KING EDWARD'S HOSPITAL FU
FOR LO

REPORT OF AN INVESTIGATION INTO THE DIETARY OF ELDERLY WOMEN LIVING ALONE

1965

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ACKNOWLEDGEMENTS

We are deeply indebted to Mrs. M. Newman and Mrs. M. Ramsey who with enthusiasm and efficiency conducted the dietary survey on the 60 subjects. Dr. V. Freeman, Medical Officer of Health, Islington, Mrs. J. Adams, Secretary of the Hornsey Old People's Welfare Committee and Miss A. Goldsmith, Secretary of the Hornsey Housing Trust, gave valuable assistance in compiling the lists of suitable subjects. We acknowledge with gratitude the loyal co-operation of the old people who made our task so pleasant and the study so interesting.

Local Authorities, Old People's Clubs and a Day Centre generously co-operated in the investigations into domiciliary and club meals and our thanks go to all those, including the catering and kitchen staffs, who were involved.

We very much appreciate the advice given by Professor B. S. Platt, Professor R. E. Tunbridge, Dr. T. P. Eddy and Miss Jean Marr in planning the investigation and the valuable help given by Dr. W. T. C. Berry who so readily gave his time in discussing the draft report.

We should also like to express our thanks to Dr. P. L. Pellett of the London School of Hygiene and Tropical Medicine, for the chemical analyses of the meals and to Miss M. F. Crowley, Biochemist and Mrs. B. Hughes, Radiographer, of the Whittington Hospital. Mr. R. J. C. Stewart and Dr. P. Payne of the Medical Research Council, Human Nutrition Unit and Dr. H. M. Hodkinson willingly gave technical assistance in carrying out the X-ray densitometry.

A. N. E-S./B.R.S.

FOREWORD

The difficulty of formulating a nutritional policy for the elderly, is due to lack of basic information on their nutritional requirements. The authors are to be congratulated on having undertaken the present, time consuming and exacting study. The evidence suggests that those receiving a low calorie intake are more likely to suffer from deficiencies of other nutrients. The vulnerability of individuals in their late 70's and early 80's to deficiencies appears to be closely related to their diminished calorie intake. Impaired mobility contributes not only to difficulties with shopping and with cooking but also to a lessened energy requirement.

The study has valuable information for all interested in the preparations of meals for the elderly whether they are Meals on Wheels schemes or the provision of meals in Clubs. It has long been recognised that the social contacts arising from the Meals on Wheels service provides a valuable link between the old people and the community. The value of such schemes in augmenting the dietary of the recipients is well brought out in this study. Equally important, however, is the reference to the loss of the nutritional value of many of the foods served due to unsatisfactory methods of preparation and cooking and to the inevitable delay in delivery of meals.

More information about the nutritional requirements of the elderly and the effect of minor illnesses upon their requirements is still necessary but this valuable pilot study has yielded useful information and should provide a stimulus and guide to more extended studies in the future.

R. E. Tunbridge.

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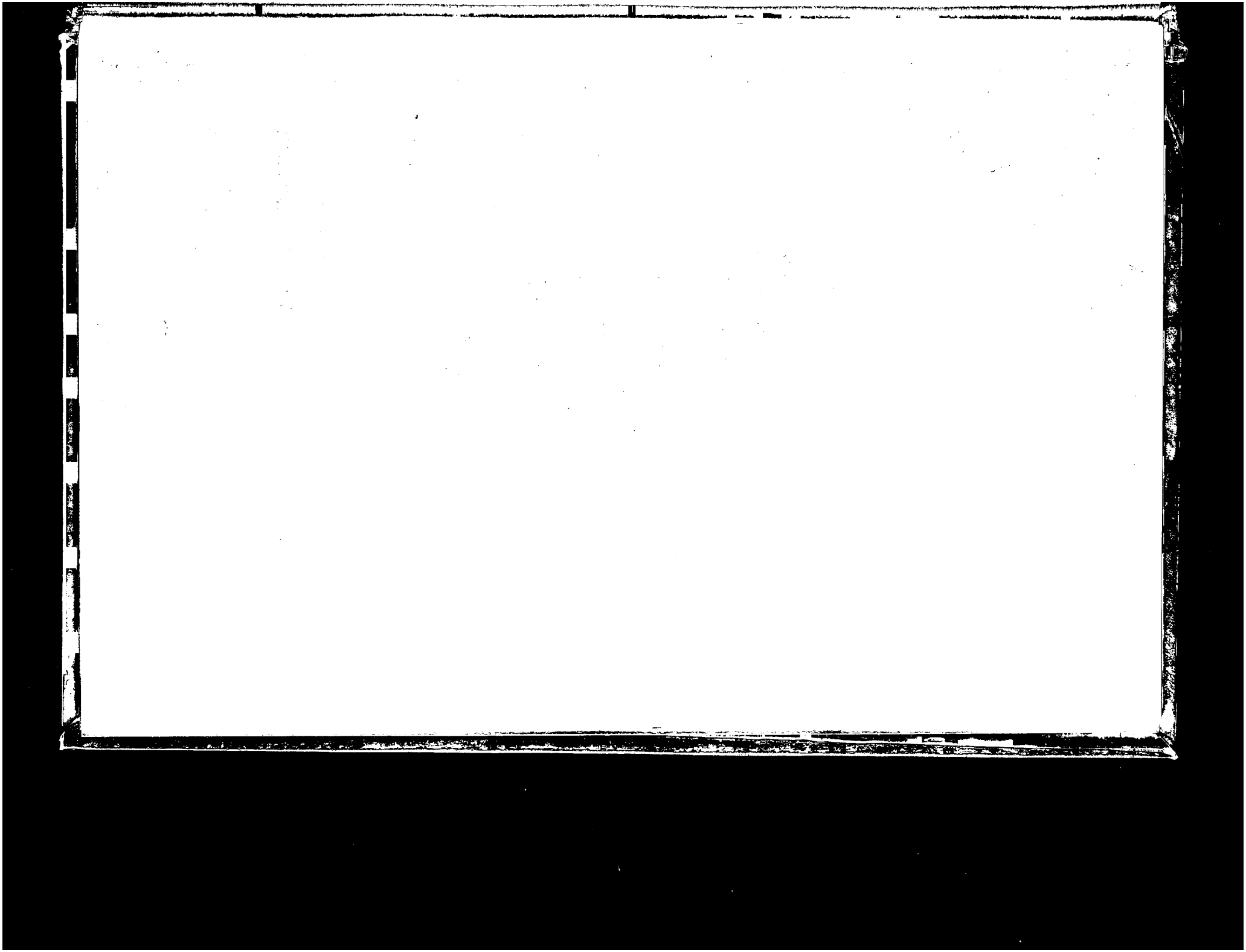
A. N. Exton-Smith, *M.D., F.R.C.P.*
Miss B. R. Stanton, *S.R.D.*

Dietary Survey by:
Mrs. M. Newman, *Diploma in Dietetics.*
Mrs. M. Ramsey, *B.Sc., S.R.D.*

and a Foreword by:
R. E. Tunbridge, *O.B.E., M.D., F.R.C.P.*
Professor of Medicine, University of Leeds.



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REPORT OF AN INVESTIGATION INTO THE DIETARY OF ELDERLY WOMEN LIVING ALONE

SECTION I

METHODS OF SURVEY

The precise nutritional needs of old people are unknown. In an attempt to discover levels of intake compatible with health it was decided to carry out a survey of the dietary of elderly women living alone, and to make a clinical assessment of the subjects, measuring their heights and weights and estimating bone density, haemoglobin values and the levels of serum calcium, inorganic phosphorus and alkaline phosphatase.

The Sample

The sixty women who took part in the survey lived in two North London Boroughs: 33 in Hornsey and 27 in Islington. All lived alone in the sense that they catered for themselves, but in six cases they lived in the same house as a relative or close friend. It was originally intended to include only women aged between 70 and 80 years. In the event 57 were in this age group but three older women were accepted, 89, 90 and 94 years. The 89 year old said that she was 79 when interviewed and only admitted her age after completing the survey. The women of 90 and 94 were admitted deliberately, because few studies on active women of this age group have been made. The average age of all the subjects was 75·9 years but there was a difference between the two groups:

Hornsey group, 33 women, average 74·6 years

Islington group, 27 women, average age 77·5 years

The 90 and 94 year olds were in the Islington Group but even if they are omitted this group is still the older with an average age of 76·0 years. Any subject who was having a special diet, e.g. for diabetes or obesity was excluded.

Hornsey residents were recruited from lists of names and addresses supplied by a Darby and Joan Club, The Local Old People's Welfare Association and the Hornsey Housing Trust. The Islington Group was selected from a list, supplied by the Medical Officer of Health, of elderly women who it was thought might be malnourished. It was hoped by these means to obtain 2 groups of women: those who were well nourished and those who might be poorly nourished and to compare their dietary intakes and physical condition.

The lists were found to be incomplete or incorrect and an average of 5 people had to be interviewed to obtain one who fitted the category of between 70 and 80 years old and who lived alone. Of those suitable about 1 in 10 refused to co-operate and a similar number were unacceptable either because they were too deaf for easy communication or too confused to understand. It may well be that the least satisfactorily nourished people were not included in the present survey because the techniques followed demanded too high a degree of co-operation and understanding for the mentally confused or lethargic. Yet it is these very people who are likely to be poorly nourished.

Methods

The survey lasted from 2nd March, 1962 to 14th January, 1963. The first four weeks were spent entirely in selecting subjects which was a longer time than had been expected. However, many of the difficulties of selection were resolved later with the help of Islington Borough Welfare Officers and at this stage selection was undertaken concurrently with visiting subjects who were taking part.

Three dietitians were involved with field studies; one worked throughout and of the other two, one started in March, the second taking over in July with a 6 week overlap to ensure that methods and techniques used throughout the 10 month period were as nearly similar as possible. The following method was used: on the first visit the investigator would explain simply the nature of the survey, what it was hoped to discover and what would be expected of the subject. On acceptance, a date was made for a further visit and in the meantime a letter of thanks, repeating the simple explanations, was sent. This letter also served to establish the investigator's bona fides. On the second visit a detailed dietary history was taken which served two purposes—a check on the subsequent week's meals since it was feared that the subject might deviate from her normal meal pattern when her diet was under detailed and constant review and to collect information on cooking facilities, distance from the shops and other social aspects. (The form used is shown in Appendix 1c).

On the second visit the investigator left the following items with each subject:—

1. A pair of scales and instruction on their use.
2. Pencil and paper for recording weights of food consumed and the times of meals.
3. Plastic bags for keeping plate and preparation waste.

Many subjects, through infirmity, were not able to weigh accurately. To help these and as a check on all subjects, investigators recorded on the first visit, larder stocks and then daily weights of bread, packaged fats, biscuits, jam, sugar, milk, potatoes etc. and by difference calculated total quantities used in the 24 hours since their previous visit. Plate and preparation waste was also checked.

The investigator called at approximately the same time once a day (at least) and the visit was timed to coincide either with the subject's return from shopping, in order to weigh unopened packages of biscuits, sugar and so on or with the main meal of the day when prepared foods could be weighed immediately prior to eating. Although few subjects weighed **all** their own food each was co-operative in keeping detailed records of the type of food and the amount in slices and servings; similar slices and servings were subsequently weighed by the investigator. Some meals were eaten away from home and the investigators obtained descriptions (usually by brand names) of food consumed. Similar food was bought, examined and weighed. Food manufacturers were helpful in giving analyses of their products. The weights of all food to the nearest $\frac{1}{4}$ oz. were entered daily on the forms provided (see Appendices 1a and b). Subsequently the total quantity of each type of food consumed in twenty four hours was used as the basis for calculations* of nutrient intakes. Club meals and meals on wheels were recorded and calculated separately in order to assess their contribution to the diet.

The survey was carried out for seven consecutive days on fifty four subjects, three took part for six days, one for five and two for four days.

Club Meals and Meals on Wheels

Early in the survey the importance of club meals and meals on wheels became apparent. It was decided to make a weighed survey of a sample of these meals and their nutrient content was calculated from food tables. Single meals were analysed chemically. An account of this investigation is given in Section V of the report.

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*Food tables used were:—

Composition of Foods, McCance & Widdowson, Special Report Series No. 297 Medical Research Council.

Nutritive Value of Wartime Foods, Medical Research Council War Memorandum No. 14.

Manufacturers analyses of prepared foods.

SECTION II

NUTRIENT INTAKES

Average Intakes of the Whole Group

Using weights of food obtained for each subject as detailed in the last Section, daily intakes of protein, carbohydrate, fat, calories, calcium, iron, vitamins C and D were calculated. Results for individual subjects are given in Appendix A. The average for the whole group is given in Table 1.

TABLE 1.

MEAN INTAKES FOR THE WHOLE GROUP
(60 SUBJECTS)

Calories	Mean 1890. Range 1155-2931 Distribution see figure (1a)
Protein	Mean 57 g. Range 36 g-93 g. % Calories from protein 12·1 Distribution see figure (1b)
Fat	Mean 74 g. Range 48 g-160 g. % Calories from fat 37.
Carbohydrate	Mean 221 g. Range 119 g-330 g. % Calories from carbohydrate 50·9.
Iron	Mean 9·9 mg. Range 5 mg-20 mg. Mean per thousand calories 5·2 mg. Distribution see figure (1c).
Calcium	Mean 860 mg. Range 390 mg.-1515 mg. Mean per thousand calories 458 mg. Distribution see figure (1d).
Vitamin C	Mean 37·6 mg. Range 2·5 mg-117 mg. Distribution see figure (1e).
Vitamin D	Mean 135 i.u. Range 10 i.u.-353 i.u.

DISTRIBUTION OF NUTRIENTS

Figures at head of columns indicate number of subjects.

Figure 1a
CALORIES

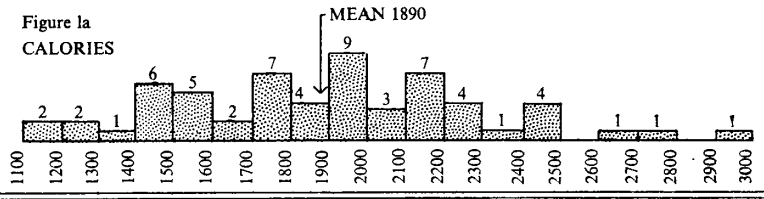


Figure 1b
PROTEIN g.

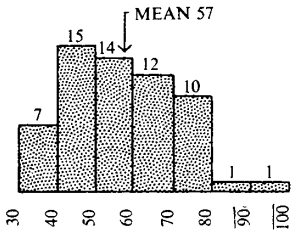


Figure 1c
IRON mg.

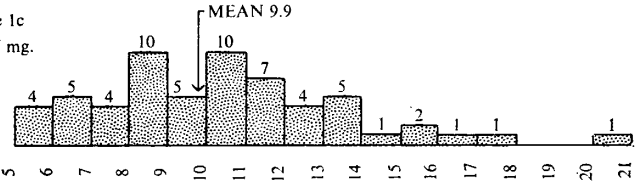


Figure 1d
CALCIUM mg.

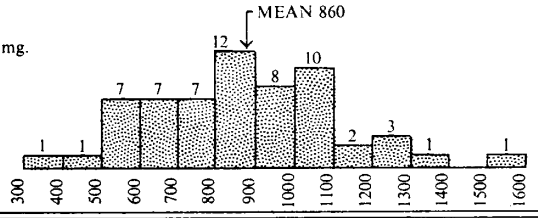
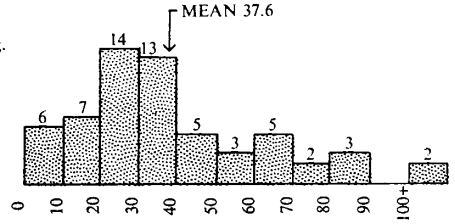


Figure 1e
VITAMIN C mg.



Comparison between Hornsey and Islington Subjects

When the mean intakes of the supposedly well nourished Hornsey Group were compared with the mean of the supposedly poorly nourished Islington Group, contrary to expectations, little difference was found.

Table II shows the comparison between the two groups. The only major difference is in the amount of vitamin C; Hornsey subjects ate food to give an average intake of 8·8 mg per day more than Islington subjects.

TABLE II.

COMPARISON BETWEEN THE AVERAGE DAILY INTAKES OF 33 HORNSEY AND 27 ISLINGTON SUBJECTS

Protein	Hornsey 57·3 g. Islington 56·7 g.
Calories	Hornsey 1936 Islington 1836
Protein expressed as % Calories	Hornsey 11·8. Islington 12·4.
Calcium	Hornsey 907 mg. Islington 804 mg.
Ca expressed per 1,000 Calories	Hornsey 468 mg. Islington 437 mg.
Iron	Hornsey 10·0 mg. Islington 9·9 mg.
Fe expressed per 1,000 Calories	Hornsey 5·1 mg. Islington 5·3 mg.
Vitamin C	Hornsey 41·6 mg. Islington 32·8 mg.
Vitamin D	Hornsey 123 i.u. Islington 150 i.u.

In considering these results it must be remembered that among the women selected by the Islington Borough Welfare Officers, on the grounds of possible malnutrition, some were too deaf or confused to co-operate in this type of survey. Therefore the group finally chosen was unlikely to be fully representative but was probably biased towards the better nourished.

Influence of Age on Nutrient Intakes

A decline in nutrient intakes was found throughout the decade, and may be illustrated by comparing intakes of subjects in their early mid and late 70's*. When subjects were arranged in three categories according to age viz: 70-73 years: 74-77 years: 78-80+ years and the nutrient intakes of each category compared a definite decrease was seen. That the decrease was caused by the quantity of food eaten rather than the quality was shown by comparing the groups for protein per cent calories and certain other nutrients per thousand calories. As seen in Table III there is a remarkable constancy of these values throughout the 10-year period.

TABLE III.

INTAKE OF CALORIES AND NUTRIENTS ACCORDING TO AGE (60 SUBJECTS)

Nutrient	Age 70-73 (24 subjects) Mean 71·8 yrs.	Age 74-77 (17 subjects) Mean 75·7 yrs.	Age 78-80+ (19 subjects) Mean 80·9 yrs.
Calories	2074	1875	1674
Protein g	63	58	47·8
Protein % Calories ..	12·2	12·4	11·4
Fat g	102	86	71
Carbohydrates g	232	217	213
Calcium mg	924	883	760
Ca/1,000 Cals	447	474	458
Iron mg	11·3	9·9	8
Iron/1,000 Cals	5·1	5·2	4·8
Vitamin C mg	42	36	29
Vitamin C/1,000 Cals ..	20	19	17

The reduction in calories was brought about mainly by a fall in protein and fat as shown in Table IV. For distribution of nutrients in the different age groups see Figures 2a, b, c and d.

