A STUDY OF ENGLISH DIETS BY THE INDIVIDUAL METHOD

PART II. WOMEN

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(With 1 Figure)

INTRODUCTION

Food requirements and intakes

It is unfortunately true to say that in spite of all the work which has been done up to the present time, our knowledge of human food requirements is largely based upon assumptions which have no experimental foundation whatever. To most people the unqualified term "requirement" seems to mean the amount of any food constituent which will maintain an individual or group of individuals in the *status quo ante* over a prolonged period of time. The term is used very loosely because (*a*) the *status quo*, which is usually average or normal health, is presumed to be a state of perfect health, but in the absence of any tests must often not be so. Difficulties in the assessment of the state of nutrition are discussed by Magee *et al.* (1935). (*b*) The *minimum* requirement is seldom determined beforehand and this must form the basis of all assessments of maintenance requirements. (*c*) The term "requirement" is often confused with "freely chosen intake", since there is a natural tendency to regard what "will maintain" as what "is required to maintain", especially as the former is capable of direct measurement and the latter is not.

It is essential in the discussion of any dietary investigation to define what is meant by "requirement". It would appear that the term can be used in two senses, minimum requirement and optimum requirement. The minimum requirement for the correct nutrition of adults may be defined as the least amount of any dietary constituent necessary to maintain a perfectly healthy individual in equilibrium for a given (usually a short) period of time. Our knowledge of minimum requirements must be based upon balance experiments carried out with the object of determining them. The intake must be adjusted so that it is just above or just below that on which an exact balance can be obtained.

Optimum requirements for adults may be stated to be the minimum requirements for perfect health plus an additional allowance for unforseen

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eventualities. The latter constitutes the margin of safety, and its determination is largely a matter of guesswork even if the minimum requirements have been carefully assessed.

Actually, very little is known about the minimum requirements of the various dietary constituents and the optimum requirements are shrouded in mystery. There is great divergence of opinion among different authorities as to the human requirements (presumably optimum requirements) for protein, fat, carbohydrate and total calories, and so far as the inorganic constituents of the diet are concerned, Sherman (1933) appears to be the only person to have made any original suggestion as to our requirements for them. His figures are based upon the average results of about 100 balance experiments, to which he adds 50 per cent. to allow for a margin of safety. The balance experiments were carried out by a number of different workers, and the results for each constituent varied greatly from one individual to another. Thus, calcium balances on intakes varying from 0·27 to 0·82 g. per day were recorded (Sherman, 1920). Even if these figures were true minimal balances, which is unlikely, it would appear that *average* results have no meaning, for the *minimum* requirement for one individual (0·82 g.) is more than twice the optimum requirement of another whose minimum requirement is 0·27 g. Further, there is no evidence that 50 per cent. above the minimum is the optimum requirement.

Stiebeling and Ward's (1933) standards for the requirements of calcium, phosphorus and iron are adapted from Sherman, and they are said to be "the approximate quantities of nutrients which should appear in well-balanced diets, if they are to furnish not only the minimum requirements of the body, but a fair margin of safety as well". These standards will be discussed in more detail later. Orr (1936) accepted Stiebeling and Ward's standards, but definitely asserted that they were "compiled for the maintenance of perfect health". The evidence cannot be said to justify such a statement.

In considering food requirements, dietary constituents may be conveniently divided into two classes. Firstly, there are those of which too much is just as harmful as too little, *e.g.* calories and possibly vitamin D. Secondly, there are those of which a certain minimum is required, but owing to the ready way in which they may be excreted, an excess is not in any way harmful, and may in fact be beneficial. Theoretically, there is no true *optimum* for these dietary constituents. Calcium and potassium are good examples.

The food intake requires no definition, but it is important to realise that its determination may be exact, and may involve no assumptions. Individual food intakes measured by a "family" method, however, can only be approximate, since only the total food eaten by the family is actually recorded.

The food intakes of women have rarely been studied in a way which enables them to be compared with those of men. All dietary studies which have been carried out by the "family" method are calculated to a "man value" basis, and the woman is not differentiated from the rest of the household. Scales of family coefficients have been constructed by about thirty-eight different workers. Some of these are reviewed and compared by Peller (1931) and by v. Tyszka (1935). According to at least twenty-six of them, the calorie requirements of a woman are 80–90 per cent. of those of a man, but there seems to be no experimental justification for this assumption.

