the second is to reflect changes in the structure of the food categories used in the survey – for example, changes in the relative importance of the many products grouped under 'other fresh vegetables'.

The nutrient factors make allowance for inedible material such as bones in meat and outer leaves or skin of vegetables; for certain foods such as potatoes and carrots, allowance is made for seasonal variations. Further allowance is made for expected cooking losses of thiamin and vitamin C.

Results are published as annual reports[1] and less-detailed quarterly reports[2] are also available from the National Food Survey Branch of the Ministry of Agriculture, Fisheries and Food, Room 511, Whitehall Place (West), London SW1A 2HH (071 270 8562). In addition, more detailed analyses may be purchased.

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APPENDIX IV MEMBERSHIP OF THE NATIONAL FOOD SURVEY COMMITTEE

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D H Buss, BSc, PhD, FRSH	Ministry of Agriculture, Fisheries and Food
S M Dixon, BSc	Ministry of Agriculture, Fisheries and Food

APPENDIX V THE 'HEALTH OF THE NATION' NUTRITION TARGETS

The Government's White Paper, the 'Health of the Nation', was published in July 1992[1] and presented a strategy for health in England. The strategy selected five key areas for action, and one of these key areas was coronary heart disease and stroke. The following dietary and nutritional targets have been set:

- To reduce the average percentage of food energy derived by the population from saturated fatty acids by 2005 to no more than 11 per cent of food energy (from 17 per cent in 1990).
- To reduce the average percentage of food energy derived from total fat by the population by 2005 to no more than 35 per cent of food energy (from around 40 per cent in 1990).
- To reduce the proportion of men and women aged 16–64 who are obese by at least 25 per cent and 33 per cent respectively by 2005 (to no more than 6 per cent of men and 8 per cent of women).

In 1991, the Department of Health's Committee on Medical Aspects of Food Policy (COMA) published its report, Dietary Reference Values for Food Energy and Nutrients for the United Kingdom.[2] COMA set population targets for intakes of fats, protein, carbohydrates, fibre and a range of vitamins and minerals. The targets set for fat and saturated fatty acids by the 'Health of the Nation' White Paper are in line with those set by COMA. The White Paper stresses that a 'whole diet' approach to meeting these targets is crucial if the balance of the diet is to be sensible.

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1. *The Health of the Nation. A Strategy for Health in England* (1992). HMSO.

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APPENDIX VI THE TOTAL DIET STUDY (TDS)

The quantities of foods that make up the 'total diet' are largely based on those determined in the National Food Survey (NFS). Import or trade statistics are used to determine the quantities of those foods not included in the NFS. The types and quantities of foods in the 'total diet' are updated annually to reflect changing eating habits in Britain.

A total of 119 categories of foods are specified for inclusion in the 'total diet'. These are combined into 20 groups of similar foods as indicated in Table 6.1. The relative proportion of each food in the group reflects the importance of the food within that sector of the average household diet.

Table 6.1: Weights (g) of foods within each total diet group based on NFS records from years indicated.

	1992	1993
Group 1 – Bread		
White, sliced	179	188
White, unsliced	81	72
Brown	63	64
Wholemeal	70	69
Other	107	107
Total	500	500
Group 2 – Miscellaneous cereals		
Flour	73	67
Buns, cakes and pastries	80	82
Chocolate biscuits	33	33
Other biscuits	78	76
Breakfast cereals	97	98
Rice	22	24
Other cereal products	117	120
Total	500	500
Group 3 – Carcase meat		
Beef	246	241
Lamb	122	129
Pork	132	130
Total	500	500
Group 4 – Offals		
Lambs' liver	210	209
Pigs' liver	104	105
Other liver	56	55
Kidney	67	62
Other offals	63	69
Total	500	500

Table 6.1 *continued*

	1992	1993
Group 5 – Meat products		
Bacon	109	105
Ham	39	40
Corned meat	24	22
Other canned or cooked meats	56	54
Pork sausages	38	41
Beef sausages	44	39
Pies, sausage rolls	19	19
Frozen meat products	73	75
Other meat products	98	105
Total	500	500
Group 6 – Poultry		
Chicken	317	317
Other poultry	152	152
Cooked poultry	32	31
Total	500	500
Group 7 – Fish		
White fish	169	166
Fatty fish	45	50
Frozen fish	118	116
Shellfish	17	19
Cooked fish	57	49
Canned salmon	20	22
Other canned fish	74	78
Total	500	500
Group 8 – Oils and fats		
Soft margarine	210	204
Hard margarine	21	18
Vegetable oils	90	96
Lard	59	52
Other fats	120	130
Total	500	500
Group 9 – Eggs	–	–
Group 10 – Sugars and preserves		
Sugar	187	181
Jam, marmalade	40	41
Syrup, honey	11	11
Jelly	6	5
Chocolates	163	169
Sweets	93	93
Total	500	500
Group 11 – Green vegetables		
Cabbage	111	107
Sprouts	53	53
Cauliflower	84	88
Leafy salads	63	68