*The group of 19 subjects entitled "late 70's," includes three aged 89, 90 & 94.

Figure 2a

PROTEIN

Distribution Protein intakes: subjects grouped according to age

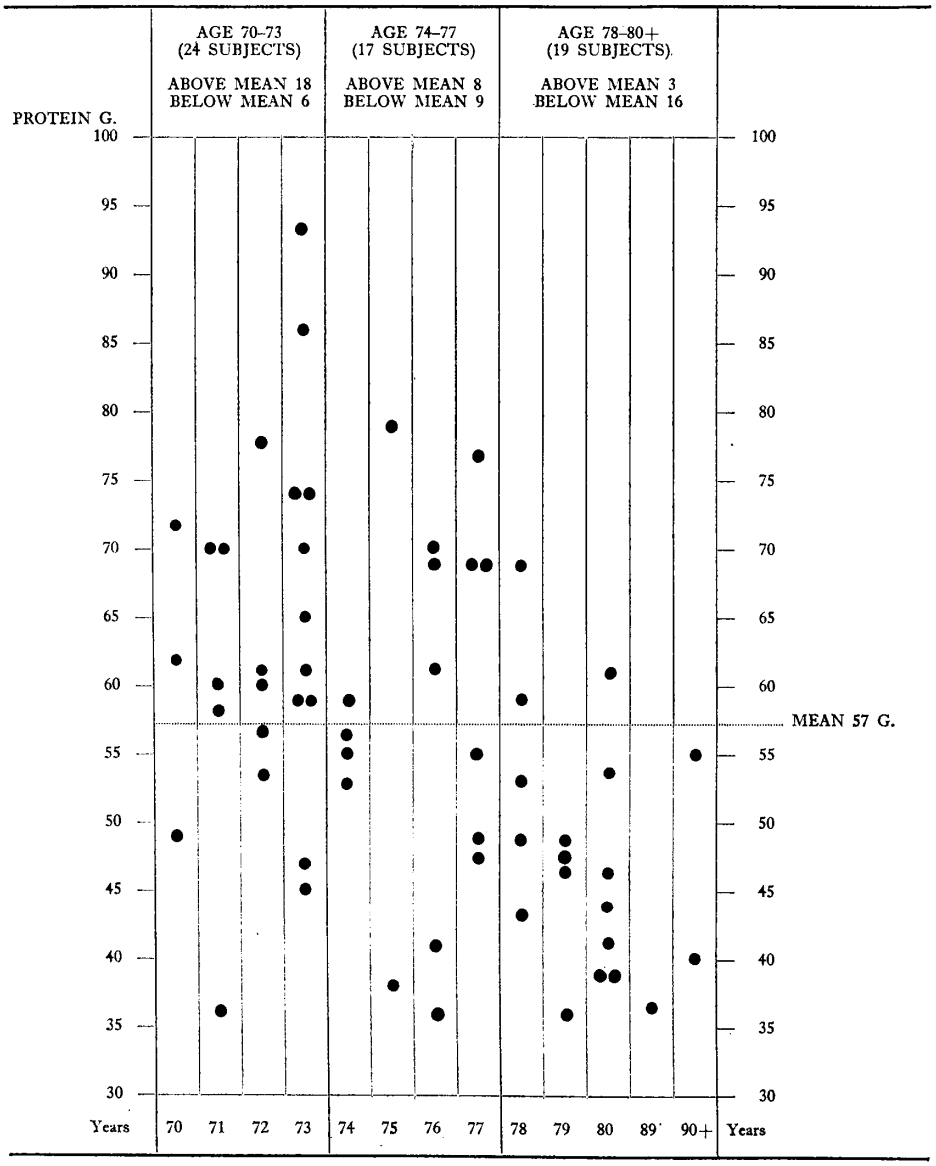


Figure 2b

CALORIES

Distribution Calories: subjects grouped according to age

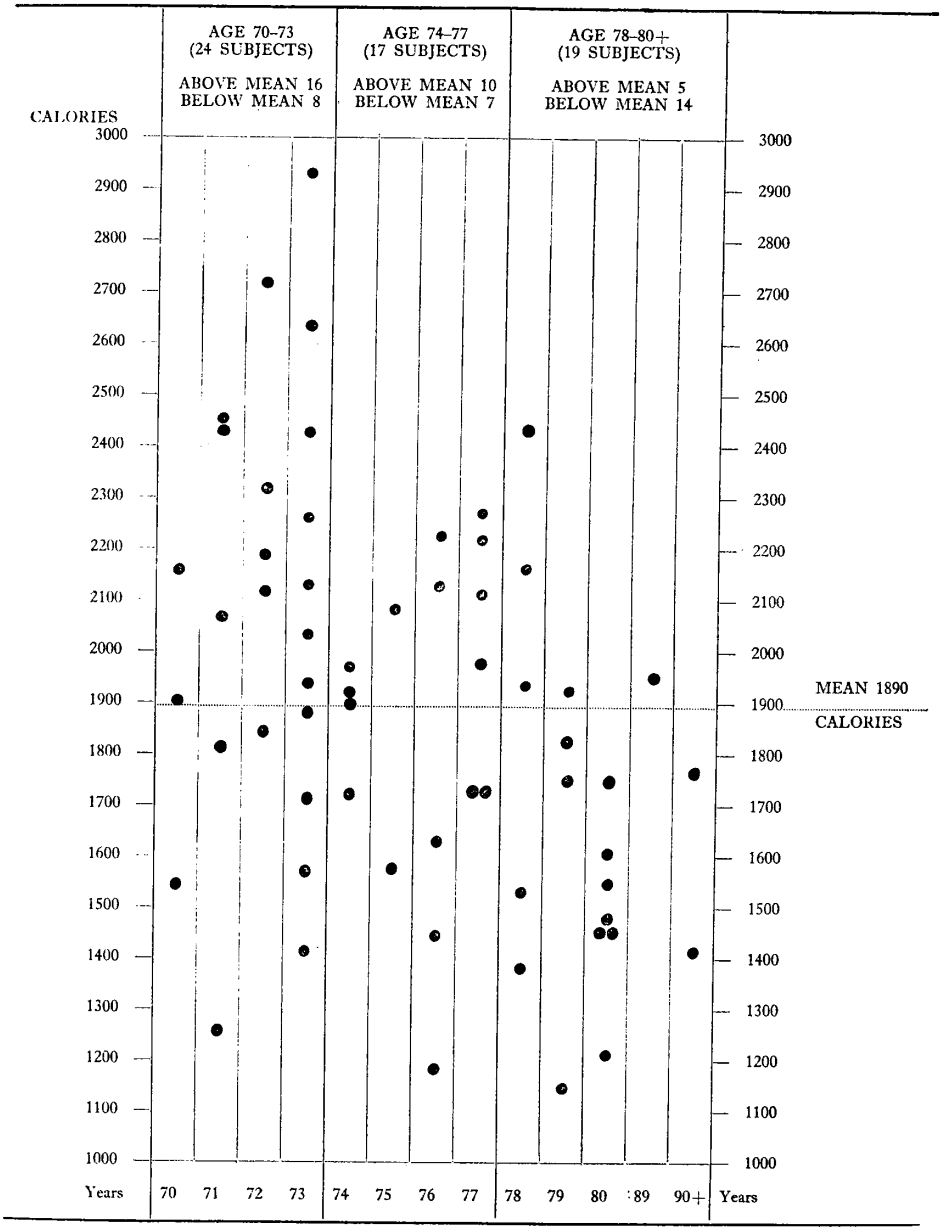


Figure 2c

CALCIUM

Distribution Calcium intakes: subjects grouped according to age

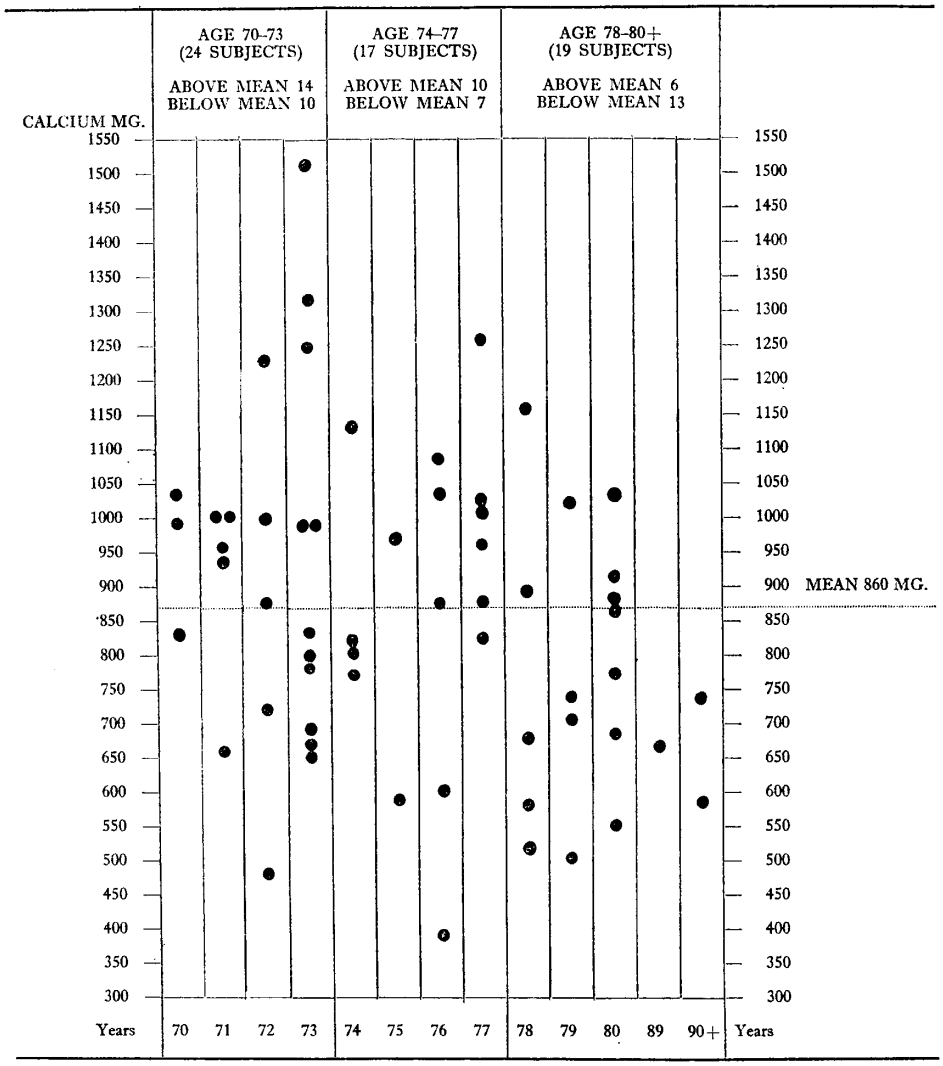


Figure 2d

IRON

Distribution iron intakes: subjects grouped according to age

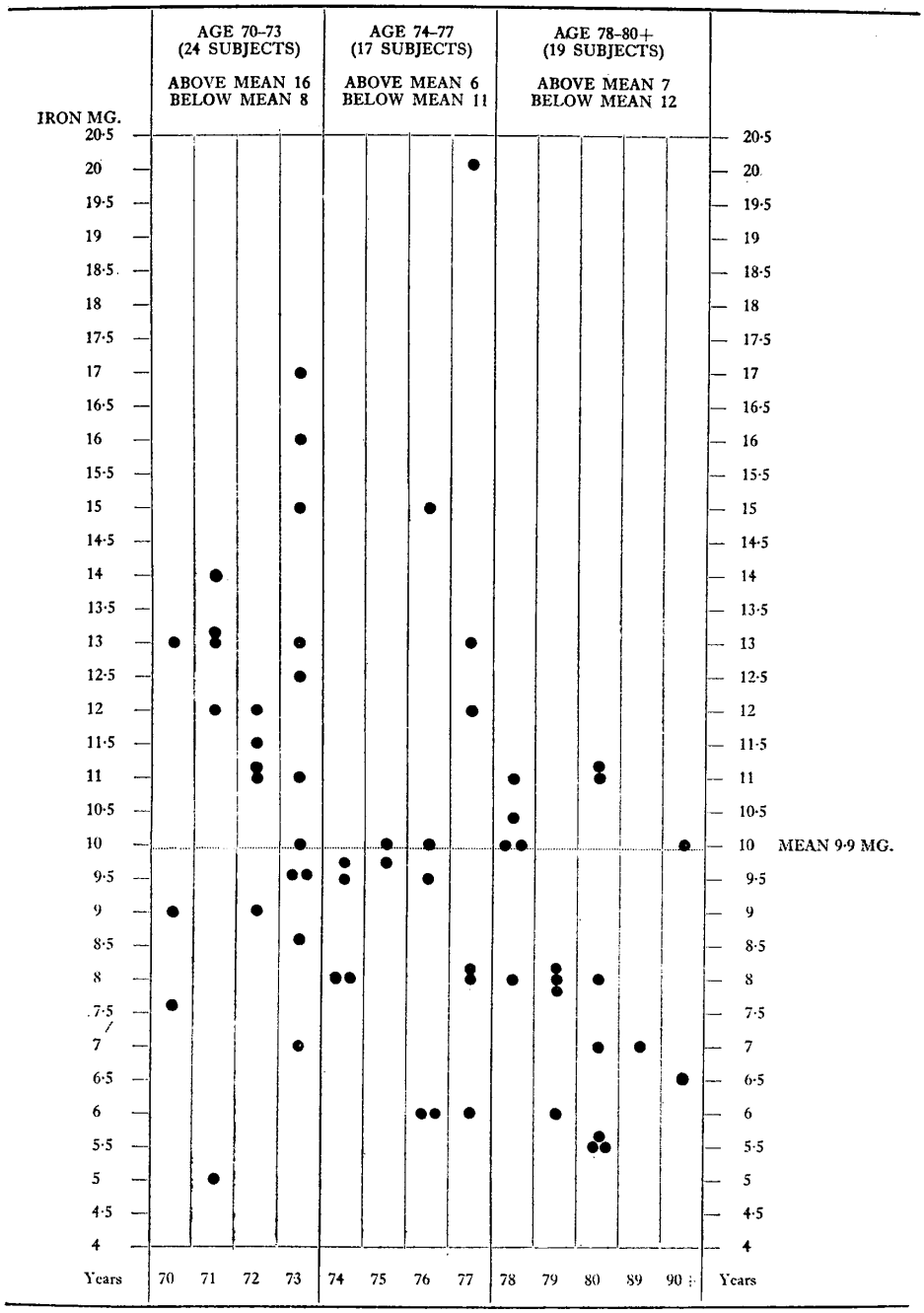


TABLE IV.

PERCENTAGES REDUCTION IN INTAKES OF SUBJECTS IN (1) MID 70's AND (2) LATE 70's COMPARED WITH SUBJECTS IN THEIR EARLY 70's

Nutrients	(1) Mid 70's (Mean 75·7 yrs.)	(2) Late 70's (Mean 80·9 yrs,)
Calories	9·5%	19%
Protein	8%	24%
Fat	16%	30%
Carbohydrates	6%	8%
Calcium	4%	18%
Iron	12%	29%
Vitamin C	14%	31%

Calorie intakes fell in the decade by 20% and this was due to a decrease in fat of 30%, protein of 24% but only of 8% by carbohydrate. Calories supplied by foods rich in protein and fat are more likely to contribute mineral salts and vitamins to the diet than mainly carbohydrate foods. Hence a fall in the protein and fat content is likely to be accompanied by a decline in some minerals and vitamins. That this occurred is seen in Table III. Calcium fell by a total of 18%, iron by 29%. Active cell mass which largely determines "requirements" diminishes with age. How quickly this happens and whether it can be arrested by dietary means is unknown. If, however, protein minerals and vitamins are needed, even in approximately the same amounts at the end as at the beginning of the decade, it seems reasonable as age advances and appetite becomes less, to discard first the mainly carbohydrate foods whereas amounts of meat, fish, eggs, milk and cheese in the diet should be maintained.

Dietary intakes of older subjects

Three of the subjects were over 80: subject 20 was 89 years, subject 49 was 94 and subject 55 was 90 years.

Their average daily intakes were:—

Subject	Age	Protein g	Protein % Cals	Calories	Ca mg	Fe mg	Vit. C mg
20	89	37	7·6	1955	670	7	77
55	90	55	12·5	1760	735	10	48
49	94	40	11	1406	579	6·5	23

Table V compares intakes of the older subjects with the mean of the whole group.

TABLE V.

INTAKES OF OLDER SUBJECTS COMPARED WITH MEAN FOR THE WHOLE GROUP

	Mean for 60	Subjects		
		20	49	55
Calories	1890	1955	1406	1760
Protein g.	57	37	40	55
Protein % Calories ..	12·1	7·6	11	12·5
Fat g.	74	75	48	76
Carbohydrate g.	221	293	212	220
Calcium mg.	860	670	579	735
Iron mg.	9·9	7	6·5	10
Vit. C. mg.	37·6	77	23	48

Only limited conclusions can be drawn from these results as the numbers involved were so small. Individually, however, these very old subjects were interesting and some details about the dietary of each are given in the following paragraphs:—

Subject 20 (age 89)

This subject ate only 1 main meal daily containing animal protein and drank less than half a pint of milk. The meat or fish of the meal was often given to her dog. She was very fond of sweet foods and ate, in 6 days, 8 oz. biscuits, 18½ oz. cakes, 9 oz. sweets and took 12 oz. sugar in beverages and an almost equal amount in puddings and fruit.

The small amount of food containing animal protein which was eaten accounts, not only for the low dietary protein level, but also for the comparatively low calcium and iron values.

Vitamin C daily intake, 77 mg. was higher than the mean for the whole group and was due to the amounts of citrus fruit, green vegetables and new potatoes eaten. The survey week was in June and the subject ate an orange on 5 days plus other stone fruit and green vegetables and new potatoes daily.