Among the most widely used "man value" scales in this country and America are those proposed by Atwater (1902), Lusk (1917), Hawley (1927), Cathcart and Murray (1931 *b*) and the League of Nations (1932). The British Medical Association (1933) and the Ministry of Health (1934) accepted Cathcart and Murray's standards.

If the "man value" of the average woman is 0·83, and if 3000 calories per day are taken as the energy requirement of the average man, then the average woman will require 2500 calories. On the basis of calories per kg. body weight, the requirements of the two sexes would be almost exactly the same (43 calories per kg.).

Bigwood and Roost (1934) have carried out a study of the food consumption in nineteen families in Brussels. These authors have pointed out that in families where the husband is unemployed, and the wife is working, the woman's food allowance should be greater than the man's. They have drawn up a scale in which the woman's calorie allowance is 2600 per day, and the unemployed man's is 2340. Hence, taking the housewife as the unit of food consumption, the unemployed man has a coefficient of 0·9.

Recently the League of Nations (1935) has suggested a basic figure of 2400 calories for the requirements of both sexes (presumably optimum requirements), and that supplements for muscular activity should be added to this. Hence, according to this committee, there is no fundamental difference between the calorie requirements of the two sexes, and the minimum requirement of a woman is 2400 calories per day. Thus, a woman "living an ordinary, everyday life" requires about 41 calories per kg. body weight per day, while a man living a similar life needs only 34 calories per kg. The committee did not give the evidence on which this statement was based.

All authorities are agreed that protein is an essential constituent of the human diet, and various suggestions have been put forward as to men's optimum protein requirements. These are summarised in the previous paper (Widdowson, 1936). So far as women are concerned, less information is available. If a man requires 100 g. of protein per day (British Medical Association, 1933), and the "man value" of a woman for protein is the same as her "man value" for calories, possibly an unwarranted assumption, then her optimum protein requirement will be 83 g. per day. Sherman (1933) and the League of Nations (1935) have proposed 1 g. of protein per kg. body weight per day, both for men and women. On this basis, a woman will require about 60 g. of protein per day. Stiebeling and Ward's (1933) protein allowance for a moderately active woman is 75 g. a day, higher than the allowance of 67 g. for a moderately or even very active man.

The League of Nations Committee considers the optimum protein allowance during pregnancy and lactation to be 2 g. per kg. body weight per day. It is clear that during lactation a woman's minimum requirements for both calories and protein will be higher, and it is probable that her optimum requirements will be higher too, but it is difficult to see why, during the first months of pregnancy, her protein intake should be doubled.

Most authorities agree that during pregnancy and lactation the intake of calcium and phosphorus should be increased (Toverud and Toverud, 1930; League of Nations, 1935), but few authors appear to have considered women's normal requirements or even intakes of mineral salts. Atwater's, Lusk's, and Cathcart and Murray's scales of family coefficients are the result of assumptions, and at best apply to calories only. Hawley's (1927) scale for protein and minerals allows for the greater requirements and intakes of children for growth, but her "man value" of a woman for these dietary constituents is the same (0·8) as for calories. Even if the average woman's calorie intake is only 80 per cent. of that of the average man, it does not follow that her calcium or iron intakes should also be 80 per cent. It has been emphasised by Widdowson and McCance (1936) that the iron requirement of women is probably as great, if not greater, than that of men, and it is possible that her requirement for the other inorganic salts is correspondingly high. Stiebeling and Ward's (1933) standard for the calcium requirement of a man is 0·68 g. per day, and of a "moderately active woman" 1·00 g., while a "very active woman" according to this author requires only 0·88 g. It is difficult to see why the calcium requirement should decrease with increasing activity.

The daily phosphorus requirements, on the other hand, are said to be less for a moderately active woman (1·20 g.) than for a very active woman or a man (1·32 g.). If a woman's calcium requirements are higher than those of a man, it seems inconsistent to suggest that her phosphorus requirements are less.