Table 6.1 *continued*

	1992	1993
Group 11 continued		
Peas	75	74
Beans	51	47
Other fresh green vegetables	63	63
Total	500	500
Group 12 – Potatoes		
Fresh potatoes	440	438
Potato products	60	62
Total	500	500
Group 13 – Other vegetables		
Onions, leeks	79	76
Carrots	94	94
Turnips, swedes	24	23
Miscellaneous	82	86
Mushrooms	22	24
Tomatoes	88	85
Cucumbers	27	28
Dried vegetables	7	6
Dried soups	3	3
Meat or yeast extract	4	4
Spreads, dressings	14	14
Pickles, sauces	55	56
Herbs, spices	1	1
Total	500	500
Group 14 – Canned vegetables		
Canned soups	115	114
Canned tomatoes	67	68
Canned peas	75	72
Canned beans	196	197
Other canned vegetables	47	49
Total	500	500
Group 15 – Fresh fruit		
Oranges	70	66
Other citrus fruit	47	47
Apples	169	164
Pears	30	29
Stone fruit	27	28
Bananas	94	101
Other fresh fruit	63	65
Total	500	500
Group 16 – Fruit products		
Canned peaches, pears	32	26
Canned pineapples	20	22
Other canned or frozen fruit	49	46
Dried fruit	38	36
Fruit juice	361	370
Total	500	500

Table 6.1 *continued*

	1992	1993
Group 17 – Beverages		
Tea	3.2	3.0
Instant coffee	1	1
Branded food drinks	0.3	0.4
Cocoa	0.3	0.3
Concentrated soft drinks	6.6	6.2
Ready-to-drink soft drinks	88.6	89.1
Total	100	100
Group 18 – Milk		
Whole milk	344	319
Skimmed milks	156	181
Total	500	500
Group 19 – Dairy products		
Condensed milk	17	15
Instant milk	8	6
Natural cheese	135	134
Processed cheese	11	11
Butter	64	58
Icecream, mousse	70	71
Yoghurt, other milk	146	155
Cream	19	19
Canned milk puddings	30	31
Total	500	500
Group 20 – Nuts		
Desiccated coconut	54	55
Peanuts	158	158
Almonds	39	39
Chestnuts	8	8
Mixed nuts	52	52
Walnuts	18	18
Brazil nuts	11	11
Hazelnuts	8	8
Cashew nuts	11	11
Marzipan	47	46
Peanut butter	94	94
Total	500	500

Food samples are bought from a wide variety of retail outlets at fortnightly intervals, on each occasion in a different area selected on a random basis, to be representative of Britain as a whole. Since 1991, samples have also been collected from Northern Ireland. The total quantities of foods are rigidly specified but, for items likely to be subject to regional or seasonal variation in availability, purchasers may buy certain items either fresh, frozen or select one item from a list of specified similar alternatives. The foods are rapidly transported to one centre where they are

prepared and cooked (where necessary) according to normal domestic practice. After preparation, the constituents of each food group are thoroughly homogenised, frozen, and then dispatched for analysis.

To ensure that sufficient sample is available for analysis, each group (except for beverages and eggs) is based on 500 g as purchased, but after preparation the actual quantities in some groups are substantially less because of losses of inedible material during preparation and further losses during cooking. The cereals group increases in weight due to uptake of water on boiling cereals such as rice and pasta. The beverages group substantially increases in weight because the tea leaves are infused with water. The contribution of the 20 food groups (in kg/person/day) to the average household diet as purchased is shown in Table 6.2, together with the gain or loss of weight in preparation and cooking.

Food groups are routinely analysed for a number of substances, e.g. pesticide residues and heavy metals, and are also periodically analysed for selected nutrients. Intakes of the food constituent from each food group are calculated by multiplying the concentration found in the analysed sample by the estimated weight of food eaten (Table 6.2).

Table 6.2: Change in weight on preparation and cooking, and relative importance of each total diet study group in 1993.