Subject 55 (age 90)

She ate 2 meals a day containing a serving of animal protein food: breakfast she cooked herself and ate egg and bacon or boiled

egg, bread, butter and marmalade. Midday meals from a Meals on Wheels service were eaten on three days and on other days she prepared her own, cooking such items as liver and bacon or chicken or chop, potato, sprouts, peas, stewed plums and rice pudding or baked custard. She used half a pint of milk daily and this, together with the larger amounts of other animal protein foods eaten, accounted for the higher protein, calcium and iron levels in her diet compared with those of subject 20.

Subject 55 was still active, besides cooking for herself, she did most of her own shopping but a home help did the housework.

Subject 49 (age 94)

She ate much less total food than either 55 or 20. Her average daily protein intake was 40 g. (below the mean for the Group). She was partially blind and although fairly active about the house, went out little and did not go far. Nor did she cook for herself.

She ate only one main meal a day and used less than half a pint of milk. Main meals were provided on three days by a Meals on Wheels service and on other days by a woman living in the same house. The small amounts of animal protein foods eaten accounted for both the low dietary protein levels and low levels of calcium and iron. Vitamin C was below the mean at an average of 23 mg daily, due to the fact that this subject ate no citrus fruit and little other fruit. Vitamin C was provided by green vegetables and potatoes, supplied largely by the Meals on Wheels service.

FOODS AS SOURCES OF NUTRIENTS

The findings for the whole group did not bear out the popular idea that old people who live alone exist almost entirely on bread, butter, jam, biscuits and cups of sweetened tea. In the main subjects ate a varied diet, cooked at least one meal a day and frequently ate fruit and vegetables. That is not to say that **all** had an excellent diet as is shown by the wide range of intakes—see page 5. Foods which were found to be the main contributors of various nutrients are described in ensuing paragraphs. The object of doing this is to enable a forecast to be made of the type of diet which might give rise to deficiencies and to formulate practical dietetic advice for the elderly. Nutrients of particular interest are protein, calcium, iron and vitamins C and D.

Protein

Protein was derived from a variety of sources: about two-thirds of the subjects included all the main protein containing foods of animal origin, meat, fish, eggs, cheese and milk. Table VI shows the average percentage contributions made by these foods.

TABLE VI.

PERCENTAGE CONTRIBUTIONS OF PROTEIN MADE BY ANIMAL PROTEIN FOODS AND BREAD IN THE DIETARIES OF 60 SUBJECTS

(figures in each column refer to numbers of subjects)

	0	Below 10%	10%—	20%—	30% and above
Meat	0	3	13	27	17
Milk	0	4	27	23	6
Bread	0	13	33	14	0
Eggs	6	41	13	0	0
Fish	16	24	14	5	1
Cheese.. ..	21	30	9	0	0

Meat contributed most protein, milk and bread tied for second place; eggs were next and cheese and fish came well at the bottom of the list.

Meat

All subjects ate meat and the average weekly consumption was 18·6 oz. per head. There were however some interesting preferences for certain cuts, animals and methods of cooking. Roast meat was the most popular and was eaten by nearly all subjects at least once a week. Forty-six ate it four or more times. Stewed meat was next in popularity and beef was eaten twice as often as lamb although lamb was cheaper at the time of the survey. Lamb contains more bone and fat which may account for its lesser appeal. Pies, sausages, joints of chicken or chops, which can be bought in individual portions sufficient for one meal, were all fairly popular. Most women bought a joint for the weekend, which might last two or at most three days, after which they bought items for single meals. The least popular

meats were rabbit and liver: rabbit because it was considered to be diseased by myxomatosis but no reason was given for liver other than that it was disliked; only nine women ate it and one ate rabbit.

Fish

Fish was markedly less popular than meat: sixteen of the sixty did not eat it and only twenty-nine got 20% or more of their protein from fish compared with forty-four who did so from meat. The average consumption of fish was 8·2 oz. weekly, (range 2-24·5 oz.,) compared with an average of 18·6 oz. for meat.

Old age pensioners, according to the *National Food Survey findings, eat an average of 6·42 oz. fish weekly. It is not possible to compare the findings of the present survey and those of the National Food Survey in respect of meat, because the amounts were recorded and calculated on different bases. White fish was more popular than oily (kippers, herrings, canned pilchards or sardines). Forty three ate white fish but only twelve ate oily. Distaste for oily fish was partly because herrings and kippers, even the filleted variety, contain a lot of little bones and partly because fish canned in oil was said to be too rich and to cause indigestion. Fried fish was preferred to steamed. Thirty-four ate fried as compared with nineteen who ate steamed. Fried fish could be bought ready cooked which was a point in its favour.

Cheese

Cheese was not a popular food. One third ate none and of those who ate it, the average weekly consumption was 3·3 oz., (in the National Food Survey, the old age pensioners' average weekly consumption was 3·42 oz.). The contribution made to the protein content of the diet was correspondingly low: most subjects got below 10%.

Cheese is a cheaper source of protein than either eggs or meat, it can be eaten raw, it is easily stored and is tasty, yet it remains unpopular. According to these sixty subjects and old people generally, cheese has the reputation of being a "binding" and indigestible food.

Eggs

Eggs were eaten as a main meal by all but seven subjects and thirteen ate eggs four or five times a week. The average consumption was 7·9 oz. or approximately four eggs weekly. (National Food Survey:

*Domestic Food Consumption and Expenditure 1961 Annual Report of the National Food Survey Committee H.M.S.O.

old age pensioners' weekly consumption was 4·15 eggs). Eggs made a bigger contribution to the protein of the diet than either fish or cheese.

Milk

Milk, mostly fresh, was used by all subjects; four used fresh and canned and one used only condensed sweetened milk. The average weekly consumption was 4·5 pints per head, (range 0·75-9·5 pints). This again was a similar figure to that of the National Food Survey, where it was found that for old age pensioners average weekly consumption was 4·87 pints. Thirty per cent. of the present group consumed less than half a pint daily and 70% more than half a pint (this included milk from all sources). Milk was next to meat in importance as a source of protein, nearly half the subjects obtained between 10 and 20% of their protein from milk and almost two fifths got more than 20%.

Bread

Bread was eaten by all subjects. Eight ate brown, thirty nine white and nine some of each. Four ate one of the starch reduced breads or crispbread biscuits under the mistaken impression that these had a lower calorie value than bread. The average consumption was 26·6 oz. per week (range 7*-57 oz.).

Bread, including all types but not including flour products or other cereals made almost as important a contribution to the diet as milk. Three quarters of the subjects obtained between 10 and 20% of their protein from bread and almost a quarter obtained between 20-30%.

Main Meals and Milk Consumption Related to Protein Dietary Levels

There was some correlation between the level of protein intake on the one hand and on the other the average number of main meals eaten weekly and the amount of milk consumed. For this purpose a "main meal" was described as a meal containing a serving of meat of any kind or fish, eggs or cheese. A "serving" was defined arbitrarily as $1\frac{1}{2}$ oz. cooked meat or more, 2 oz. cooked fish or more, one or more eggs and at least $\frac{3}{4}$ oz. cheese. The mean protein content of sixty diets was 57·0 g., thirty subjects ate diets which were below this value and thirty ate diets above. The thirty whose intakes were above

*Subject eating only 7 oz. bread ate larger than usual quantities of both plain and sweet biscuits.

the mean ate an average of thirteen main meals a week, i.e. almost two daily and drank almost ¾ pt. milk daily, whereas those with intakes below the mean ate an average of ½ pt. milk daily. Far greater differences were seen between subjects with the lowest intakes (less than 40 g.) and those with intakes above the mean as shown in Table VII.

TABLE VII.

RELATIONSHIP BETWEEN PROTEIN INTAKE, NUMBER OF MAIN MEALS AND MILK CONSUMPTION

	No subjects	Av. number main meals/ week	Average consumption milk oz/week
Protein intake above mean	30	13	101
Mean 57·0 *g.*			
Below mean	30	10	75
Average daily intake below 40 g.	8	8	60

The relationship between total protein and weekly number of main meals is differently expressed in Table VIII.

TABLE VIII.

INTAKE OF TOTAL PROTEIN RELATED TO NUMBER OF MAIN MEALS

Number Subjects	No. Main Meals Weekly	Total Protein g. per Week
17	14+	462
17	11–14	427
16	8–10	349
10	7 or less	314
Total .. 60		

Although the numbers of subjects involved are small, these tables provide some indication of the extent to which a simple questionnaire, aimed at discovering the number of main meals and the amount of milk consumed, would give a rough assessment of the consumption of protein by women who are unable to take part in a weighed dietary survey. Further work along these lines would be useful, because it is among such women that the danger of malnutrition is most likely.

Some correlation was also found between the state of health as assessed in forty-four subjects—see page 29—and the number of main meals eaten. Of eleven subjects eating two or more main meals daily, nine had better than average health and two worse. Of six subjects eating one or fewer main meals a day, one had better than normal health and five worse.

Calcium

Milk, bread and cheese were the most important sources of dietary calcium. Fifty-eight subjects got 60% or more from these three foods and the other two got almost 50%.

Milk was the most important single food source. Thirty-two subjects got more than half their calcium from milk, two got more then three quarters and only one obtained less than a quarter. Bread although next in importance contributed far less; eleven got about a quarter but forty-nine got less than this. Cheese, potentially a richer source than either milk or bread, was eaten in comparatively small quantities and twenty-one ate none at all. Thirty-seven subjects obtained less than a quarter of their calcium from cheese and only two obtained a half or more Table IX shows the calcium intake related to consumption of milk, bread and cheese.

TABLE IX.

INTAKE OF CALCIUM RELATED TO CONSUMPTION OF MILK, BREAD AND CHEESE

(Mean Calcium Intake 860 mg.)

Calcium Intake	No. Subjects	Average Consumption oz/week		
		Milk	Bread	Cheese
Above mean	30	106	32	3·9
Below Mean	30	69	21·5	2·5
Subjects with intakes below 600 mg. ..	9	51	15·7	0·5

Iron

The most important sources of iron were meat and particularly liver, flour products including bread, and eggs. All but one subject got more than half their iron from these foods. The one exception ate nearly a pound of plain chocolate in seven days and this accounted for more than 50% of her iron intake. Apart from this rather odd source, liver contributed more than any other single food item. Only nine women ate it but their average daily iron intake was 13·6 mg. compared with the mean for the group of 9·9 mg. Bread was next to meat products in importance and contributed a quarter or more for twenty four subjects but less than this for thirty-six. The corresponding figures for eggs were, fifty-three subjects obtained a quarter or less, seven did not eat eggs and only one subject obtained more than a quarter. Table X shows the contributions made by meat, bread and eggs to the total dietary iron.

TABLE X.

INTAKE OF IRON RELATED TO CONSUMPTION OF MEAT, BREAD AND EGGS

(Mean iron intake 9·9 mg. per day)

Iron Intake	No. subjects	No. subjects eating liver	Average Consumption oz/week		
			Bread	Meat	Eggs
Above Mean ..	29	9	32·9	22·4	8·6
Below Mean ..	31	0	20·9	15	6·1
Below 7 mg. ..	11	0	17	10·7	3·6

Vitamin C

The chief dietary sources of vitamin C were fruits and vegetables although one woman obtained some from a brand of slimming biscuit. Four women did not eat fruit and one ate no fresh vegetables. All these had intakes lower than the daily mean: 37·6 mg. Their intakes were: 3 mg., 9 mg., 10 mg., 18 mg., and 27 mg. The last subject ate fair amounts of salad and root vegetables. None of the subjects showed clinical signs of scurvy. Table XI shows the average weekly weights of fruit and vegetables consumed by sixty subjects.

TABLE XI.

AVERAGE WEIGHT, PER WEEK, OF DIFFERENT TYPES OF FRUIT AND VEGETABLES CONSUMED

	Number Subjects Eating None	Average Consumption of group: oz/week
Fruits		
Citrus	34	5·3
'other'	7	12·2
Tomatoes	26	4·2
Vegetables		
'greens'	7	12·4
Roots	20	4·2
Potatoes	8	20·9

Citrus fruit included fresh or canned orange and grapefruit also fresh lemon juice. "Other" fruit included raw or cooked apples, pears, bananas, stone fruit and tomatoes raw or cooked.

Green vegetables included raw or cooked leafy vegetables, fresh peas or beans and cauliflower; roots included carrots, onions, beetroot, swede, parsnip and marrow.

The type of fruit and vegetable eaten influenced dietary vitamin C levels as much or more than the total quantities eaten. This is shown in Tables XIIa and XIIb.

TABLE XIIa.

CONSUMPTION OF CITRUS, 'OTHER' FRUITS AND TOMATOES RELATED TO THE VITAMIN C CONTENT OF THE DIET

(Mean Intake Vitamin C 37·6 mg.)

Vitamin C Intake	Number of Subjects	Average Consumption oz/week		
		Citrus Fruit	'Other' Fruits	Tomatoes
Above Mean ..	24	11·4	14·8	6
Below Mean ..	36	1·5	14·0	3
Below 10 mg/day	7	1·7	4	0

Subjects above the mean ate almost ten times as much citrus fruits as those below but there was little difference between amounts of other fruit eaten. Total quantities of tomatoes eaten were small in both cases yet those above the mean ate twice as much as those below. Seven subjects with intakes below 10 mg. ate little fruit of any kind.

TABLE XIIb.

CONSUMPTION OF GREEN AND ROOT VEGETABLES AND POTATOES RELATED TO THE VITAMIN C CONTENT OF THE DIET

(Mean Intake Vitamin C: 37·6 mg.)

Vitamin C intake	No. of Subjects	Average Consumption oz/week		
		Green	Root	Potato
Above Mean ..	24	17·8	5	23·8
Below Mean ..	36	9	3·7	19·3
Below 10 mg. ..	7	1·4	5	6·7

The biggest difference between those above and those below the mean, lay in the amounts of green vegetables eaten, whilst subjects with the lowest intakes i.e. below 10 mg. ate little vegetables of any kind. The number of times citrus fruits, tomatoes and green vegetables were eaten in a seven day period had a marked effect on vitamin C levels as shown in Table XIII.

TABLE XIII.

VITAMIN C INTAKES RELATED TO NUMBER OF TIMES CERTAIN GROUPS OF FRUITS AND VEGETABLES WERE EATEN WEEKLY

		Daily Average Vitamin C mg.		
	10 mg. and below	11 mg—	30 mg—	60 mg. and over
Citrus Fruit ..	0·5	0·5	1	5
Other Fruit ..	1·5	3·5	3·5	4
Tomatoes ..	0	0·5	3	2·5
Green Vegetables	1	2·5	3	4·5
Roots	1	1	1·5	1·5
Potatoes	2	4·5	5·5	4·5

On this evidence it appears that a diet containing less than one serving daily of green vegetables or tomatoes or citrus fruit is likely to have a vitamin C content below the mean for this group and below the recommended daily allowance of 30 mg.* It is unknown, however, whether the recommended allowances apply to this age group.

There was some evidence of seasonal fluctuation in vitamin C intakes. Of thirty-six subjects whose intakes were below the mean, 36 %were surveyed in winter i.e. between October and April and 64% in the summer months, whereas for subjects with intakes above the mean, 25% were surveyed in winter and 75% in summer. Seasonal variations, however, were much less important than the type and quantity of fruits and vegetables eaten.

Vitamin D

The content of vitamin D in foods is very variable so that absolute dietary values calculated from tables are unlikely to be accurate. But valid comparisons between groups can be made as the errors affect all calculations equally. The mean intake of vitamin D for the 60 subjects was 135 i.u. per day (range 10-353 i.u./day). Forty subjects were below the mean and 20 above.

The foods which chiefly influenced the level of intake were fat fish, margarine and eggs but because few subjects ate the first two foods, they made little contribution to the dietary of the whole group. On the other hand eggs were eaten by 53 of the 60 and contributed more than any other single food. A little over half the women obtained more than 60% of their vitamin D from eggs but only six subjects got as much from fat fish and one from margarine. Milk was taken in fair quantities by all subjects (average 4·5 pints per head/ week) but it contributed less than 10% for two thirds of the subjects. Cheese also contributed little; it was not eaten by one third and those who ate it did so in comparatively small amounts (3·3 oz. per head per week). Butter was eaten by 57 subjects with an average consumption of 6·1 oz. (range 1·5 to 14 oz.), yet fewer than two thirds got more than 10% of their vitamin D from butter. Margarine was eaten by only 14 subjects, five of whom used it to replace butter partly or entirely; the average per head weekly consumption of these subjects was 3·07 oz., (range 0·5 to 12 oz.). Margarine made little contribution to the vitamin D intakes of the whole group but gave high values for the dietaries of individuals who ate it in any quantity. Table XIV summarises these findings.

*Bartley, W., Krebs, H. A. and O'Brien, J. R. P., Vitamin C Requirement of Human Adults Report by the Vitamin C Sub-committee of Accessory Food Factors Committee, Medical Research Council Special Report Series 280.

TABLE XIV.

PERCENTAGE CONTRIBUTION OF SPECIFIED FOODS TO VITAMIN D VALUE OF THE DIET

Figures in each column refer to the number of subjects

	0%	Below 10%	10%—	20%—	30%—	40%—	50%—	60% and over
Butter	3	20	19	9	4	1	1	3
Margarine ..	46	4	3	4	—	—	2	1
Milk	—	41	14	1	3	1	—	—
Cheese	21	38	—	—	1	—	—	—
Eggs	7	1	2	3	3	6	4	34
Fat Fish	48	—	—	—	1	1	4	6

The influence of certain foods on vitamin D intakes is also shown in Table XV. Ten subjects had average intakes well above the mean of 135 i.u./day, and eight had correspondingly low intakes, average 19 i.u./day.

TABLE XV.

INTAKE OF VITAMIN D RELATED TO CONSUMPTION OF SPECIFIED VITAMIN D CONTAINING FOODS

(Mean intake 135 i.u./day)

Number Subjects	Average Vit. D. Intake i.u./day	Average Consumption in oz/week						
		Liver	Butter	M'rine	Cheese	Milk	Fat Fish	Eggs
10	235	0·2	2·6	3	2·7	88	2·7	12·1
8	19	0	4	0·1	2	72	0	0·8

The chief differences lie in the amounts of fat fish, eggs and margarine eaten.

Dislikes

In order to discover whether a widespread dislike of certain foods could affect the nutritional value of the diet, each subject was asked if there was any food which she never ate. One third said that they ate all foods, two thirds mentioned one or more foods which they never ate. Three gave answers covering many foods, e.g. subject 50 never ate "other people's cooking" but this could not be taken literally as she ate bread and biscuits.