Stiebeling and Ward's standards for iron requirements are the same (15 mg. a day) both for men and for women.

A few studies of the food intakes of American college women have been made, but since these were mainly women of a similar class, occupation and age, they cannot be said to be representative of the female population.

No comparative investigations on men and women appear to have been carried out. Hawley (1929), who studied the diets of men and women in 227 institutions in America, and calculated their protein, calcium, phosphorus and iron intakes, has expressed all her results on a "man value" basis, taking a woman's "man value" as 0·8, so that information as to the food intakes of the two sexes is not available.

An investigation has now been carried out on the amounts of the various food constituents consumed by women on freely chosen diets. There is no evidence that the average intake of any one constituent is the optimum intake, and in fact Widdowson and McCance (1936) have shown that the average intake of iron among women is almost certainly less than the optimum intake for perfect nutrition, for their haemoglobin levels can be increased by 10 per cent. by giving them additional iron.

PRESENT INVESTIGATION

METHODS

The present investigation, which was carried out in parallel with a similar investigation on men (Widdowson, 1936), has consisted in a study of the individual food intakes of sixty-three women. Their ages ranged from 18 to 65 years, they lived in their own homes, and their occupations, which were various, have previously been described (Widdowson and McCance, 1936). In no case were there restrictions of diet due to lack of money, so the food may be considered to have been "freely chosen".

The method followed was the same as that described for men (Widdowson, 1936). A summary of the results is shown in Table I, and each of the dietary constituents is also expressed as a percentage of the mean values found for men, which are given in the previous paper.

A detailed analysis of the individual diets is shown in Table II.

Calories

The average calorie intake was 2187 per day, or 71 per cent. of the mean value found for men. Hence the average "man value" of these women is not 0·8, but 0·7, a much lower figure than has generally been accepted. Even expressed in terms of calories per kg. body weight, the *intake* of the women is only 81 per cent. of that of the men. These figures are very different from those suggested by the League of Nations (1935) for the "basic" energy *requirements* of women, which are 120 per cent. of those of men expressed as calories per kg. body weight. Cathcart and Murray (1931 *a*, *b*) calculated separately the food intakes of the father and mother in five families belonging to their St Andrews study (1931 *b*), and found that in all cases the man obtained more calories than he was entitled to on the basis of Atwater's (1902) or Lusk's (1917) scale. They found that the food consumption of the wife was not only well below that of the husband, but definitely below the conventional 83 per cent. of the man's intake. They suggest that the "man value" to be assigned to a woman is not 0·83, but 0·70, almost the same figure as that obtained in the present investigation. In spite of this, Cathcart and Murray (1931 *b*) accepted a figure of 0·83 as the "man value" of a woman. Clark (1933) made an attempt in sixteen families to determine the food intake of the mother as distinct from the rest of the household. Unfortunately the investigation period only lasted for 2 days, but during this time the women's average calorie intake was 24 per cent. lower than it should have been, calculated from Cathcart and Murray's "man value" scale. Wheeler and Mallay (1935), in a study of the food freely selected by twenty-eight women students who undertook co-operative housekeeping, found a mean intake of 2397 calories per day.

The individual calorie intakes in the present study varied from 1453 to 3110 per day. It will surprise most conventional students of nutrition that one-third of these women were obtaining less than 2000 calories per day from their food, and that nine were leading active lives on intakes of less than 1700 calories per day. Three of these were housewives, two were secretaries, two were cooks, one a dietitian, and one a student, all people with free access to food. It would clearly be very difficult, in the light of these facts, to make any forecast as to an individual women's calorie intake, let alone her requirement.

Calorie intake and body weight

The heights and weights of all the subjects of the investigation were recorded. The normal weight for height and age was read off for each individual from tables given by the Actuarial Society of America (1929), but a correction was applied so that $4\frac{1}{2}$ lb. were allowed for clothes instead of 6 lb. as in the original tables. The percentage deviation from the normal was calculated for each person, and an attempt was made to correlate this with calorie intake. There was, however, no significant correlation between body weight and calorie intake, and this agrees with the result previously obtained for men.