	Weight purchased (kg/day)	Change (%) (to nearest 5%)	Average weighting of group as eaten (kg/day)
Bread	0.113	0	0.113
Miscellaneous cereals	0.094	+5	0.099
Carcase meat	0.047	–40	0.028
Offals	0.002	–35	0.001
Meat products	0.060	–25	0.045
Poultry	0.032	–45	0.018
Fish	0.020	–35	0.013
Oils and fats	0.030	0	0.030
Eggs	0.018	–10	0.016
Sugars and preserves	0.069	0	0.069
Green vegetables	0.055	–30	0.039
Potatoes	0.161	–15	0.137
Other vegetables	0.086	–15	0.073
Canned vegetables	0.045	–20	0.036
Fresh fruit	0.087	–25	0.065
Fruit products	0.043	0	0.043
Beverages	0.210	+310	0.861
Milk	0.285	0	0.285
Dairy products	0.057	0	0.057
Nuts	0.002	0	0.002
Total	1.516		2.030

APPENDIX VII MAFF'S NUTRIENT DATABANK

The Ministry's nutrient databank was originally developed for use in the Dietary and Nutritional Survey of British Adults.[1] The original database used in that survey has been archived, together with all the other survey information, at the University of Essex Data Archive. Since the National Diet and Nutrition Survey programme was established, the databank has been extended and updated for use in the current survey of children aged 1½–4½ years.

The nutrient databank contains information on over 3500 foods, including manufactured products and recipe dishes, alcoholic and soft drinks, and vitamin and mineral supplements. Every food and drink has a unique food code number and is assigned to a food group. There are 55 main food groups, some of which are divided into subsidiary groups. These groups are used when analysing the data for consumption of different types of food and their contributions of nutrients to the diet.

The nutrients associated with each food are stored in a computer databank so that nutrient intakes can be calculated from consumption data. Each food within the databank has values assigned for 54 nutrients (see Table 7.1). The Ministry's Nutrition Branch is responsible for maintaining, developing and updating this nutrient databank.

In order to meet the Ministry's objectives for the dietary surveys and to ensure that the information collected on nutrient intakes is as accurate as possible, the way in which foods are coded needs to be very detailed. There is the need to distinguish between products that have significantly different nutrient contents. Both the databank, and the dietary surveys carried out, are designed to identify these differences where they occur. Products that differ little, if at all, by brand have the same food code. But when foods are cooked in different ways, or fried in different types of fats, then different food codes are assigned. Many products are fortified with vitamins or minerals, and these must also be distinguished from their unfortified counterparts.

The majority of nutrient data for many of the basic foods are taken from the fifth edition of *McCance and Widdowson's The Composition of Foods*[2] and its supplements, or from the Ministry's rolling programme of nutritional analysis of food products. Some data are also obtained from food manufacturers. Where appropriate, the nutrient content of home-made dishes is calculated from their individual constituents using a computer recipe program.

In order to analyse the results of the National Diet and Nutrition Survey and to avoid underestimating nutrient intakes, the nutrient databank must have a value assigned for every nutrient in every food. It is therefore sometimes necessary to estimate some nutrient values for foods when few data are available.

The nutrient databank is continuously updated as analytical projects on foods are completed and evaluated, as new products appear on the market, or when the

Table 7.1: Nutrients in the databank.

Energy (kcal)	Sodium (mg)	
Energy (kJ)	Potassium (mg)	
	Calcium (mg)	
Protein (g)	Magnesium (mg)	
Fat (g)	Phosphorus (mg)	
Carbohydrate (g)	Iron (mg)	Haem iron (mg)
Alcohol (g)	Copper (mg)	Non-haem iron (mg)
Water (g)	Zinc (mg)	
	Chlorine (mg)	
Starch (g)	Iodine (µg)	
Total sugars (g)	Manganese (mg)	
Glucose (g)	Retinol (µg)	β-carotene (µg)
Fructose (g)	Carotene (µg)	α-carotene (µg)
Sucrose (g)	Vitamin D (µg)	β-cryptoxanthin (µg)
Maltose (g)	Thiamin (mg)	
Lactose (g)	Riboflavin (mg)	
Other sugars (g)	Niacin equivalent (mg)	
	Vitamin C (mg)	
Intrinsic and milk sugars (g)	Vitamin E (mg)	
Non-milk extrinsic sugars (g)	Vitamin B_6 (mg)	
	Vitamin B_{12} (µg)	
Saturates (g)	Folate (µg)	
Mono-unsaturates (g)	Pantothenic acid (mg)	
Cis-n-3-polyunsaturates (g)	Biotin (µg)	
Cis-n-6-polyunsaturates (g)		
Trans-fatty acids (g)	Fibre (Southgate) (g)	
Cholesterol (mg)	Fibre (Englyst) NSP (g)	

nutritional profile of manufactured foods changes. Full details of the Ministry's nutrient databank have been published.[3]

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APPENDIX VIII DIETARY SURVEY METHODOLOGIES

Dietary assessment of individuals can be done by either recording actual consumption at the time of eating foods or by interviewing subjects about their recent past food intake. The survey methods chosen for a particular study are dependent on: the purpose of the survey; the food(s)/nutrient(s)/non-nutrient(s) of interest; literacy of the subject; and the resources available. The methods most often used by MAFF for assessing food intake are described below.