Subject 58 who had only two or three teeth and no dentures never ate "hard or tough foods" such as fruits and vegetables. Subject 57 also never ate tough foods and both these women had low vitamin C intakes.

Foods mentioned by name were:—

Cheese, seven times; reasons for not eating cheese were that it was indigestible or "binding". Fruit, seven times: subjects said that they had been advised, many years ago, not to eat fruit with pips and seeds and/or acid fruits because of diverticulitis or indigestion. Some also said they could not peel citrus fruit easily. Offal and eggs were each mentioned five times. Meat in various forms including rabbit was mentioned seven times. Potatoes, green vegetables and fish were each mentioned three times. Other foods mentioned once or twice were tinned foods, porridge, milk puddings and breakfast cereals.

The nutritional value of the diets of those subjects, who disliked and therefore, did not eat cheese, vegetables, fruit, offal or eggs might be adversely affected.

SECTION III

NUTRITION AND HEALTH

After the completion of the nutrition survey the 60 subjects were requested to attend for clinical and radiological examination. It was thought advisable that this should be carried out at the hospital because of the necessity of making the radiological assessment of bone density under standardised conditions. Forty-four subjects agreed to this further study. Its main purpose was to see if any relationship existed between their state of health and their dietary intake.

Clinical Assessment

In each case a letter was sent to the subject's general practitioner explaining the nature of the investigation and requesting information on illnesses which might have affected the state of nutrition. Enquiry was also made to ascertain if the subject was receiving iron or vitamin supplements. For the assessment of the state of health the following information was recorded:—

1. *Clinical*
   (a) Subject's own opinion of health.
   (b) Assessment of physical condition.
   (c) Assessment of mental state.
   (d) Assessment of activity.
   (e) Assessment of nutrition.
2. *Physical Data*
   (a) Weight.
   (b) Height.
   (c) Skin-fold thickness.
3. *Laboratory Investigations*
   (a) Haemoglobin.
   (b) Serum calcium, inorganic phosphorus and alkaline phosphatase.
   (c) Serum Electrophoresis.
4. *Radiological*
   X-ray of the left hand under standard conditions and measurement of the density of the proximal phalanx of the third finger by means of a photoelectric densitometer.*

*Description of the method used in densitometry see :—Hodkinson, H. M., Exton-Smith, A. N. and Crowley, M. F. (1963) The Diagnosis and Assessment of Osteoporosis Postgrad. med. J. **39**, 433.

All the clinical studies were carried out by one observer (A.N.E-S), and as far as possible the same radiographer performed the X-rays using the same machine and techniques.

Comparison of the 'Clinical Group' with the whole series

The value of this further study would be correspondingly greater if it could be shown that data obtained from the group of 44 subjects, who were assessed clinically, were representative of the whole series of 60 subjects. Table I shows that the proportion of subjects in each age group is similar in the clinical group to that of the whole series.

TABLE I.

PERCENTAGE OF SUBJECTS IN EACH AGE GROUP IN THE TWO SERIES

	Age 70—73	Age 74—77	Age 78—80+
Whole Series (60)	41%	27%	32%
Clinical Group (44)	41%	25%	34%

Although one of the main reasons for refusal to attend was difficulty in travelling under the rather harsh winter conditions of the early months of 1963, all the subjects were given the offer of a hired car to bring them to hospital and we have no reason to believe that the health of the sixteen subjects who did not attend was worse than that of the group as a whole.

Health of the 44 Subjects

The results of the subjective assessment and the observer's evaluation of the subject's physical condition, mental state and degree of activity are shown in Table II. In each assessment the subject was placed in one of four grades a description of which is given in column 1 of the table.

TABLE II.

STATE OF HEALTH OF THE SUBJECTS ACCORDING TO AGE GROUP

Assessment	No.	%	70–75	76 and over
Subject's Own Assessment				
4. Excellent, very well indeed ..	17	39	10	7
3. Good for age, only minor complaints	13	30	6	7
2. Fair, more specific complaints ..	12	27	5	7
1. Poor, anxious about health ..	2	4	0	2
General Condition				
4. Excellent, Normal-plus	11	25	9	2
3. Good, 'Normal for age'	22	50	8	14
2. Fair	10	23	4	6
1. Poor	1	2	0	1
Mental State				
4. Excellent, lively, full of spirits ..	19	44	12	7
3. Good, alert, normal	21	48	8	13
2. Apathetic or depressed	2	4	1	1
1. Impaired, mild deterioration ..	2	4	0	2
Activity				
4. Walks several miles a day ..	14	32	10	4
3. Normal, adequate for independence	17	39	6	11
2. Limited outside house	10	23	3	7
1. Largely confined to house ..	3	6	2	1

It will be seen that about three-quarters of the subjects enjoyed normal or excellent health; the subject's own evaluation of her health was often slightly better than that of the observer. One quarter of the subjects were assessed as having fair or poor health and rather more than a quarter had markedly limited powers of locomotion. On the other hand, there were a few subjects who, in spite of advanced age, appeared to be remarkably fit. They enjoyed an active life, they were mentally alert and in good spirits and some subjects walked for many miles each day. For the most part the grading under each of the four assessment headings was similar with the exception that there were fewer who showed mental changes than physical deterioration.

Subjects with the highest placing under each assessment tended to be in their early seventies and with increasing age more disablement became apparent. This is shown by the rise in proportion of the 76's and over compared with the 75's and under with the lower

assessment grades (Table II). There were, however, a few notable exceptions to this generalisation. A subject aged 90 and another of 89 enjoyed a state of health which one might expect to find in a woman of 12 to 15 years younger.

As Sheldon* (1948) points out in the differentiation between normal and normal-plus it is essential to take age into account; this distinction is easier to make as age increases for as the general level of activity falls so does the singularity of those retaining unusual physical health stand out. In the present study the findings of a marked decline in the physical powers in the second half of the 8th decade are in accord with those of Sheldon's survey of a random sample of the elderly population of Wolverhampton.

The classification of subjects into three main groups (ignoring for the moment the one subject whose health was recorded as bad) is only a crude assessment of their health and as may be expected the largest group consists of 'normal' subjects. This classification, however, did emphasize the necessity of adopting different standards of 'normality' with advancing age even within the narrow age period of 70-80 years. It was, therefore, decided to take age into account and to group the subjects according to whether their health was judged to be better or worse than the average. In practice little difficulty was encountered in making this division (and with two exceptions out of the 44 subjects the state of general health corresponded with the physical activity).

The results of classifying the health of subjects in this way are shown in Table III.

TABLE III.

CLASSIFICATION OF HEALTH OF SUBJECTS ACCORDING TO WHETHER IT WAS BETTER OR WORSE THAN AVERAGE FOR THEIR AGE

Age Group	Better	Worse
70–73	9	8
74–77	6	7
78–80+	8	6
	23	21

*Sheldon, J. H. The Social Medicine of Old Age, London, 1948.

Nutritional State

The assessment of the nutritional state in the elderly can rarely be made on objective clinical signs. There is difficulty in distinguishing between evidence of malnutrition and manifestations of the natural process of ageing. Moreover criteria of normality must change even in the narrow range of ages of the subjects forming the present series. What could be considered as a normal nutritional state in a person of 80 might be assessed as poor nutrition in a subject of 70.

Bearing in mind these limitations a clinical assessment of the nutritional status of each subject was made in the following four grades:—

Normal, well-nourished.
Obese.
Fair, undernourished, thin.
Poor with evidence of specific deficiencies.

As none of the subjects showed specific signs of a deficiency state, it has been possible to group the subjects under 3 headings—normal, obese and undernourished, (or thin). The numbers of subjects in these groups and their mean skin-fold thickness* are shown in Table IV.

TABLE IV.

NUTRITIONAL STATUS AND SKIN-FOLD THICKNESS ACCORDING TO AGE

Body Leanness–Fatness	No. of Subjects	Mean Skin-fold thickness (mm.)			
		All Subjects	Subjects aged 70–73	Subjects aged 74–77	Subjects aged 78–80+
Normal	28	8·3	10·4	8·5	5·1
Thin	9	5·1	6·0	5·5	4·4
Obese	7	15·0	15·6	9·8	9·5
	44		11·0	7·9	6·7

The marked fall in skin-fold thickness during the eighth decade is apparent. By the end of the decade the average skin-fold thickness of the nutritionally normal subjects is approximately half that of the

*Skin-fold thickness was measured with Harpenden callipers over the lateral aspect of the upper arm.

early seventies. The reduction in the body weight which occurs during the same period is seen in Table V.

DIETARY INTAKE

Changes with Age—Calories

The calorie intake tends to fall with age (see table) and this fall is significant within the ten year age range of 70 to 80 years. Analysis of the calorie intake according to the nutritional status of the individual shows that this fall with age occurs irrespective of whether the subjects are of normal nutrition, undernourished or obese (Table V).

TABLE V.

MEAN CALORIE INTAKES AND WEIGHTS OF SUBJECTS CLASSIFIED ACCORDING TO NUTRITIONAL STATUS AND AGE

Nutritional State	Ages 70–73		Ages 74–77		Ages 77–80+	
	Cals.	Wt. (Kg)	Cals.	Wt. (Kg)	Cals.	Wt. (Kg)
Normal	2180	58	1792	54	1820	52
Thin	1694	47	1817	44	1598	44
Obese	2050	74	1682	72	1789	67
	2104	59	1844	56	1704	51

It is apparent from Table V that the ratio of calorie intake per Kilogram body weight remains fairly constant in each age period; and the loss of body mass which occurs with age is associated with a diminution in food intake. It is also interesting that at each age period the calorie intakes of the obese were less than those of the normally nourished both absolutely and relative to their Kilogram body weight*.

Changes with Age—Nutrients

The average daily intakes of calories and nutrients for the subjects who have been classified according to age is shown in Table VI. For ready comparison the corresponding figures (taken from Section II Table III) for the whole series of 60 subjects are also shown. There is

*These results are of interest in view of the suggestion of Quaade (Lancet ii, 429, 1963, "Insulation in Leanness and Obesity") that differences in insulation may explain why some persons remain lean in spite of a greater food intake and in others obesity may persist in the absence of gross overeating. A thick layer of subcutaneous adipose tissue reduces heat loss. He adds "many obese patients may have some excuse for their condition in that their calorie expenditure is limited by an effective subcutaneous insulation, and hence they may be right when they deny that their food intake is excessive".

a fairly close similarity for the 'clinical' group and the series as a whole in each of the age periods. The reduction in intake between the early seventies and the late seventies is striking, (see also table VII).

TABLE VI.

AVERAGE DAILY INTAKES OF CALORIES AND NUTRIENTS FOR 44 SUBJECTS. THE FIGURES IN BRACKETS SHOW THE CORRESPONDING INTAKES FOR THE WHOLE SERIES OF 60 SUBJECTS

	Age 70–73		Age 74–77		Age 78–80+	
Subjects 44 (60) ..	17	(24)	13	(17)	14	(19)
Calories	2104	(2074)	1844	(1875)	1704	(1674)
Protein g.	64	(63)	56	(58)	48	(47·8)
Protein % Cals. ..	12·1	(12·2)	12·0	(12·4)	11·2	(11·4)
Carbohydrate g. ..	234	(232)	220	(217)	220	(213)
Fat g.	103	(102)	82	(86)	72	(71)
Calcium mg. ..	976	(924)	809	(883)	863	(760)
Iron mg.	10·7	(11·3)	10·2	(9·9)	8·4	(8)
Vitamin C mg. ..	41	(42)	37·4	(36)	30·0	(29)

TABLE VII.

PERCENTAGE REDUCTION BETWEEN INTAKES OF EARLY 70's AND LATE 70's* FOR 44 SUBJECTS

Calories	19%
Protein	25%
Carbohydrate	6%
Fat	30%
Calcium	12%
Iron	21%
Vitamin C	27%

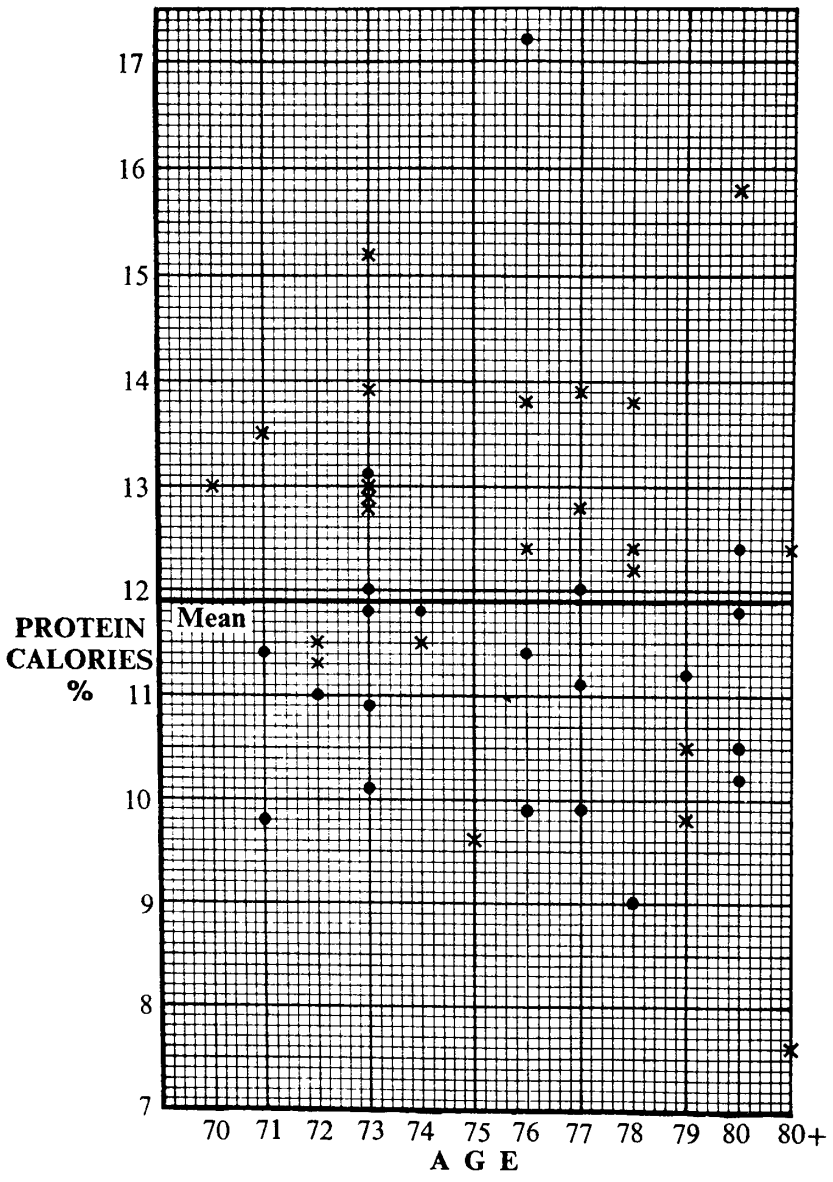
The fall in intake is especially marked in the case of fat and protein and this accounts for most of the decrease in total calorie intake. By contrast the fall in carbohydrate consumption is relatively small. There is, however, very little fall in the percentage of calories contributed by protein—it being 11·2% for the subjects aged 77-80+ compared with 12·2% for those in the 70-73 year age group.

*The group of 14 subjects entitled 'late 70's' includes two subjects over the age of eighty—subjects Nos. 20 and 55

General Condition of the Subjects and their Dietary Intake

Although it is common knowledge that people eat less food with advancing age the marked fall (19%) in calorie intake within the age period of 70-80 years was unexpected. In making a comparison between diet and health it is important to see that any correlation that exists is not masked by changes in the total intake occurring with age. The percentage of calories derived from protein is one of the most useful indicators of the quality of the diet in that several other nutrients are commonly associated with the protein of various foods. The advantage of some assessment of the quality of the diet which is independent of its absolute contents of any nutrient is that the total amount of food that individuals consume may change, but the quality of the diet may remain constant. The pattern of their diet today is therefore likely to provide some indication of what it was like during the preceding years. This is important because deterioration in general condition of the sort observed in these elderly women may be the result of dietary imbalance operating over earlier years. The percentage of calories contributed by protein for the three age groups has therefore been calculated (see Table VI), This shows a remarkable constancy and indicates that the quality of the diet changes little in this decade. The percentage of calories contributed by protein has therefore been used for comparing diet with state of health. The results of this comparison in which subjects have been classified according to whether their health is better or worse than average are shown in Fig. 1.

Fig. 1 — Comparison of the state of health with % calories of the diet contributed by protein.



The correlation between health and diet is striking. All except four of the 21 subjects whose diet was better than average enjoyed better than average health; whereas 17 out of 23 subjects whose diet was worse than average had poorer health. This correlation was found with reasonable consistency in each of the three age periods as shown in Table VIII. This is not to say that the diet must have affected the health. The reverse might equally be true.

TABLE VIII.

PERCENTAGE PROTEIN CALORIES IN DIET

General Health	Age 70-73		Age 74-77		Age 78-80+	
	Above Average	Below Average	Above Average	Below Average	Above Average	Below Average
Better than average	8	1	4	2	5	3
Worse than average	1	7	1	6	2	4

'The Super-normal'—Calorie & Protein Intakes

The health of 4 subjects in the series can be said to be outstanding. They had the highest score on their own assessment and in the assessments of their physical condition, mental state and degree of activity. These four subjects were all in their early seventies (i.e. 72, 73, 73, 74). Their mean calorie intake was 2297 with 75 grams of protein per day. (protein % calories 13·1).

If the loss of one point in the score in any of the four assessments is allowed then an additional 8 subjects qualify. The calorie and protein intakes of these subjects were seen to be notably less than those of the previous 4 subjects, namely 1920 calories and 60 grams of protein respectively. Their age range was slightly greater but apart from one subject of 90 and another of 76 they were aged 75 years or less.

Variation of Protein Intake with Age and Weight

Corresponding to the progressive reduction in appetite and in food intake in the later seventies there is a fall in weight of the subjects during the eighth decade. A comparison of the protein intake per kilogram body weight for each age period is shown in Table IX.

TABLE IX.

PROTEIN INTAKE PER KILOGRAM BODY WEIGHT FOR EACH AGE PERIOD

	Age 70–73 (17)	Age 74–77 (13)	Age 78–80+ (14)
Protein per Kg. body weight ..	1·08	0·99	1·0

The ratio remains remarkably constant during the eighth decade. Thus it seems likely that the physiological balance is maintained by reduction in intake corresponding with the fall in body mass. The results, however, do not indicate whether the reduction in food intake is primarily responsible for the fall in body weight or whether the reduction in body mass is due to some other cause and the decrease in intake is an adjustment to this.