Total protein

The protein intake of American college women has been determined by several workers. One method which has been adopted by several investigators is the estimation of the nitrogen excreted in the urine while the subject is on a freely chosen diet. To the urinary nitrogen is added 10 per cent. for the nitrogen excreted in the faeces, and, assuming that the subjects are in nitrogen balance, the amount of nitrogen excreted is taken to represent the intake of nitrogen in the food. Denis and Borgstrom (1924), using this method, found the average nitrogen excretion of nine women in New Orleans to be equivalent to an intake of 53 g. of protein per day. Hetler (1932) in a study of eighty-five healthy women students by the same method, reported an average protein intake of 56·8 g. per day, and Kramer, Evers *et al.* (1934) about 62 g.

Wheeler and Mallay (1935), who studied the food intakes of twenty-eight woman students, found an average consumption of 70 g. of protein per day, and Mitchell (1935) in a similar investigation reported a mean intake of about 0·94 g. per kg. body weight, which would be approximately 55 g. per day.

The average total protein intake in the present investigation was 67 g. per day, or 69 per cent. of the men's intake (Table I). This is equivalent to 1·1 g. per kg. body weight, but the individual variations were great. No woman was eating more than 90 g. of protein per day, 8 g. less than the average found for men (Widdowson, 1936). Most women would probably find it difficult to eat 120 g. per day during pregnancy, as recommended by the League of Nations (1935). One subject was eating only 28 g. of protein per day, but apart from this no woman was consuming less than 49 g.

Table I. *Daily food intake of sixty-three women of the middle class. Summary of results*

	Average	Maximum	Minimum	Standard deviation	Average expressed as a percentage of the mean value for men
Total calories per day	2187	3110	1453	388	71
Calories per kg. body weight (normal weight for height and age)	35·5	55·6	26·6	7·6	81
Total protein (g. per day)	67·3	90·0	28·0	12·4	69
Animal protein (g. per day)	46·0	64·0	9·0	11·3	69
Total fat (g. per day)	100·5	151	63	20·6	77
Total carbohydrate (g. per day)	233	384	113	58·5	67
% of calories from protein	12·8	17·3	6·9	2·2	—
% of calories from fat	42·7	54·9	32·6	4·7	—
% of calories from carbohydrate	43·6	56·5	16·7	6·0	—
Total calcium (g. per day)	0·63	1·16	0·23	0·16	72
Total phosphorus (g. per day)	1·13	1·72	0·48	0·25	70
"Available" (non-phytin) phosphorus (g. per day)	1·09	1·62	0·45	0·22	69
Total iron (mg. per day)	11·4	17·3	5·5	2·50	68
"Available" (inorganic) iron (mg. per day)	7·9	12·4	5·0	1·64	73
Intake of milk (pints per day)	0·45	0·86	0	0·17	78
Intake of meat (oz. per day)	3·0	6·0	0·1	1·2	60
Intake of bread (oz. per day)	4·5	8·1	1·2	1·6	56
Calories per penny	109	166	29	21·4	—

Animal protein

The mean intake was 46 g. per day, a satisfactory figure according to any of the estimated requirements, and 68 per cent. of the total protein. The individual figures, however, appear to show that it is quite possible to maintain excellent health on an amount of animal protein as small as 9 g. per day.

Fat and carbohydrate

The mean fat intake was 100 g. per day (77 per cent. of the men's intake). This is a surprisingly high figure as compared with the average calorie intake. The individual results, which varied from 151 to 63 g. per day, are not of such importance as those of dietary constituents such as total calories or calcium. Nothing can compensate for a deficient intake of calcium, but fats and carbohydrate are interchangeable within wide limits for calorific purposes, and therefore a small intake of one may be compensated for by a large intake of the other.

The average amount of carbohydrate in the diets was 233 g. per day or 67 per cent. of the men's intake.

Percentage of total calories derived from protein, fat and carbohydrate

The women derive an average of 12·8 per cent. of their total calories from protein. This is very close to the corresponding value found for men (13·1 per cent.).