Weighed record

Dietary assessment via weighed records have formed the basis of numerous studies of human nutrition. In clinical work it has been recommended that weighed records of up to 14 days are required, whilst in epidemiological studies at least 3 days' data are needed.[1] A weighed record involves the subject weighing all food and drink immediately before consumption and all plate waste, edible and inedible, at the end of the meal. Standard recipes may be used or for a more precise weighing record, a record is also kept of the weights of all ingredients used in the preparation of the recipes, the total cooked weight of the recipe dish and the cooked weight of the individual's portion and plate waste. This methodology is time-consuming and demanding of the subjects. However, weighed intake records are considered one of the most accurate methods of assessing current food intake.[2]

Estimated record

Estimated records, like weighed records, require a diary record of all food and drink consumed but foods are not weighed. Instead, amounts of foods and drinks consumed are estimated, usually with portions described in household measures (cups, spoons, etc.), with/without the aid of diagrams or photographs. The advantages of this method are that it is easier to complete than a weighed record and so there is less risk of under-reporting or changing food consumption. The disadvantages are that descriptions of quantities tend to be inaccurate and that processing descriptive data is very time-consuming. The errors involved in estimating weights, however, can reach 90 per cent and are regularly in the 20–50 per cent range.[1]

Diet recall

The respondent is asked to recall the actual food and drink consumed on specific days, usually the immediate past 24 hours (24-hour recall), but sometimes for longer periods. The main advantage of this method is that it is relatively quick to carry out and involves little work for the subject, so refusal rates are lower than for some other methods. The disadvantages relate to its inaccuracy in both the number of foods recalled, the quantities, and its inability to estimate the habitual diet of individuals. Low intakes tend to be over-reported and high intakes under-reported.[3] Variation between observed nutrient intakes and those obtained from 24-hour recall in studies with students, children and the elderly range from 4 to 400 per cent.[2]

Diet history

The diet history provides an estimate of 'usual' consumption. The respondent is questioned about 'typical' or 'usual' food intake in a 1–2 hour interview. The aim is to construct a typical seven days' eating pattern. The interview may discuss each meal and inter-meal period in turn or each day of the week in turn. Questions are usually open-ended, although a fully structured interview may be used. The diet history may be preceded by a 24-hour recall and/or supplemented with a checklist of foods usually consumed. The advantage of this method is that it is fairly quick to carry out and involves little work for the subject. The disadvantages are that it is inaccurate, especially regarding quantities consumed, and relies upon the memory of the subject. From the limited number of studies conducted, the dietary history does not measure actual food intake, as judged by comparisons with food records kept over a commensurate period of time.[2]

Food frequency questionnaire

The respondent is presented with a list of foods and is required to say how often each is eaten in broad terms such as *x* times per day/per week/per month, etc. Foods listed are usually chosen for the specific purposes of a study and may not assess total diet. The food frequency questionnaire may be interviewer-administered or self-completed. Assessment of the quantities of food consumed on each eating occasion/day may also be included. The advantages of this method are that it is quick and easy for the subject to complete. It may be the only suitable method for large-scale epidemiological studies. The main disadvantage is that it is not able to characterise an individual's intake. However, in studies on populations, the method is able to characterise adequately dietary intake in groups. The food frequency questionnaire may be a useful cross-check for other methods to ensure that consumption of certain foods are not overlooked (e.g. snacks during the day).

Duplicate diet

The respondent is asked to collect equivalent portions of all foods and beverages consumed, for direct analysis, in order to estimate intake of energy, nutrients and/or other food constituents. Often equivalent portions of water are omitted from the collection. The samples may be combined or separated. This method is very expensive.

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This report describes surveillance carried out from 1989 to 1993 on the nutrient composition of food and on food consumption by populations and individuals. Selected data are presented from the National Food Survey, the Dietary and Nutritional Survey of British Adults, the survey of Food and Nutrient Intakes of British Infants aged 6-12 months, and the pilot study for the National Diet and Nutrition Survey of children aged 1½ - 4¼ years. A wide range of foods has been studied in detail since 1988 and selected nutrient composition data are given for some of these. Studies undertaken to develop suitable methodologies to determine the main pro-vitamin A carotenoids, the total folate content, components of dietary fibre and individual fatty acids in foodstuffs are described. Several projects to improve the measurement of food intake have also been carried out during this period and are described.

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