Anaemia and Iron Intake

Haemoglobin estimations were made on 28 subjects. Two subjects were found to have haemoglobin levels of less than 80%. As shown in Fig. 2 there appears to be some relationship between iron intake and haemoglobin level, but since there are many factors concerned with the production of anaemia in old people that have not been investigated (e.g. occult gastro-intestinal haemorrhage) only limited conclusions should be drawn from these results. It is interesing to note that six subjects were not appreciably anaemic (haemoglobin levels over 90%) although they had low dietary iron intakes of 8 mg or less per day.

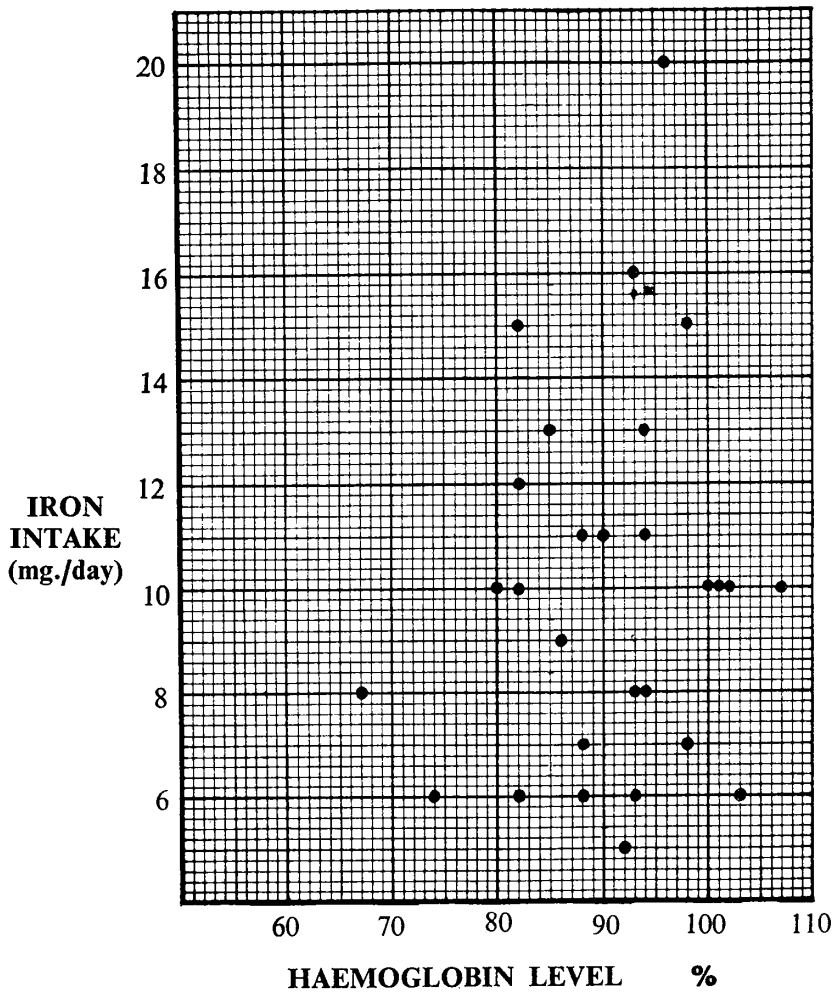
Bone Density and Diet

In the case of 43 subjects determinations of bone density were made using the proximal phalanx of the third finger of the left hand*. Twelve subjects were found to have marked skeletal rarefaction with bone densities of 5, 6 and 7 arbitrary units; another twelve had densities in the intermediate range of 8, 9 and 10 units and 19 had densities in the range of 11 to 17 units.

*For a description of the method see:—Hodkinson, H. M., Exton-Smith, A. N., and Crowley, M. F. (1963). The Diagnosis and Assessment of Osteoporosis. Postgrad. med. J. **39**: 433.

In a series of hospital in-patients the chemical determination of bone ash has shown a good correlation between bone density and calcium content (mg/c.c.). The results of this study are to be published. The method is considered to be satisfactory for the assessment of skeletal rarefaction in surveys of this type.

Fig. 2 — Relationship between haemoglobin levels and iron intake.



Analysis of the physical data of the subjects with bone density in the intermediate range and those in the high density range showed similar findings. These two are therefore grouped together as subjects with 'normal' bone density for comparison with those showing skeletal rarefaction, which will be called the 'low density group'.

The physical data for the subjects forming the 'low density' and 'normal' groups are given in Table X. It will be seen that three-quarters of the subjects in the low density group are aged 76 or over, whereas only half the number of normal subjects are in this age range. The average weight of the low density group is significantly less than that of the normal group. That this is not due to differences in skeletal size is indicated by the fact that the bone dimensions as assessed on hand radiographs are almost identical in the two groups.** Moreover the average heights are similar; the slightly diminished stature of the low density group is consistent with some degree of vertebral collapse which might be expected in this group. Corresponding with the differences in weight the skin-fold thickness is much less in the low density group than in the normal.

TABLE X.

COMPARISON OF SUBJECTS HAVING SKELETAL RAREFACTION AND THOSE WITH NORMAL BONE DENSITY

	Low Density Group	Normal Density Group
Age 75 and below	3 subjects	16 subjects
Age 76 and above	9 subjects	15 subjects
Average weight	46 kg.	59 kg.
Average height	58¾ ins.	60 ins.
Skin-fold thickness	6·6 mm.	9·1 mm.

The average dietary intakes of calories, protein and calcium is shown in Table XI.

TABLE XI.

DIETARY INTAKES OF CALORIES, PROTEIN AND CALCIUM FOR NORMAL SUBJECTS AND THOSE WITH SKELETAL RAREFACTION

	Low Density Group	Normal Group
Calories	1758 Cals.	1945 Cals.
Protein	49·4 g.	60·2 g.
Protein % Cals.	11·3	12·4
Protein/body weight	1·12 g/kg.	1·01 g/kg.
Calcium	814 mg.	945 mg.

**An index of skeletal size has been calculated by measuring the length and average diameter of the third proximal phalanx on the radiograph. The results are expressed in arbitrary units.

It will be seen that in absolute amounts there is a striking difference between the protein intakes of the two groups, but this is due entirely to the difference in body weight of the two groups; the protein intake per kg. body weight is similar for the normals and for those showing skeletal rarefaction. Although the mean intake of calcium is slightly less for the low density group there is such wide individual variation that the difference is not significant.

Bearing in mind the decline in intake of nutrients during the 8th decade and the disparity in age structure between the low density and normal groups it is important to ascertain how far the nutritional differences can be attributed to age alone. To eliminate the possible effects of age the subjects of the 2 groups have been age-matched. There were 12 subjects in the low density group; two of these were aged 89 and 90 and these subjects have been omitted because there were no subjects over the age of 80 in the normal group for comparison. Table XII shows data for the two groups with the low density cases matched according to age with subjects having normal bone density.

TABLE XII.

COMPARISON OF DIETRY INTAKES OF SUBJECTS IN LOW DENSITY GROUP WITH AGE-MATCHED NORMAL GROUP

	Low Density Group	Age-matched Normal Group
	70–80 years	70–80 years
Weight	46·8 kg.	55·8 kg.
Calories	1737 Cal.	1760 Cal.
Protein	50·2 g.	53·6 g.
Protein % Calories	11·6 %	11·5 %
Calcium	806 mg.	860 mg.
Vitamin D	72 i.u.	90 i.u.

It will be seen from this table that the striking differences in weight between the subjects of the two groups persists after they have been matched according to age. Examination of the dietary data fails to implicate either protein or calcium deficiency as a cause of skeletal demineralisation in this group of elderly subjects. There is, however, a (25%) difference in the intake of Vitamin D for the two groups and although not statistically significant this seems suggestive enough to merit further study.

The Nature of Skeletal Rarefaction

It is proposed to include in a report published elsewhere a comparison between the two groups of the serum calcium, inorganic phosphorus and alkaline phosphatase levels. But it is worthy of mention here that osteomalacia probably contributes to skeletal demineralisation in this age group on the basis of low vitamin D intakes and this view was expressed by Malm (1958)* who investigated the calcium requirements of 44 men ages 20-76 years in the State Prison in Oslo. Of the 38 men who were examined radiologically 5 had skeletal demineralisation and a further 5 had doubtful demineralisation. Three men had the biochemical characteristics compatible with demineralisation of the osteomalacic type based on their nutritional history and metabolic response to high and low calcium intakes. Malm tentatively concludes that mixed dietary insufficiency, and specifically a relative lack of vitamin D and calcium is the common contributory cause in the 10 men with moderate or slight demineralisation.

The recommended daily allowance for vitamin D in adults has not yet been clearly assessed. According to the National Research Council (1953)† "the need for supplemental vitamin D by vigorous adults leading a normal life seems minimal. For persons working at night and for nuns and for others whose habits shield them from sunlight, as well as for elderly persons, the ingestion of small amounts of vitamin D is desirable". On the basis of the findings of comparatively low vitamin D intakes in this group of elderly women in the present survey and the common occurrence of demineralisation partly due to osteomalacia which is probably of nutritional origin a similar conclusion is reached. Not only is bony demineralisation an important cause of ill-health in elderly people but it also largely accounts for the altered pattern of fractures (with the high incidence of fractures of the femoral neck) in old age. Further work is clearly necessary to establish whether this potential cause of disablement could be prevented by more adequate nutrition.

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*Malm, O. J. (1958) Calcium Requirement and Adaption in Adult Men Scand. J. Clin. and Lab. Invest. **10**, Suppl. 36, Oslo.

†Recommended Dietary Allowances, U.S. National Research Council Publication, 302, 1958.

SECTION IV

SOCIAL ASPECTS

There are factors other than food preferences and prejudices which influence food intakes, e.g. shortage of money, loneliness, difficulties with shopping, lack of proper cooking appliances or places for storing food. These and some other social aspects of the dietary are discussed in the following paragraphs.

Length of Time Subjects had Lived Alone

All sixty subjects were living alone in the sense that they catered independently for themselves but six (subjects 6, 15, 22, 34, 40 and 41) lived in the same house as a friend or close relative. Usually the relationship was friendly and helpful, as in the case of subject 15 whose niece cooked the midday meal, but in other cases there was no contact and even a sense of hostility.

The women were questioned about the length of time they had lived alone. Four did not know and one answered wistfully that it was so long that she had lost count.

16 had lived alone for 20 or more years (one for 55 years).

13 for 10-20 years.

11 for 5-10 years.

16 for less than 5 years.

The length of time subjects had lived alone did not appear to affect their capacity to cater for themselves nor yet their interest in food but this factor was impossible to separate from others such as declining strength and vitality.

Cooking

All the women had cooking appliances and most of them had the conventional gas cooker with oven and boiling table of 2 or more rings and a grill.

47 (78%) had a gas cooker.

5 had 1 or more gas boiling rings, but no oven. One woman had an oil-fired oven as well but seldom used it.

7 had an electric cooker with oven.

1 had an oil-fired boiling ring.

The mere fact of having a cooker gives no idea of its age, efficiency or cleanliness. Some were gleaming new models whilst others were of rusty iron, fifty or more years old and covered with accumulated cooking debris and spent matches. It was something of a revelation to the investigators that women living in squalid conditions still ate a nutritious and varied diet. In other words dirt and squalor did not necessarily go hand in hand with sub-nutrition.

Fifty of the women (83%) did their own cooking and of the remaining 10:—

2 cooked at the weekends and either had club or domiciliary meals for the rest of the week.

5 did no cooking and relied on domiciliary meals.

2 cooked partly for themselves and were helped by neighbours or relatives.

1 was entirely dependent on a neighbour.

Number of Rooms

Only one of the 60 subjects (no. 19) lived in a bungalow designed especially for old people. Her accommodation consisted of a room with a bedroom annexe and a small kitchenette. Two subjects (numbers 55 and 58) lived in Council flatlets erected since the war but all the rest were in rooms, or flats in adapted houses. Some lived in well furnished rooms with adequate facilities but others occupied a room or rooms without separate toilet and water supply.

17 women (28%) lived in 1 room, and 3 had a kitchenette in addition. 40 or two thirds had more than 2 rooms. Seventeen women lived on the ground floor with toilet on the same level. Thirty six had to descend one flight of stairs either to go out or to reach the W.C. and 7 had to negotiate 2 flights of stairs. Of the 43 who had stairs, four subjects were unable to manage them alone.

Unfortunately when the survey was planned the importance of food storage arrangements was not realised, but when visiting, and especially in hot weather, the inadequacies of food stores for those living in one or two rooms was all too apparent. Without facts a definite statement cannot be made but a strong impression was left on the investigators that either food was wasted through becoming uneatable, for example, meat contaminated with blow flies and milk going sour or food just 'on the turn' was eaten. Only one woman had a refrigerator and to save expense this was not used. Most of the women had cupboards or boxes and sometimes these would be on a landing for coolness but many examples of uncovered food were seen.

Interest in Food

Each woman was asked whether she was interested in food and/or cookery and if so what had aroused her interest and where she had obtained information. This question was aimed at finding out whether food propaganda, put out by the press (newspapers and magazines), radio and television or talks at Old People's Clubs have had or could have any impact on this age group.

Forty four (74%) said that they had no particular interest in food or cookery.

The sixteen who were interested gave their sources of information as:—

Press and Radio — 5
Mother — 4
Cookery Books — 3
Previous Job — 2
College Course — 2

The volume of information, especially on "slimming diets", which appears in the popular press has had little or no influence on this group nor have talks at Old People's Clubs. It is not clear whether this is due to the rarity of such talks or whether they do not interest older people.

There is no doubt that advice on food, especially on what to buy with a limited income, and how to store and cook it would be useful for old people. The investigators were left with the impression that, if advice were to be followed, it would need to be given individually and by someone known and trusted, as for example by the Health Visitor or a Dietitian in the hospital out-patient department.

Shopping

All the active women did their own shopping but 8 of the 60 were housebound and their shopping was done by:—

Home helps — 4
A son — 1
Neighbours — 3

Very little food was delivered:
12 (20%) women had no food delivered.
45 (78%) women had milk delivered
3 had milk plus (a) bread (2)
(b) groceries and eggs.

Distance from shops was measured in time because many of these elderly women, although not lame, were slow walkers and some had to negotiate 2 flights of house stairs.

The time taken to reach the shops from their homes was:—
5 minutes or less — 16 subjects
10 minutes or less — 22 subjects
15 minutes — 19 subjects.

3 women used public transport to reach a cheap market or cheaper shops than in their immediate neighbourhood.

1 woman was taken by car.

In a city like London, shopping for the active or moderately active was not a problem when the women were fit and the weather fine. Most of the active women went out three or four times a week enjoying their shopping as an excuse to meet people, but sickness or bad weather, such as the cold winter of 1962-63, could cause real hardship. The sick or housebound were not helped by increasing home deliveries of food. Often they were left alone or with an unco-operative neighbour who would not answer the door and take in supplies. Their help with shopping came from friends, relatives or home helps.

Food Costs

All subjects were asked how much they spent on food but information was extremely difficult to get. It was soon obvious that direct questions were resented but some information was obtained by an oblique and tactful approach. Furthermore a subject might exaggerate either to impress the investigator with her poverty and need for more pension and National Assistance, or with her affluence and superiority over the neighbours.

Thirty subjects or half the sample gave no information: from the remaining half, the following was obtained:—

Weekly Expenditure on Food

About £1 — 9
About 30/- — 11
£2-£3 — 9 (one of these included 15 cigarettes daily in the "Food Money".)
More than £3 — 1.

Three of the subjects mentioned the importance of food gifts from relatives.

It is impossible to offer more than an impression about the relationship between the standard of dietary and cost of food, but the standard bore less relationship to total money spent, than to the ability of the subject to buy wisely and to use food economically. Some women bought unnecessary foods on impulse and wasted quite a lot whereas others planned their meals, bought what was required and used it all.

There was even less information about income than about food costs. All the women drew the old age pension, 39 or 65% drew National Assistance but did not say how much, and 7 said that they had small private earnings or income in addition to their pension.

Meal Pattern

The number of main meals containing animal protein and their significance in the total protein intake is discussed on pages 17 to 19. It was also of interest to discover whether these meals were taken as breakfast, midday or evening meals.

Ninety-five per cent. took a main meal at midday as compared with 75% who ate a main meal in the evening and 48% who did so at breakfast time—see Table I.

TABLE I.

DISTRIBUTION OF MAIN MEALS THROUGHOUT THE DAY

(Main Meals are defined as containing a serving of meat, fish, eggs or cheese)

Meal	Times Eaten Weekly	Number Subjects
Breakfast .. .. .. Eaten by 29 (48%)	0	31 (52%)
	3 or less	15 (25%)
	4 and over	14 (23%)
	(5 ate cooked breakfast daily)	
Midday .. .. .. Eaten by 57 (95%)	0	3 (5%)
	4 or more	57 (95%)
	(45 ate a midday meal daily)	
High Tea or Supper .. .. Eaten by 45 (75%)	0	15 (25%)
	3 or less	22 (37%)
	4 or more	23 (38%)
	(6 ate main dish for supper daily)	

Breakfast meals consisted of:

a cup of tea only (5 subjects); breakfast cereal, milk and sugar, bread and butter (17 subjects); bread and butter but no cereal (9 subjects). Fourteen also regularly ate fruit of some kind and there was a widespread belief that bananas equalled eggs in protein value. For those taking a cooked dish, egg was the most popular (eaten by 23) and bacon the next (eaten by 11). Sausage and fish were eaten once and twice respectively and a rather unusual choice was cheese which one subject ate twice in one week.

High tea and suppers were mostly simple meals but only two women ate warmed up food left over from dinner. The rest either ate bread and spread (butter, margarine, preserves) cakes and biscuits or an easily prepared and cooked dish such as egg (30 subjects), cold meat, pork pies, ham (22 subjects), cheese or fish (19 subjects), hot meat or poultry (10 subjects) or sausages (3 subjects). More than half the fish eaten came ready cooked from the local fried fish and chip shop.

There were no clear cut indications of any particular social factor or factors which might seriously affect an individual's nutritional state except club and domiciliary meals. The importance of these is discussed in the next section.