Table II. *Chemical composition of the individual diets of sixty-three women*

No.	Age	Occupation	% above or below normal weight for height	Calories per day	Calories per kg. per day	Total protein g. per day	Animal protein g. per day	Fat g. per day	Carbohydrate g. per day	% calories from protein
1	19	Cook	+15·2	2634	43	79	57	125	280	12·3
2	20	Secretary	− 2·6	2754	45	76	47	128	309	11·4
3	20	,,	+11·8	1453	26	58	43	77	122	16·4
4	21	Student	−12·9	2515	41	81	59	138	221	13·2
5	21	,,	− 2·7	2213	37	68	47	91	235	12·6
6	21	,,	+17·0	2327	40	63	41	114	247	11·1
7	22	Clerk	+ 2·2	2044	40	78	52	117	162	14·4
8	22	Children's nurse	+ 6·8	2400	48	76	55	129	215	13·0
9	22	Student	− 2·0	2515	43	84	60	119	259	13·7
10	22	Cook	+ 6·1	3110	55	85	52	141	355	11·2
11	22	Student	+ 1·6	1848	30	52	29	83	215	11·5
12	22	,,	−15·4	2012	28	63	45	91	222	12·7
13	22	,,	− 4·1	2330	38	50	21	122	241	8·8
14	22	,,	+ 3·2	2373	38	83	56	99	273	14·3
15	22	Secretary	+ 2·1	1984	36	53	30	111	179	11·0
16	23	Dietitian	− 9·2	2930	44	80	59	121	363	11·2
17	23	Housework	+ 2·0	2720	48	63	41	127	311	9·5
18	23	Student	− 3·5	1985	34	49	31	95	219	10·1
19	23	Teacher	+21·8	2420	40	73	57	118	250	12·4
20	23	Student	0	2780	48	61	36	103	384	9·0
21	23	Secretary	− 5·4	2315	42	58	34	95	292	10·2
22	23	Student	+ 5·5	2474	40	65	32	96	321	10·7
23	23	,,	+ 4·1	1790	29	48	27	79	208	11·1
24	24	Civil servant	− 2·6	2566	42	86	64	151	197	13·7
25	25	Shop assistant	− 3·8	2132	32	56	34	88	265	10·8
26	25	Student	−19·3	2061	33	49	29	84	265	9·6
27	25	Housework	+ 2·1	2070	38	78	62	94	214	15·5
28	26	Student	−19·1	1628	29	58	44	70	180	14·6
29	27	Typist	0	2350	36	85	62	103	256	14·8
30	28	Teacher	+ 3·2	1789	28	56	36	86	186	12·7
31	28	,,	+ 6·1	2395	38	78	51	107	264	13·4
32	28	Student	−10·7	2280	37	75	53	93	270	13·5
33	28	Research	− 5·0	1771	30	71	51	69	205	16·5
34	29	Chiropodist	+ 1·1	2983	50	86	55	120	368	11·8
35	30	Secretary	−21·0	2515	36	83	62	121	256	13·5
36	30	Clerk	−13·8	2132	39	64	45	89	253	12·3
37	30	Cook	+20·6	1675	29	28	9	75	209	6·9
38	31	Housewife	−11·4	2143	35	76	58	102	216	14·5
39	33	Civil servant	+20·5	2130	32	78	58	98	219	15·0
40	33	Dietitian	+ 9·7	1535	24	50	36	75	154	13·4
41	34	Housewife	+ 7·4	2195	34	72	50	111	212	13·5
42	34	Cook	−10·0	1787	29	75	59	83	173	17·2
43	35	Research	−15·2	2111	35	60	39	118	189	11·7
44	35	Housewife	+12·4	2180	34	79	62	101	210	14·8
45	36	Teacher	− 9·5	2658	49	81	54	118	298	12·4
46	36	Housework	− 6·6	2933	45	90	62	126	341	12·6
47	36	Housewife	− 4·6	1825	29	63	46	94	169	14·0
48	39	,,	+ 7·4	2762	34	76	60	84	113	11·2
49	41	Teacher	+ 3·3	2090	34	63	41	98	225	12·3
50	44	Housewife	−18·8	2477	37	70	47	138	222	11·6
51	45	,,	+ 7·8	1768	26	75	55	86	161	17·3
52	48	Teacher	−17·4	1951	32	54	35	81	236	11·4
53	50	,,	+10·2	2410	37	71	45	111	265	12·0
54	52	Housewife	− 2·6	2147	36	57	41	110	218	10·8
55	54	,,	+14·2	1851	28	69	49	85	188	15·3
56	55	,,	+11·8	1670	26	68	48	63	197	16·7
57	55	,,	− 7·2	2588	39	61	34	128	280	9·6
58	55	,,	−13·1	1695	24	62	42	71	190	15·0
59	56	Cook	+32·4	1686	27	60	44	80	170	14·6
60	56	Housewife	−10·0	1878	27	67	48	78	214	14·6
61	58	,,	+ 3·5	1692	24	53	34	78	183	12·8
62	58	Secretary	+38·1	1535	24	63	47	65	164	16·9
63	62	Housewife	− 8·8	2152	33	60	42	86	221	11·4