SECTION V

MEALS ON WHEELS, INVALID MEALS ON WHEELS AND CLUB MEALS

Seventeen of the sixty subjects regularly ate domiciliary or club meals. Partly because of this and partly because of the obvious value of these meals, it was decided to investigate more fully this aspect of feeding elderly people.

Subjects eating domiciliary and club meals

Nine subjects attended a Darby & Joan Club which supplied midday meals daily and high teas daily except on Sundays. Five subjects had domiciliary meals on five days a week; two had them on three days and one had domiciliary meals on two days.

The Darby & Joan Club was run by a voluntary association and membership was open to all local residents over the age of 60. The nine subjects who used this club regularly, took meals as follows, during a seven day survey period:—

Subject No.	*Total Meals*
23	10 (6 dinners, 4 teas)
16	8 (6 dinners, 2 teas)
2	7 dinners
1	6 dinners
20	4 dinners
3 & 14	3 dinners each
17	3 (2 dinners, 1 tea)
22	2 dinners

Midday meals were taken more frequently than teas.

The contribution made by Club meals to the dietary is shown in the following table.

TABLE 1.

PERCENTAGE CONTRIBUTION MADE BY CLUB MEALS TO SUBJECT'S TOTAL DIET

Subject	Total Number Meals	Protein	Calories	Calcium	Iron	Vit. C.
23	10 (4*)	38·5	37·5	32·5	45·5	42·5
16	8 (2*)	38	32·5	22	45·5	74
2	7	49	37	32	57	54
1	6	36	23	20·5	32·5	16
20	4	29·5	16	17·5	30	22
3	3	20	11	17·5	19	11·5
14	3	23	14·5	8	19·5	9
17	3 (1*)	17·5	13·5	10	18·5	22·5
22	2	7·5	6	4	10·5	19

*Figures in brackets are high tea meals.
Average number of midday meals per subject: 4 per week.

People choose to eat at a Darby & Joan Club because of the social contacts made; because it is pleasanter to have a meal prepared and the washing up done by others and because it can be cheaper than buying at retail prices and cooking food at home. One subject calculated her food costs for two weeks: one week when high tea and midday meals were eaten at the Club and the other when all meals were eaten at home. Without taking fuel into account, she calculated a saving of 6/- a week when meals were taken at the Club. For details see Table II.

TABLE II.

COMPARISON FOR ONE SUBJECT, BETWEEN COST OF MEALS AT THE DARBY & JOAN CLUB AND COST OF ALL MEALS AT HOME

(Prices estimated on those current in 1962)

Food at Home				Dinner and High Tea at Club Other Meals at Home			
Meat	10s.	0d.		Meat	—		
Vegetables	2s.	6d.		Vegetables	—		
Fruit	3s.	0d.		Fruit	1s.	0d.	
Cheese		6d.		Cheese	—		
Eggs	1s.	6d.		Eggs		9d.	
Butter	1s.	6d.		Butter		9d.	
Bread	1s.	6d.		Bread		9d.	
Sugar	1s.	2d.		Sugar		7d.	
Tea	1s.	3d.		Tea		9d.	
Cakes	1s.	0d.		Milk	1s.	6d.	
Jam		6d.		Cereal	1s.	6d.	
Milk	3s.	2d.		Dinner x 7	10s.	6d.	
Cereal	1s.	6d.		High Tea x 6	4s.	0d.	
	£1	7s.	7d.	With extra cup of tea	1s.	0d.	
Plus Fuel	£1	9s.	1d.		£1	3s.	8d.
				Fuel Nil.			

Subjects who used the Darby & Joan Club were all active women, capable of shopping and preparing their own food. On the other hand, subjects for whom domiciliary meals were supplied were either housebound, blind, or were considered by the Local Health Authorities to be in need of additional nourishment. It is of interest to discover, not only the contribution made by domiciliary meals, but also what the women ate on days when such meals were not available.

Subject 41.

This subject had had a nervous breakdown. Health visitors found that she was not shopping or cooking for herself and Meals on Wheels were advised. Invalid meals on wheels: 5 days weekly.

Other Days

Saturday: Midday meal: egg, bacon and bread prepared by subject.

Sunday: Midday meal: conventional Sunday dinner cooked by son and shared with him.

	Pr. g.	Cals.	Ca mg.	Fe mg.	Vit C mg
Average for days with carried meals ..	70·7	2230	1350	13·4	31·5
Average for days without carried meals ..	63·7	1790	1004	8·7	44·6

Subject 52.

Deaf and rather confused: only went out to get her pension and meals for the weekend.

Invalid Meals on Wheels: 5 days.

Other Days

Saturday: Midday meal at local cafe.

Sunday: Midday meal: ham sandwich purchased the day before.

	Pr. g.	Cals.	Ca mg.	Fe mg.	Vit C mg
Average for days with carried meals ..	70·6	2094	1033	11·9	24·5
Average for days without carried meals ..	31·0	1523	517	5·7	0

Subject 53.

Great difficulty in walking and hence in shopping. Only an oil stove for cooking.

Invalid Meals on Wheels: 5 days.

Other Days

Saturday: Midday meal: pork sausage and bread prepared by subject.

Sunday: Midday meal: cold ham, bread and Lyons fruit pie.

	Pr. g.	Cals.	Ca mg.	Fe mg.	Vit C mg
Average for days with domiciliary meals ..	44·8	1361	641	7·7	22·5
Average for days without domiciliary meals	55·2	2133	711	10·81	3·5

Subject 56.

Senile: Health Visitors found that she had not been shopping or cooking for herself.

Invalid Meals on Wheels: 5 days.

Other Days

Saturday and Sunday: Midday meals: Canned meat and fresh vegetables cooked by subject.

	Pr. g.	Cals.	Ca mg.	Fe mg.	Vit C mg
Average for days with domiciliary meals ..	45·6	1450	702	6·05	10·7
Average for days without domiciliary meals	39·7	1568	941	4·2	14·9

Subject 60.

Paralysed and could only move about her room in a wheel chair.

Invalid Meals on Wheels: 5 days.

Other Days

Saturday and Sunday: Canned soup, cold or canned meat reheated, bread and butter brought in by a Home Help during the week. Subject prepared meals herself using these foods.

	Pr. g.	Cals.	Ca mg.	Fe mg.	Vit C mg
Average for days with domiciliary meals ..	60·4	2141	377	12·1	72
Average for days without domiciliary meals	61·6	2340	823	10	38·8

Subject 49.

Aged 94 and partially blind.

Meals on Wheels: 3 days.

Other Days

Friday: Midday meal: fried fish and chips from a nearby shop.

Saturday, Sunday and Monday: Midday meal cooked by neighbour.

	Pr. g.	Cals.	Ca mg.	Fe mg.	Vit C mg
Average for days with domiciliary meals	45	1763	720	7·6	18·9
Average for days without domiciliary meals	35·7	1138	474	5·7	25·9

Subject 51.

Walked with great difficulty and was almost housebound. Her hands were deformed with arthritis and she was unable to prepare food herself.

Invalid Meals on Wheels 3 days: Tuesday, Wednesday and Thursday.

Other Days

Monday, Friday, Saturday and Sunday midday meals: A neighbour did all the shopping and cooked a dinner meal each day.

	Pr. g.	Cals.	Ca mg.	Fe mg.	Vit C mg
Average for days with domiciliary meals	65·9	2207	1176	10·2	21·9
Average for days without domiciliary meals	58·4	2076	934	9·0	33·7

Subject 55.

Aged 90: fairly active for her age but found difficulty with heavy shopping. Home help brought in vegetables.

Meals on Wheels delivered 2 days but part of one was saved and used on a third day. (Carried meals on Tuesday and Thursday—part of Tuesdays kept and used on Wednesday).

Other Days

Monday, Friday, Saturday and Sunday: Subject cooked her own midday meal.

	Pr. g.	Cals.	Ca mg.	Fe mg.	Vit C mg
Average for days with domiciliary meals	46·6	1500	665	7·7	15·7
Average for days without domiciliary meals	62·2	1961	788	12·0	71·5

On days when domiciliary meals were not available, half the subjects were catered for through the kindness of neighbours and half managed alone. They either took meals at a local café or ate meals easily prepared from cans or frying pans. It is impossible to generalise on so small a number but these women are probably typical of many hundreds. If so, then domiciliary meals are making a valuable social and nutritional contribution to feeding the elderly infirm. Neighbours are prepared to help out but would baulk at taking full responsibility: the elderly person will eat a few café or cold or canned meals but if this were the only fare, it would be expensive and would quickly pall.

For five subjects the nutritional value of the diet was less (markedly so for subject 52) when they did not have domiciliary meals but for two subjects the dietary was better on days without them. For one (subject 60) there was little difference. Percentage contribution to the dietary made by domiciliary meals is shown in the following table.

TABLE III.

PERCENTAGE CONTRIBUTIONS MADE BY DOMICILIARY MEALS TO TOTAL DIET

Subject	Total Number Meals	Protein	Calories	Calcium	Iron	Vit. C
41	5	32	25	18	30	27
52	5	46	29	31	47	75
53	5	31	20	15	32	16
56	5	35	20	15	38	59
60	5	31	14	9	32	19
51	3	12	6	4	17	0
49	3	25	16	11	28	27
55	2 (over 3 days)	11	10	6	11	2

As in the case of Club meals, the contribution fell with the number of meals (Table I) but frequency was not the only factor. Some of the eight women actually did better for some if not all nutrients on days when there were no domiciliary meals, Factors other than frequency were:—

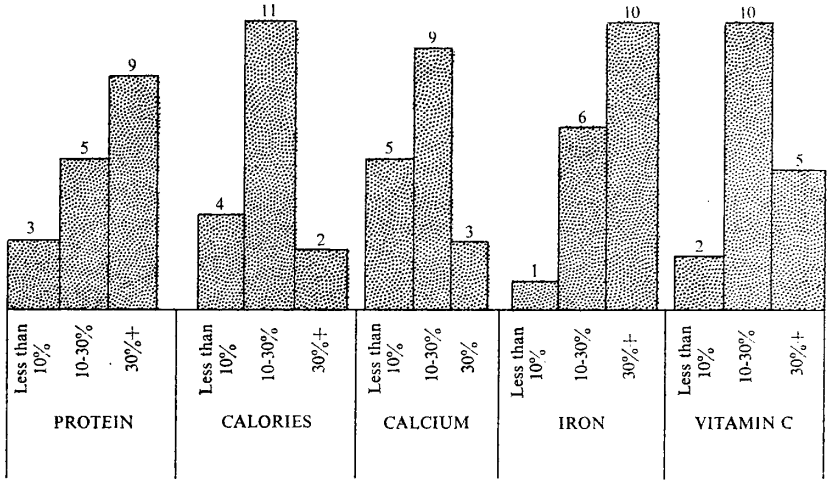
(i) nutritive value of the home diet.
(ii) the nutritive value of the domiciliary meal.
(iii) how much of the domiciliary meal was eaten.

It will be seen from Figure 1 that over half the subjects obtained more than 30% of their protein and iron from domiciliary meals but in the majority of cases the contribution of calories, calcium and vitamin C was less than 30%.

FIGURE 1

CLUB AND DOMICILIARY MEALS

Percentage of total nutrients obtained from club and domiciliary meals. Figures at head of columns refer to number of subjects out of a total of 17.



Further Information

The contribution of domiciliary and club meals to the dietary of older people appeared to warrant closer study and it was therefore decided to survey 5 establishments of varying kinds. Four of these supplied meals to one or more of the subjects studied but the Day Centre was in an entirely different part of London although it catered for people of similar age.

The establishments were:

1. Darby & Joan Club: 2 main meals available i.e. dinner and high tea; dinners supplied every day, high teas each day except Sunday.
   Cost of food: Dinner 2/1d.
   Charge to individuals: Dinner 1/6d.
   High Tea 8d.
2. Meals on Wheels: Midday meal supplied two days a week
   Cost 1/9d. not including transport.
   Charge to individuals 8d. per meal.

3. & 4. Invalid Meals on Wheels:	Midday meal supplied 5 days a week and especially designed for invalids and those needing therapeutic diets. Cost 4/6d. to 4/8d. inclusive of food, staff and transport. Cost to Old Age Pensioners 1/4d. per meal.
5. Day Centre:	One midday meal weekly. Elderly people were brought by ambulance to the Centre and the meal was only one of the services provided. Cost of Food 2/-. Charge to individuals 11d.

(Charges for meals were those current in 1962-63.)

To make the results of the investigations comparable it was decided to survey at all institutions only midday meals intended for normal diets.

Survey Method

The method used was the same in all cases. A preliminary visit was made to explain to the person in charge, and particularly to the cooks and kitchen helpers, what was involved and to enlist their help. Initial contact with kitchen staff was of great value and a realisation that "it was to help the old folk" assured co-operation.

Two investigators then visited to take weighings of at least 5 different meals during service time. Individual helpings of food were weighed and recorded as food was served. Scales were placed on the hot cupboard or table, the plate or container weighed and readings taken as kitchen helpers added each item in turn, e.g.:—

	Weight	*Difference*
Plate	1 lb. 2 oz.	—
Potato	1 lb. 6 oz.	4 oz.
Cabbage	1 lb. 9 oz.	3 oz.
Meat	1 lb. 11 oz.	2 oz.

Kitchen helpers were asked to use normal spoons and ladles and to follow their usual procedure. Weighings were taken throughout the service time and, following an erratic start, weights of servings varied little. After the first day, kitchen helpers became accustomed to serving on to scales and waiting for the weight to be recorded. Between 30 and 50% of the total number of meals served were weighed.

Meat was drained as far as possible before weighing and the gravy which was not weighed was added later. Composite dishes e.g. meat or fruit pie were split up and the pastry was weighed separately from the filling. Recipes for made-up dishes, puddings mostly, were obtained from the cook. If they differed markedly from McCance & Widdowson's* recipes for similar dishes (in most cases they did) then either adjustments to the figures were made or the recipes were analysed using McCance & Widdowson's tables for the raw ingredients, the total being divided by the number of portions.

As a check on calculations a meal was selected at random for chemical analysis. Fresh vegetables were also sampled both raw and at various times after cooking—see pages 56, 57 and 58.

It was only possible to weigh plate waste at the Darby & Joan Club and the Day Centre. In both these waste was quite small. Plate waste could not be weighed for domiciliary meals except for those subjects who were taking part in the survey, and for them it was slightly greater than that at the Day Centre or at the Darby & Joan Club.

Detailed results are given in Appendix B. A summary of the results is given in Table IV.

SUMMARY OF RESULTS

TABLE IV.

AVERAGE NUTRITIVE VALUE OF DOMICILIARY AND CLUB MEALS IN DIFFERENT ESTABLISHMENTS

	Darby & Joan Club	Meals on Wheels	Invalid Meals on Wheels		Day Centre
			Kitchen 1	Kitchen 2	
	Av. 6 Meals	Av. 5 Meals	Av. 7 Meals	Av. 7 Meals	Av. 5 Meals
Protein g. ..	22·5	25·5	34·3	27·4	18·4
Calories ..	570	572	787	525	500
Protein % Cals.	15·8	18	17	21	14·7
Ca mg.	200	161	410	158	137
Ca per 1000 Calories ..	350	280	520	300	274
Fe mg.	5·8	3·5	5·5	6·7	3·07
Fe per 1000 Calories ..	10	6	7	12	6
Vit. C mg. ..	14·6	10·3	16·6	10·2	12·4

*The Composition of Foods by R.A. McCance & E. M. Widdowson Special Report Series No. 297.

A sample meal from each kitchen was chemically analysed; the meal was selected at random and was taken on the same day to laboratories at the London School of Hygiene and Tropical Medicine. Analyses were carried out by Dr. Pellett and his colleagues.

Comparison between the results obtained by analysis of the meal with food tables and by chemical analysis are given in Table V.

TABLE V.

COMPARISON BETWEEN ANALYSIS OF A MEAL BY FOOD TABLES (F.T.) AND BY CHEMICAL ANALYSIS (C.A.)

Club or Kitchen		Protein g	Fat g.	CHO g. (by diff.)	Calories
Darby & Joan Club..	F.T.	22·3	15·0	57·7	450
	C.A.	19·3	25·0	51·0	513
Meals on Wheels ..	F.T.	23·4	26·3	76	615
	C.A.	37	17·6	106	745
Invalid Meals on Wheels 1	F.T.	25·2	32·3	94	755
	C.A.	22·2	20·5	82	613
Invalid Meals on Wheels 2	F.T.	28·6	6·3	58·8	397
	C.A.	32·0	2·6	55	382
Day Centre	F.T.	29·7	27·9	82·9	693
	C.A.	27	35·5	77	736

There is fair agreement between the two sets of figures especially for protein values, but fat values do not agree well. This may be because all meals, except that from Invalid Meals Kitchen 2, contained a fried or made up dish in which it is impossible to judge the amount of fat absorbed in cooking.

Vitamin C estimations were carried out for all but one of the kitchens. Samples of raw vegetables were taken and further samples after cooking and at varying times after keeping hot. The cooked samples were cooled, immersed in metaphosphoric acid, packed in dry ice and delivered for analysis within a few hours.

Results of these analyses are given in Table VI.

TABLE VI.

VITAMIN C VALUES OF RAW AND COOKED VEGETABLES IN DOMICILIARY AND CLUB MEALS

Meals on Wheels

	Vit. C mg/100 g.		Vit. C mg/100 g.
Potato Raw	12·5	Cabbage Raw	21·0
Boiled 1 hr. and 50 mins.	8·6	Boiled for 1 hr. and 25 mins.	11·0
Kept hot for 40 minutes ..	7·9	Kept hot for 1 hr. and 25 mins.	2·9
Loss	37%	Loss	86%

Cooking started at 9.30 a.m. (potatoes) and 9.50 a.m. (cabbage).

Vegetables were then despatched on a van and the last delivery was at 1.30 p.m. (not sampled).

Invalid Meals on Wheels: Kitchen 1

	Vit. C mg/100 g.		Vit. C mg/100 g.
Potato Raw	18·8	Cabbage Raw	59·2
Boiled 45 mins. and mashed	9·1	Boiled 45 mins.	18·5
*kept hot for 1¼ hrs. (first delivery) ..	2·9	Kept hot 1¼ hrs. (first delivery)	17·6
*kept hot for 4¼ hrs. (last delivery) ..	1·8	Kept hot for 4¼ hrs. (last delivery) ..	9·4
Loss	90%	Loss..	84%

*Delivery to the first home was at 11 a.m. and vegetables were dished up ready for service at 9·45 a.m. Final delivery was at 2 p.m., i.e. 4¼ hours after the food was cooked and served.

Invalid Meals on Wheels: Kitchen 2

	Vit. C mg/100 g.		Vit. C mg/100 g.
Potato Raw	9·9	Cabbage Raw	46·8
Cooked for 1 hr. 40 mins.	6·9	Cooked 1 hr. 40 mins. ..	18·9
Mashed for 10 mins. ..	5·3	Kept hot 3 hrs. 20 mins. ..	12·2
*Kept hot 3 hrs. 20 mins..	0·4		
Loss	96%	Loss..	74%

*This represented the time between serving and delivering to the last home.

Day Centre

	Vit. C mg/100 g.		Vit. C mg/100 g.
Potato Raw	12·1	Cabbage Raw	51·9
Roast for 2 hrs.	—	Boiled 45 mins.	14·6
Kept hot 1 hr.	4·9	Kept hot 1 hr.	8·4
Loss	60%	Loss..	84%

Percentage losses in cooking and subsequently in keeping hot were very high. For cabbage, losses ranged from 74% to above 80%. Some of the loss was due to keeping food hot, inevitable for domiciliary meals which might take up to 3 hours to deliver but it was difficult to justify keeping vegetables hot for an hour before service in the Day Centre where the kitchen and dining room adjoined. Moreover long cooking undoubtedly contributed to the loss of vitamin C and cooking times of 1½ hours or more for boiling cabbage and potatoes were unnecessary. Mashing potatoes hastened destruction of vitamin C because of the air beaten in during mixing; in both samples of mashed potatoes losses were 90% compared with 37% for boiled potatoes and 60% for roast.

Nutritional Values

There were considerable differences between the nutritional values of club meals and domiciliary meals supplied from different kitchens—see Table IV. Invalid Meal Kitchen 1 consistently supplied more of all nutrients except iron than any of the others, although Invalid Meal Kitchen 2 supplied more protein and iron per unit calorie. Meals provided by the Day Centre were consistently lower in value for all nutrients, also for nutrients per unit calorie.

Differences can be accounted for, in part, by the selection of foods, by size of portions and by the recipes used.

1. **Selection**

Selection most influenced iron and vitamin C values: the two lowest iron values were 3·5 mg. for Meals on Wheels and 3·07 mg. for the Day Centre. Neither served liver and this food is the biggest single contributor of iron. The two establishments which provided meals with the lowest vitamin C values (10·2 and 10·3 mg.) served only root vegetables or dried pulses as a second vegetable.

2. **Portion Size**

Average Servings of some Common Foods (ounces)

	Darby & Joan	Meals on Wheels	Invalid Meals on Wheels		Day Centre
			Kit. 1	Kit. 2	
Meat	2·25	1·75	2·6	4·5*	1·75
Fish	3·0	4·5	5	4·75	4·25
Potato	4	4	4·5	4·25	2·5
Green Veg. ..	2·5	2·75	2	2·5	2
Root Veg. ..	1·75	1·75	2·75	2·25	not served
Milk Pudding ..	7	6·5	10·5	6·5	4·5
Sponge Pudding	2·25	2·25	2·0	not served	2·25
Custard ..	5	4	7	5	3

*This includes 2 portions of stewed meat in which, unavoidably, there was some gravy: hence portion of *meat* is likely to be nearer 2·5 oz.

There was a difference between average servings: the Day Centre, which provided the least nutritious meal, gave the smallest portions. This, however, does not account entirely for the considerable differences between the nutritive value of Invalid Meals on Wheels (Kitchen 1) and the Day Centre.

3. Recipes Used

Coupled with the size of portion, the recipes used made the biggest difference between the nutritional value of meals. Invalid Meal Kitchen 1 provided meals with the highest protein, calorie and calcium content, and this was achieved partly by giving larger servings, but mainly by using better recipes than other kitchens. A higher proportion of fat to flour was used in pastry and puddings, margarine and dried milk were added to creamed potatoes and liquid milk was reinforced with dried milk and margarine for making milk puddings and custard.

Nutritional Values related to human needs

Nutritive values of club and domiciliary meals have meaning only when values are related to human nutritional needs. Seventeen subjects who ate such meals have been reviewed already but it is also of interest to relate the findings of investigations at five kitchens to recommended nutrient allowances. In figure 2 each circle represents the recommended dietary allowances of the Food and Nutrition Board, National Research Council, for women over 65 for one week:—

55 g. protein x 7 = 385 g.
1,800 Calories x 7 = 12,600 Calories.
800 mg. Ca x 7 = 5,600 mg.
12 mg. Iron x 7 = 84 mg.
*30 mg. Vit. C x 7 = 210 mg.

The blocked part of the circle represents that portion of the weekly allowance provided by domiciliary or club meals which has been calculated by multiplying the average nutrient value of meals by the number of times these meals were eaten.

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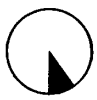
* Vitamin C recommended allowance; Vitamin C Requirements of Human Adults; Medical Research Council, Special Report Series No. 280.

FIGURE 2

PROPORTION OF TOTAL WEEKLY NUTRIENT ALLOWANCE CONTRIBUTED BY DOMICILIARY AND CLUB MEALS

MEAL CENTRE	PROTEIN	CALS.	CA.	FE.	VIT. C
DARBY AND JOAN CLUB	 23%	 19%	 14%	 27%	 28%
Total Average Contribution of 4 meals	90 g.	2280 cals.	800 mg.	23.2 mg.	58.4 mg.
MEALS ON WHEELS	 13%	 9%	 6%	 8%	 10%
Total Average Contribution of 2 meals	51 g.	1144 cals.	322 mg.	7.0 mg.	20.6 mg.
INVALID MEALS (1)	 44%	 31%	 36%	 32%	 40%
Total Average Contribution of 5 meals	171.5 g.	3935 cals.	2050 mg.	27.5 mg.	83 mg.
INVALID MEALS (2)	 35%	 21%	 14%	 40%	 24%
Total Average Contribution of 5 meals	137 g.	2625 cals.	790 mg.	33.5 mg.	51 mg.
DAY CENTRE	 5%	 4%	 2%	 3%	 6%
One meal	18.4 g.	500 cals.	137 mg.	3.07 mg.	12.4 mg.

There is no significant contribution to the nutritive value of the dietary when less than 4 meals a week are provided. It must be stressed, however, that the function of the Day Centre was to give social and other services in addition to providing meals. It is also apparent from the table that frequency of supply was only one factor; the nutritive value of the meal was equally important as shown by the outstanding contribution made by Invalid Meal Kitchen 1 which has been discussed already on page 58.

Discussion

Domiciliary or club meals are regarded as the main meal of the day and the remaining meals are likely to be snacks of lesser nutritive value. Domiciliary meals are often supplied for people who are incapacitated, housebound or undernourished and for all these reasons they should be selected and prepared to give a very high level of nourishment. It would not be too much to aim at providing a third of the day's recommended allowance of protein and between a quarter and a third of the allowance of calcium and iron. Vitamin C is difficult to supply in domiciliary meals which have to be kept hot for long periods but even those should aim at an average of 15 mg of vitamin C, or half the recommended allowance.

Recommended nutrient content for domiciliary and club meals

Protein not less than 25 g.
Calcium not less than 200 mg.
Iron not less than 3 mg.
Vitamin C not less than 15 mg.

If at least half the total protein of the meal is obtained from a variety of animal foods containing protein, and some of the vitamin C is supplied by freshly cooked green vegetables, then the meal will also contribute valuable amounts of other vitamins and mineral elements.

Foods to give these recommended nutrients

The meal should contain: an average of 2 oz. cooked meat or offal or 4 oz. cooked fish or $1\frac{1}{2}$ oz. cheese.

Additional protein should be obtained from milk in puddings, custards and sauces, one or other of which should be served daily and made with fresh milk undiluted with water.

Portions should consist of: Milk pudding, not less than 7 oz. (3 portions to 1 pint). Custard, not less than 5 oz. (4 portions to 1 pint).

To increase the nutritive value milk could be reinforced with dried milk in the proportion of 2 oz. to 1 pint milk, or dried whole cream milk may be used in the proportion of 4 oz. to 1 pint water. The quantities of milk puddings, custards and sauces recommended also provide most of the calcium in the meal.

Vitamin C content depends mainly on the choice of vegetables and the way in which they are cooked. Well-cooked fresh green vegetables contribute most, root vegetables including old potatoes little, mashed potatoes less, and dried vegetables including processed canned peas, none at all. Raw vegetables are not subject to cooking loss and during summer months full use should be made of raw tomatoes and lettuce. Watercress and spring onions are also valuable sources but are often refused by the elderly. It should be remembered that finely sliced and shredded vegetables lose vitamin C by enzyme action and it is better to leave tomatoes, lettuce leaves and watercress whole.

Domiciliary and club meals form only a part of the dietary and must never be regarded as a substitute for the whole.

As a minimum the rest of the diet should contain daily:

½ pint milk,

A serving of meat (including bacon/sausage etc.) fish, cheese or egg,

4 or more slices of bread and butter,

An orange, tomato, or green vegetable.

SECTION VI

SUMMARY

(Under the heading of Conclusion to be found at the end of the summaries of Sections II-V reference is made to certain aspects which we consider merit further study).

SECTION I — THE DIETARY SURVEY

1. The aim of this survey was to attempt to discover the levels of nutrient intakes in old people compatible with health.

2. Sixty women living alone at home were investigated. Their ages were between 70 and 80 years, with the exception of three who were 89, 90 and 94 years old. A clinical assessment was later made on 44 of the subjects.

3. Thirty-three of the subjects lived in the Borough of Hornsey and 27 in Islington. The Islington subjects were referred by the Medical Officer of Health and it was thought that some of them might be poorly nourished.

4. All the subjects were visited daily by a dietitian for a period of one week. Prior to this the investigators obtained a detailed dietary history. This served two purposes—a check on the subsequent week's meals since it was thought that some subjects might deviate from their normal meal habits when their diet was under review and to collect information on cooking facilities, distance from the shops and other social aspects.

5. Each subject was instructed how to weigh her food on a pair of scales provided and to put into plastic bags food wasted in preparation or left uneaten on the plate. Although only a few subjects were able to weigh **all** their own food each was co-operative in keeping detailed records of the type of food and the amount in slices and servings; similar slices and servings were subsequently weighed by the dietitian.

6. The total quantity of each type of food consumed in the 24 hours was used to calculate from food tables the intake of protein, carbohydrate, fat, calories, iron, calcium and vitamins C and D.

7. In view of the importance of club meals and domiciliary meals a weighed survey of a sample of these meals was made. Values of nutrient intakes obtained from food tables were checked for some meals by chemical analysis.

SECTION II — NUTRIENT INTAKES AND SOURCES OF NUTRIENTS

1. Although it was anticipated that the Islington subjects might be less adequately nourished the results showed that there was little difference between their average daily intakes and those of the Hornsey subjects.

2. For the whole series of 60 subjects the daily intakes of nutrients were as follows:—

	Mean	*Range*
Calories	1890	1155—2931
Protein g.	57	36— 93
Fat g.	74	48— 160
Carbohydrate g. ..	221	119— 330
Calcium mg. ..	860	390—1515
Iron mg.	9·9	5— 20
Vitamin C mg. ..	37·6	2·5— 117
Vitamin D i.u. ..	135	10— 353

3. When the subjects were arranged in three groups according to their age (viz. 70 to 73 years, 74 to 77 years and 78 to 80+ years), there was found to be a decrease in intakes of all nutrients with advancing age. The percentage fall in intake for the subjects in their late seventies compared with those in their early seventies was as follows:—

Calories 19%, protein 24%, fat 30%, carbohydrate 8%, calcium 18%, iron 29% and vitamin C 31%.

4. These decreases appear to be caused mainly by the subjects eating less total food and not by an appreciable deterioration in the quality of the diet.

5. Particular attention was paid to the types of food eaten by the subjects and their preferences for certain foods and dislike of others.

6. An average of 18½ ounces of meat per week was eaten by all subjects (there were no vegetarians). Roast meat was the most popular and liver the least. Chops and meat which could be purchased in small quantities were convenient for these old people living alone since few of them had cool storage space for 'family' joints. Chicken which now can be purchased in small quantities is becoming increasingly popular. Rabbit was eaten by only one subject.

7. Fish was less popular than meat, since 16 of the 60 subjects did not eat it at all. The average consumption was 8·2 oz. per week.

8. Cheese was not eaten by 21 subjects and for those who did eat it, the average consumption was 3·3 oz. Cheese is a cheaper source of protein than either eggs or meat, it can be eaten raw and is easily stored, but many of the subjects thought it was an indigestible food.

9. For the 60 subjects average consumption of eggs was 4 per week and these were eaten chiefly boiled or poached for breakfast or supper. Only 7 subjects did not eat eggs.

10. The average intake of milk for the 60 subjects was $4\frac{1}{2}$ pints per week; 30% drank less than $\frac{1}{2}$ pint per day. Milk was second in importance to meat as a source of protein.

11. Meat was the prime source of protein: 20% or more of the total protein was obtained from meat by 44 subjects, from milk by 29 subjects and from bread by 14 subjects. Fish, cheese and egg all contributed much less. Meat, including liver, was also the most important contributor of iron.

12. Where a main meal is defined as one containing a serving of meat, fish, egg or cheese eaten with bread or vegetables, then 17 (28%) of the subjects had 14 or more weekly (out of a possible maximum of 21 meals). Ten (17%) ate 7 main meals or less per week. The average protein intake per week of the former group was 462 g and for the latter 314 g.

13. The average protein intakes can be roughly related to the number of main meals eaten weekly. It seems likely that details of the main meals eaten and the amount of milk consumed would give a rough assessment of the dietary levels of protein, calcium and iron.

14. Milk was the most important source of calcium. 32 subjects got more than half their total calcium from milk. Eleven subjects obtained about a quarter from bread; but only 2 subjects obtained a large proportion from cheese.

15. Fruits (i.e. apples, pears, plums, apricots, peaches and cherries) which are poor sources of vitamin C, were more popular than those which are rich sources (tomatoes, citrus fruits, and summer berry fruits). It seems unlikely that diets which contain less than one serving a day of either citrus fruits or tomatoes or green vegetables will reach the recommended allowance of 30 mg vitamin C per day.

16. There was considerable individual variation in the intakes of vitamin D and 40 of the 60 subjects obtained less than the average of 135 i.u. per day. Eggs provided the main source and half of the women obtained more than 60% of vitamin D from this source. Butter, milk and cheese made a relatively small contribution.

17. *Conclusion:* Taking the 60 subjects as a whole the mean intakes of calories and other nutrients were satisfactory. In the main they ate a varied diet, cooked at least one meal a day and frequently ate fruit and vegetables. There were, however, a number of individual instances of a poor diet. The popular idea that many old people who live alone exist almost entirely on bread, butter, jam, biscuits, and cups of sweetened tea was not borne out in this enquiry. But more work needs to be done to include those elderly people who are mentally confused or too unco-operative to take part in a weighed survey. For the confused elderly person a simple questionnaire might be evolved with the aim of estimating quantities of specified foods and meals. Such an enquiry would give gross intakes only but would serve to spotlight the undernourished, since the present study shows a relationship between the amount of milk and the number of main meals taken daily on the one hand and on the other the intakes of protein, calcium and iron.

SECTION III—NUTRITION AND HEALTH

1. Following the dietary survey 44 of the 60 subjects agreed to attend the hospital for a clinical assessment of their health. This included assessments of the physical condition, the mental state, the subject's activity and the nutritional state. The weight, height and skin-fold thickness were recorded; the haemoglobin, serum calcium, inorganic phosphorus and alkaline phosphatase were estimated, and a measurement of the radiological density of the bones was made under standard conditions.

2. Three-quarters of the subjects enjoyed normal or excellent health; the subject's own evaluation of her health was often slightly better than that of the medical observer. A quarter had fair or poor health and rather more than a quarter had markedly limited powers of locomotion. In the latter half of the 8th decade an increase in the amount of disablement became apparent.

3. This classification of health emphasized the necessity of adopting different standards of 'normality' with advancing age even within the narrow age period of 70-80 years. The subjects were therefore also classified according to whether their health was better or worse than average for their age.

4. Nine subjects were thin, 7 obese and 28 'normal'. The mean skin-fold thicknesses of the subjects in these groups were 5·1, 15·0 and 8·3 mm. respectively. By the end of the eighth decade the mean skin-fold thickness of the 'normal' subjects was approximately half that in the early seventies.

5. Subjects were grouped in three age periods, namely 70-73, 74-77 and 78-80+ years. At each age period the calorie intakes of the obese were less than those of the normally nourished both absolutely and expressed as a ratio of calories per kilogram body weight. The persistence of obesity in the absence of gross overeating might be explained by the limitation of calorie expenditure due to the effective thermal insulation provided by the thick layer of subcutaneous fat.

6. The mean body weight (51 kg.) of the subjects in the highest age group was 14% less than that of the subjects in their early seventies (59 kg.). For the 44 subjects the percentage reduction in intakes of calories and nutrients during the eighth decade was similar to that of the whole series of 60 subjects (see Section II).

7. This remarkable reduction in intakes within such a narrow age period was rather unexpected. On the other hand, the percentage of calories contributed by protein (which may be used as an index of the quality of the diet) showed little change during this decade.

8. The same index of percentage of calories contributed by protein has been used for comparing diet with the state of health. The correlation between diet and health is striking; all except 4 of the 21 subjects whose diet was better than average enjoyed better than average health, whereas 17 out of 23 subjects whose diet was worse than average had poorer health.

9. There was a rough correspondence between the subjects' haemoglobin level and their dietary iron intake, but exceptions were numerous.

10. By determinations of bone density in 43 subjects 12 were found to have marked skeletal rarefaction. Comparison of the low density group with the skeletally normal showed that their body weight was

significantly less although there was no difference in the skeletal dimensions and heights of the two groups. There was a marked difference in intakes of protein and of calcium between the two groups, but when expressed in terms of body weight the intakes were similar.

11. As the incidence of skeletal rarefaction increased slightly with age it was necessary to eliminate possible effects of age by comparing data from the low density group with an age-matched normal group. When this correction for age had been made there was still a striking difference in the mean weights of the two groups; their intakes of calories, protein and calcium were approximately the same, but there was a considerable difference in intakes of vitamin D.