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Table II (*continued*)

% calories from fat	% calories from carbo-hydrate	Calcium g. per day	Total phos-phorus g. per day	Avail. phos-phorus g. per day	Total iron mg. per day	Avail. iron mg. per day	Calories per penny	Milk pints per day	Bread oz. per day	Meat oz. per day
44·2	43·6	0·74	1·28	1·24	12·3	7·5	112	0·53	4·6	3·5
43·1	46·0	0·79	1·50	1·32	15·3	12·4	138	0·43	8·1	2·8
49·3	34·5	0·39	0·84	0·83	8·7	6·3	110	0·25	4·1	2·6
50·8	36·0	0·55	1·31	1·30	12·0	8·0	116	0·21	6·0	4·8
38·4	43·5	0·68	1·14	1·12	11·3	7·8	92	0·67	3·5	3·8
45·5	43·5	0·31	0·92	0·92	12·4	6·7	137	0·27	4·7	4·5
53·2	32·5	0·54	1·24	1·22	11·5	7·8	92	0·32	3·7	2·8
50·0	37·0	0·59	1·19	1·15	13·8	9·2	99	0·44	3·3	4·0
44·0	42·0	0·72	1·22	1·22	10·8	8·8	96	0·44	4·9	2·1
41·8	46·7	0·80	1·37	1·35	14·5	10·9	130	0·46	7·4	3·5
41·6	47·6	0·31	0·68	0·67	8·7	5·1	136	0·27	6·0	3·2
42·0	45·1	0·42	0·98	0·97	11·7	8·5	112	0·34	3·2	3·3
48·5	42·5	0·55	0·95	0·88	10·4	7·5	161	0·21	5·6	1·6
38·6	47·2	0·69	1·34	1·33	12·4	8·2	118	0·68	4·8	3·5
52·0	36·8	0·51	1·04	0·94	7·2	6·2	65	0·33	4·9	0·6
38·5	51·0	0·77	1·40	1·14	13·3	8·7	100	0·71	4·5	4·3
43·2	47·0	0·87	1·17	1·15	8·4	7·1	119	0·51	3·9	2·0
44·4	45·2	0·66	1·04	0·98	9·7	8·3	90	0·57	2·6	1·8
45·0	42·3	0·63	1·12	1·12	10·0	7·3	127	0·64	3·0	3·6
34·4	56·5	0·94	1·19	0·88	11·5	10·0	124	0·74	5·0	2·4
38·0	51·7	0·89	1·15	1·09	9·3	8·6	135	0·48	5·1	0·4
34·9	53·0	0·48	1·12	0·99	11·3	9·7	126	0·32	8·0	2·3
41·4	47·7	0·77	0·91	0·87	8·6	6·5	81	0·62	2·4	1·8
54·9	31·5	0·62	1·39	1·35	11·1	9·0	110	0·62	6·6	3·1
38·4	51·0	0·69	0·99	0·96	8·7	7·0	122	0·59	6·3	1·5
37·8	52·5	0·76	1·00	0·95	8·8	8·0	135	0·46	3·4	0·4
42·2	42·3	0·67	1·31	1·30	17·3	10·1	94	0·28	4·0	5·3
39·8	45·3	0·98	1·05	1·64	11·7	8·2	105	0·16	1·2	3·0
40·7	44·5	1·16	1·63	1·53	12·4	11·5	102	0·86	3·9	3·1
44·8	42·6	0·34	0·78	0·78	9·7	6·6	106	0·21	5·6	2·9
41·4	45·0	0·70	1·34	1·29	12·1	9·5	92	0·48	4·3	3·6
37·8	48·5	0·93	1·29	1·25	12·1	9·0	106	0·65	4·7	3·1
36·2	49·0	0·71	1·12	1·11	12·5	7·0	120	0·49	4·9	3·4
37·5	50·5	1·08	1·72	1·62	15·6	12·1	125	0·78	5·5	3·3
44·7	41·7	0·57	1·33	1·27	16·2	8·8	89	0·47	2·6	6·0
38·9	48·8	0·47	1·01	0·98	11·8	6·9	114	0·43	3·1	3·9
42·0	51·2	0·23	0·48	0·45	5·5	5·0	124	0·16	4·1	0·1
44·0	41·3	0·72	1·28	1·28	12·2	9·5	120	0·57	3·8	3·0
42·8	42·1	0·72	1·52	1·52	10·7	9·5	107	0·54	5·2	2·3
45·6	41·0	0·50	0·82	0·82	7·4	5·0	98	0·32	2·9	2·7
47·0	39·5	0·57	1·03	1·03	11·4	6·0	112	0·49	4·3	4·7
43·2	39·6	0·63	1·11	1·11	10·7	6·3	92	0·54	2·6	3·5
51·5	36·7	0·67	1·10	1·06	10·2	7·0	98	0·46	4·8	3·1
43·1	39·5	0·66	1·20	1·20	10·0	7·1	85	0·51	3·5	3·6
41·3	46·0	0·73	1·34	1·28	14·1	10·2	112	0·36	6·1	3·3
39·8	47·8	0·62	1·40	1·36	16·6	9·4	129	0·34	5·4	4·9
48·0	38·0	0·51	0·96	0·95	9·9	6·9	82	0·49	2·0	3·3
28·2	16·7	0·56	1·23	1·18	16·4	8·5	29	0·00	1·2	3·4
43·4	44·2	0·64	1·01	1·01	9·7	7·0	128	0·53	7·4	1·6
52·0	36·7	0·76	1·20	1·18	11·4	8·7	102	0·77	4·2	2·9
45·1	37·6	0·56	1·18	1·18	16·8	9·0	82	0·46	7·3	3·9
38·8	49·7	0·49	0·91	0·87	9·8	7·1	95	0·21	3·7	3·0
42·8	45·0	0·44	1·12	1·08	13·4	8·5	113	0·31	5·2	3·7
47·0	41·6	0·48	0·90	0·89	10·4	6·2	134	0·43	4·5	3·1
42·7	41·6	0·35	0·91	0·88	11·8	6·1	107	0·25	5·4	0·3
35·0	48·3	0·53	1·22	1·12	12·6	10·1	69	0·49	4·2	1·1
46·0	44·5	0·42	0·93	0·93	10·6	7·0	166	0·31	6·7	3·5
39·0	46·0	0·54	1·01	0·99	9·4	5·8	94	0·46	5·9	4·6
44·0	41·3	0·52	0·93	0·92	10·6	6·0	126	0·27	4·2	2·9
38·6	46·6	0·59	1·04	1·04	10·7	5·9	112	0·56	4·0	3·3
43·0	44·3	0·52	0·88	0·88	9·9	6·5	100	0·31	3·6	1·9
39·5	43·8	0·70	1·18	1·10	10·6	7·7	84	0·39	3·4	2·9
37·0	42·0	0·56	0·98	0·95	9·9	6·8	118	0·47	3·6	2·3

In the previous paper attention was called to the relatively high proportion of calories derived from fat in the diets of individual men of the English middle class to-day. The distribution of calories between fat and carbohydrate in the present investigation, however, is even more striking. It was found that fat and carbohydrate contributed an almost equal number of calories to the women's diets (42·7 and 43·6 per cent. respectively). There seem to be no previous records, either in this or any other country, of a similar calorie distribution. The low calorie consumption found for the women is due to their low carbohydrate intake. Seven of the women were obtaining more than half their calories from fat, and no individual was obtaining less than 30 per cent.