12. These findings suggest that osteomalacia may contribute to the skeletal rarefaction so commonly found in old age.

13. *Conclusions:* Further study is needed to elucidate the reasons for and the effects of the striking decrease in calorie and other nutrient intakes during the eighth decade. It is important to know whether the decrease is due to a pathological reduction in appetite and whether an effort should be made to offset it with a diet richer in nutrients per unit calorie. Only a longitudinal study in which individuals are assessed from the age of 70 for as many years as possible would determine how often this decrease occurs and whether it is gradual or sudden as the result of illness.

The exact needs for vitamin D in adults have not yet been assessed, but it is obviously important to determine whether or not skeletal rarefaction, which is an actual and potential cause of ill-health in old age, could be prevented by a larger vitamin D intake in earlier years.

SECTION IV—SOCIAL ASPECTS

1. All sixty subjects lived alone; one quarter had been alone for 20 or more years. The length of time they had lived alone did not affect their capacity to cater for themselves nor their interest in food.

2. Three-quarters of the subjects had a gas cooker, seven had an electric cooker, one had only an oil burner and the remainder had gas boiling rings without an oven.

3. Fifty of the women (83%) did their own cooking; two cooked only at the weekends and had club meals in the week, five did no cooking

and relied on domiciliary meals, the remaining three were helped by neighbours or relatives.

4. Facilities for food storage were often inadequate and in several cases food was wasted because it became uneatable. Uncovered food was often seen on tables and elsewhere.

5. Three-quarters of the subjects had no particular interest in food or cookery. Five of the sixteen who were interested mentioned the press and radio as their source of information. But articles in the press and talks in Clubs on food had little interest for this group.

6. In many instances advice on food, especially on what to buy, how to store and how to cook it would have been of benefit, but this advice would need to be given individually.

7. For these city dwellers who remained active or moderately active shopping was no problem. For the housebound more help from friendly neighbours or home-helps would be very valuable.

8. It was difficult to obtain reliable information on income and on what proportion of it was spent on food.

9. *Conclusion:* The main points to emerge from the social aspects of the survey were the importance of home-helps for shopping, especially for the housebound or in times of bad weather, the need for cheap small refrigerators and the great need for informed and kindly advice on budgeting and choosing nutritious meals. Talks and demonstrations at old people's clubs might be useful but the most valuable help would be that given by a known and trusted person such as a health visitor or dietitian.

SECTION V — MEALS ON WHEELS, INVALID MEALS, AND CLUB MEALS

1. In order to assess the place of domiciliary and club meals in the dietary of older people a study was made of five establishments; a Darby and Joan Club, a meals on wheels service, invalid meals on wheels from two centres and a Day Centre for infirm old people.

2. Old people choose to eat at a club because of the social contacts, because it is more convenient to have a meal prepared and the washing up done by others and because it is often cheaper than buying at

retail prices and then cooking the food at home. The invalid meals on wheels service is for disabled people and for those requiring a therapeutic diet. At the Day Centre each old person received only one mid-day meal weekly, but the meal was only one of the services provided.

3. The average nutritive value of the meals served by the different authorities was calculated and as a check on these calculations a number of meals taken at random were subjected to chemical analysis. The results obtained by these two methods showed fairly close agreement for protein and carbohydrate but in the case of fat there was some disparity.

4. It was noticed that in all domiciliary meal services considerable time may elapse between the cooking of food and its service to the patient at home. In the case of one centre, vegetables were dished up ready for serving at 9·45 a.m.; the first delivery at home took place at 11 a.m. and the final delivery was made at 2 p.m., i.e. $4\frac{3}{4}$ hours after the food was cooked and served. Even in the Day Centre where the kitchen adjoined the dining room vegetables were kept hot for one hour before service.

5. The loss of vitamin C in cooking and during the time vegetables were subsequently kept hot is high. In the case of cabbage the losses ranged from 74% to above 80%. The mashing of potatoes increases the loss of vitamin C; in samples of mashed potatoes the loss of vitamin C was 90% compared with 37% for boiled potatoes and 60% for roast.

6. Seventeen of the 60 subjects ate club meals or carried meals regularly as part of their diet. The percentage contribution of the club meals to the total diet of the week varied in respect of protein intake from 7·5% for one subject who had two club meals, to 49% for a subject who had 7 club meals.

7. The proportion contributed by domiciliary and club meals to the total weekly nutrient allowance of the subjects naturally depended on the number of times the meals were taken and the size of the portions served; but much also depended on the nutritive value of the meal. The Day Centre served a meal only once a week, it gave the smallest portions and the meal was the least nutritious of those served in the five establishments. One of the invalid meal centres gave larger servings and used much better recipes than other establishments. This centre made the following contributions in its 5 meals to the total weekly dietary of the subjects—calories 31%, protein 44%, calcium 36%, iron 32% and vitamin C 40%.

8. As domiciliary meals are usually supplied for people who are incapacitated, housebound or undernourished they should be prepared to give a high level of nourishment. We consider that the following should be the MINIMUM nutrient content for a domiciliary or club meal—protein 25 g, calcium 200 mg, iron 3 mg, and vitamin C 15 mg. The types of food which might most usefully be selected for these meals are considered (see page 61).

9. *Conclusion:* Domiciliary and Club Meals are of great potential value, but should be provided four or more times a week in order to have an effective influence on the total dietary standard. Recipients usually regard this meal as the main one of the day and often take only snacks at other times. Hence it is essential that this meal should supply a good proportion of the day's needs for protein, vitamins and minerals. Many Darby and Joan Clubs provide cheap or subsidised meals for old people and this is one of their important functions. In those clubs where a kitchen or cooking staff are not available it might be possible to obtain supplies of cooked meals from a nearby hospital, Local Authority or even school kitchen.

APPENDIX A

INDIVIDUAL RESULTS FOR 60 SUBJECTS
(Average Daily Intakes)

H and I indicate Hornsey and Islington subjects respectively

Subject Number	Age	Starting Date	Protein g.	Fat g.	Cbo. g.	Cals.	Ca. mg.	Fe mg.	Vit. C mg.	Vit. D i.u.
1 H	71	26/3/62	70	116	286	2430	1000	14	61	67
2 H	73	27/3/62	59	94	223	1935	800	9·6	22	38
3 H	78	27/3/62	49	98	283	2176	676	10	36	34
4 H	80	10/4/62	42	61	231	1600	870	7	7	62
5 H	74	10/4/62	59	93	229	1970	1139	10	88	76
6 H	73	3/7/62	45	75	141	1413	687	7	61	47
7 H	74	10/4/62	56	90	223	1900	767	8	11	76
8 H	75	30/4/62	39	59	230	1580	583	10	38	217
9 H	72	30/4/62	60	84	288	2114	1000	9	15	90
10 H	71	30/4/62	36	57	155	1257	654	5	9	126
11 H	70	30/4/62	49	79	163	1550	832	9	29	329
12 H	71	14/5/62	60	101	318	2455	955	12	4	68
13 H	72	28/5/62	78	136	298	2713	1237	12	27	102
14 H	79	28/5/62	49	70	259	1833	1026	8	39	10
15 H	70	28/5/62	72	114	219	2167	996	13	46	67
16 H	70	28/5/62	62	80	240	1900	1030	7·7	20	68
17 H	74	29/5/62	55	74	257	1916	809	9·5	25	73
18 H	78	12/6/62	43	79	130	1392	574	10·4	34	78
19 H	77	12/6/62	48	77	217	1737	866	6	7·6	36
20 H	89	13/6/62	37	75	293	1955	670	7	77	14
21 H	73	15/6/62	59	87	282	2131	982	10	35	115
22 H	74	2/7/62	53	84	191	1728	816	8	25	107
23 H	78	2/7/62	53	57	182	1530	518	8	49	56
24 H	80	2/7/62	61	73	165	1549	1038	11	27	88
25 H	73	3/7/62	71	112	183	2017	988	15	80	75
26 H	77	16/7/62	49	108	206	1980	1024	8	43	47
27 H	73	16/7/62	74	108	249	2264	1323	12·5	117	77
28 H	79	16/7/62	48	86	248	1930	739	8	30	103
29 H	73	19/7/62	66	98	142	1712	788	10	53	54
30 I	77	5/11/62	77	105	245	2211	1011	20	58	63
31 H	73	5/11/62	93	142	330	2930	1515	16	30	79
32 H	71	25/6/62	58	109	143	1807	937	13	63	174
33 H	71	26/6/62	70	102	227	2083	1008	13	104	89
34 I	76	9/7/62	70	61	195	1627	868	10	13	274
35 I	77	9/7/62	69	112	259	2286	961	13	35	289
36 I	80	9/7/62	39	65	119	1208	545	5	24	12
37 I	79	9/7/62	49	85	203	1746	705	8	24	167
38 I	76	10/7/62	36	66	172	1453	390	6	8	69
39 H	76	23/7/62	70	112	239	2219	1085	15	60	114
40 I	75	23/7/62	79	124	165	2096	968	10	30	82
41 I	77	23/7/62	69	87	250	2104	1251	12	35	118
42 I	72	23/7/62	56	98	311	2316	719	11	52	90
43 I	73	13/8/62	74	74	240	1889	659	17	40	100
44 I	73	13/8/62	87	160	214	2647	1246	13	73	37
45 I	77	13/8/62	56	83	191	1731	827	8	27	152
46 I	76	13/8/62	42	47	156	1194	598	6	32	42
47 I	73	13/8/62	61	115	296	2420	832	11	29	242
48 I	79	27/8/62	36	49	143	1155	501	6	2·6	353
49 I	94	27/8/62	40	48	212	1406	579	6·5	23	20
50 I	78	27/8/62	69	100	300	2422	1155	11	38	183
51 I	76	27/8/62	62	77	306	2132	1038	9·5	28·6	105
52 I	78	27/8/62	59	61	284	1930	885	10	17	28
53 I	73	24/9/62	48	85	159	1580	661	8·6	17	56
54 I	72	24/9/62	54	99	187	1840	480	11	34	99
55 I	90	8/10/62	55	76	220	1760	735	10	48	149
56 I	80	8/10/62	44	58	195	1480	770	5·5	12	73
57 I	80	10/12/62	46	63	182	1480	915	11	18	27
58 I	80	5/11/62	39	63	200	1490	859	5·6	26	24
59 I	80	11/11/62	54	79	200	1750	680	8	10	73
60 I	72	7/1/63	61	111	243	2198	861	11·5	63	18

APPENDIX 1a

Date ..... Day .....

Name .....

Meal or Time	Food	Weight in ounces or measure

APPENDIX 1b

For Use by Investigator

Name..... Number.....

Date Started..... Today's Date..... Hour.....

Food	Weight 1	Weight 2	Difference	Waste	Weight eaten	Code No.
Beverage, patent						
Biscuits, plain						
Biscuits, sweet						
Bread						
Butter						
Cereal						
Cheese						
Cheese spread						
Cocoa powder						
Dripping						
Eggs						
Flour						
Jam						
Lard or Cooking Fat						
Margarine						
Milk						
Marmalade						
Porridge oats, dry						
Squash						
Sugar						
Sweets						
Tea, dry						

FOOD SURVEY QUESTIONNAIRE

Date.....

Name (M. S. W.)..... Age..... Retirement Age.....

Address .....

Former Occupation..... Occupation Now.....

Do you normally live alone..... For how long.....

Do your own cooking..... Cooking Facilities.....

Do your own shopping..... How far from shops.....

Food Deliveries..... Pension..... N.A.* .....

Flat or house..... No. Rooms..... Stairs.....

Pets..... G. P.'s Name.....

DIETARY HISTORY

BREAKFAST	DINNER/LUNCH	TEA	SUPPER
Tea with sugar	Meat	Tea with sugar	Soup
Bacon	Fish	Bread	Meat
Eggs	Sausage	Butter	Fish
Fish	Offal	Cake	Eggs
Sausage	Cooked/canned meat	Other	Cheese
Cereal with milk	Potatoes		Potatoes
Porridge with milk	Greens		Salad/Veg.
Bread or Toast	Roots		Bread
Butter	Sweet/pudding		Butter
Other	Other		Biscuit
			Cake
			Milk or Beverage
			Other

BETWEEN MEAL EXTRAS
OTHER FOODS
DAILY MILK
WEEKLY BUDGET ON FOOD

IS THERE ANYTHING WHICH YOU NEVER EAT?
RESTAURANT MEALS
VISITORS

KNOWLEDGE

Are you interested in food..... cooking.....

Where did you learn about these things?

Press..... Radio/T.V..... Talks.....

* National Assistance

DOMICILIARY AND CLUB MEALS

AVERAGE NUTRIENT VALUES

Institution or Local Authority	Meals	Protein g.	Fat g.	CHO g.	Cals.	Ca mg.	Fe mg.	Vit. C mg.
Darby & Joan Club March, 1962	Boiled Beef Boiled Potatoes Cabbage Carrots Mince Meat Slice Custard	21	20·8	63·4	526	200·9	3·9	22·7
	Veal & Ham Pie Mashed Potato Cabbage Semolina Pudding Jam Sauce	26·5	21·4	66·0	556	235·0	3·3	15·8
	Fried Cod Chips Blancmange Canned Fruit Salad	24·2	21·6	80·6	602	222·5	3·2	6·0
	Boiled Bacon Mashed Potato Carrots (canned) Processed Peas Congress Tart Custard	17·9	37·7	67·3	678	119·4	3·7	5·9
	Minced Meat Yorkshire Pudding Mashed Potato Cabbage Macaroni Pudding	23·0	29·0	63·1	594	232·6	4·0	17·0

DOMICILIARY AND CLUB MEALS

AVERAGE NUTRIENT VALUES

Institution or Local Authority	Meals	Protein g.	Fat g.	CHO g.	Cals.	Ca mg.	Fe mg.	Vit. C mg.
Darby & Joan Club	Liver Mashed Potato Cabbage Prunes & Custard	22·6	15·3	60·0	461	187·1	16·7	20·4
Day Centre November, 1962	Beef Stew Dumplings Mashed Potato Haricot Beans Stewed Apple Custard	12·0	14·9	54·3	392	108·6	2·7	6·3
	Boiled Bacon Mashed Potato Cabbage Pease Pudding Rice Pudding	16·6	26·0	47·7	491	154·5	2·68	17·4
	Baked Rissoles Mashed Potato Cabbage Apple Crumble Custard	14·9	24·7	57·8	512	135·9	3·6	18·3
	Fried Fish Mashed Potato Processed Peas Steamed Treacle Roll	32·9	30·4	80·0	719	167·0	3·1	5·8

DOMICILIARY AND CLUB MEALS

AVERAGE NUTRIENT VALUES

Institution or Local Authority	Meals	Protein g.	Fat g.	CHO g.	Cals.	Ca mg.	Fe mg.	Vit. C mg.
Day Centre November, 1962	Roast Beef & Gravy Yorkshire Pudding Roast Potato Cabbage Sago Pudding Jam Sauce	15·7	15·2	48·0	386	119·8	3·3	14·2
Local Authority Invalid Meals Kitchen 1 September, 1962	Mutton Stew Mashed Potato Haricot Beans Sponge Pudding Custard	36·0	35·4	103·6	862	399·1	8·3	11
	Rissoles Mashed Potato Haricot Beans Prunes & Custard	23·0	28·7	89·8	696	304·7	6·0	11
	Fried Fish Mashed Potato Carrots Sago Pudding	43·2	32·2	104·4	868	512·0	1·9	12·2
	Roast Lamb Mashed Potato Cabbage Canned Peaches Custard	28·0	23·0	90·3	669	381·5	5·3	25·5

DOMICILIARY AND CLUB MEALS

AVERAGE NUTRIENT VALUES

Institution or Local Authority	Meals	Protein g.	Fat g.	CHO g.	Cals.	Ca mg.	Fe mg.	Vit. C mg.
Invalid Meals Kitchen 1 September, 1962	Stewed Beef Mashed Potato Carrots Canned Peaches Custard	40·9	18·5	92·5	687	376·8	7·3	17·1
	Meat Pie Mashed Potato Cabbage Rice Pudding	35·0	34·3	126·1	938	486·0	4·4	22·8
	Liver and Bacon Mashed Potato Marrow Rice Pudding	34·4	33·7	101·6	835	435·8	12·0	12·7
Local Authority Invalid Meals Kitchen 2 January, 1963	Braised Chop Mashed Potato Swede Canned Peaches Custard	33·7	31·3	54·7	634	178·2	10·4	18·7
	Baked Fish Mashed Potato Carrot Sago Pudding	26·9	5·7	53·8	369	196·0	1·6	8·4

DOMICILIARY AND CLUB MEALS

AVERAGE NUTRIENT VALUES

Institution or Local Authority	Meals	Protein g.	Fat g.	CHO g.	Cals.	Ca mg.	Fe mg.	Vit. C mg.
Invalid Meals Kitchen 2 January, 1963	Roast Beef Mashed Potato Carrots Apple Pie Custard	23·6	28·3	67·4	617	147·7	4·3	8·0
	Beef Stew Mashed Potato Parsnip Semolina Pudding	22·2	27·5	54·5	547	165·5	4·1	12·9
	Roast Lamb Mashed Potato Processed Peas Semolina Pudding	28·5	19·7	49·3	486	135·4	5·3	8·4
	Roast Lamb Mashed Potato Carrot Prunes and Custard	25·5	19·3	50·3	474	119·2	5·0	8·3
	Liver and Bacon Mashed Potato Haricot Beans Flaked Tapioca Pudding	31·6	21·9	58·1	550	165·7	15·8	6·8

DOMICILIARY AND CLUB MEALS

AVERAGE NUTRIENT VALUES

Institution or Local Authority	Meals	Protein g.	Fat g.	CHO g.	Cals.	Ca mg.	Fe mg.	Vit. C mg.
Local Authority Domiciliary Meals Supplied two or three days weekly August, 1962	Roast Lamb Gravy Processed Peas Boiled New Potatoes Jam Tart Custard	25·3	18·5	84·6	586	125·7	1·3	8
	Roast Lamb Gravy Savoy Cabbage Boiled New Potatoes Rice Pudding	21·6	15·6	51·7	427	175	3·7	15·8
	Fried Fish Carrots (canned) Boiled New Potatoes Steamed Pudding Custard	32·8	20·8	78·8	620	211·6	2·7	10·3
	Mince Butter Beans Boiled New Potatoes Steamed Pudding Custard	24·6	16·3	96·3	613	177·2	4·8	9·5
	Meat Pie Processed Peas Boiled New Potatoes Prunes and Custard	24·6	16·3	96·3	613	177·2	4·8	9·5

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