It will be seen that the women's average consumption of bread is 4·5 oz. per day, only 56 per cent. of the men's average intake. Women take sugar in their tea less frequently than do men, and these two factors together probably account for their low carbohydrate intake. They consume relatively more cakes and pastries than the men.

Calcium

Kramer, Evers *et al.* (1934) found an average excretion of over 1 g. of calcium per day among twenty-five American college women on a freely chosen diet. Wheeler and Mallay (1935) reported an intake of 0·92 g. per day and Mitchell (1935) 0·8 g. among American women students.

In the present investigation the calcium intake had a mean value of 0·63 g. per day. This is very little less than Sherman's suggested figure of 0·68 g. for the normal calcium requirements for adults but significantly lower than Stiebeling and Ward's (1933) standards for women. It is 72 per cent. of the men's average intake. Thus the average calcium intakes of these men and women bear the same relationship to one another as their calorie intakes. The question to be discussed is whether the women's calcium intake is adequate. Haemoglobin provides a sensitive index of the adequacy or inadequacy of the iron intake. By this criterion men's iron intakes appear to be sufficient for their normal requirements, while women's are on the whole insufficient, although the man/woman ratio for iron intake is about the same as the man/woman ratio for calorie intake. Hence it appears that this man/woman ratio of calorie intakes cannot be applied to iron requirements, and it is quite possible that it should not be applied to the requirements of calcium. Unfortunately we have no ready index of mild calcium deficiency, and it is impossible to say with certainty whether or not these women were obtaining sufficient calcium from their food. There is, on the other hand, no reason to suppose that they were not, even though some of the individual intakes were very low. Fourteen individuals were having less than 0·5 g. per day and one only 0·23 g. As in the case of men, milk was the main single source of calcium, and milk and calcium showed a correlation coefficient of +0·60. Calcium requirements during pregnancy and lactation are a separate problem, outside the scope of the present investigation.

Total and available phosphorus

The average intake of total phosphorus was 1·13 g. per day (70 per cent. of the men's intake). This is lower than Sherman's (1933) suggested requirement of 1·32 g. Previous investigations of women's daily phosphorus intakes have shown them to be 1·49 g. (Kramer, Evers *et al.* 1934), 1·32 g. (Wheeler and Mallay, 1935) and 0·95 g. (Mitchell, 1935).

The significance of values for "available phosphorus" in human dietaries are discussed by McCance and Widdowson (1935) and Widdowson (1936). The women were obtaining an average of 1·09 g. of phosphorus in an available form. In only three instances did the intake of total or available phosphorus fall below 0·8 g. per day.

Total and available iron

The total and available iron intakes have been discussed in detail elsewhere (Widdowson and McCance, 1936). Evidence was then produced that the amount of iron in the food of women at the present time is probably inadequate for their physiological requirements.

Frequency distribution

Fig. 1 shows the frequency distributions of the various dietary constituents. They are in each case normal.

The effect of age on food intake

The effect of age on food intake has been investigated as in the case of the men, by dividing the women into three approximately equal groups (see Table II). Group I includes all individuals between 19 and 24 years, Group II between 25 and 36 years, and Group III between 37 and 62 years. The results in Table III show the mean values for the three groups. It will be observed that there is a

Table III. *Variation of food intake with age*

	Mean for Group I 19–24 years	Mean for Group II 25–36 years	Mean for Group III 37–62 years
Total calories per day	2360	2140	2020
Calories (per kg. body weight per day)	40	35	31
Total protein (g. per day)	68	69	65
Animal protein (g. per day)	45	49	45
Total fat (g. per day)	112	97	91
Total carbohydrate (g. per day)	253	234	203
% calories from protein	11·9	13·2	13·3
% calories from fat	44·0	42·0	41·5
% calories from carbohydrate	44·0	44·8	41·9
Calcium (g. per day)	0·64	0·68	0·54
Total phosphorus (g. per day)	1·14	1·16	1·04
Available phosphorus (g. per day)	1·09	1·14	1·01
Total iron (mg. per day)	11·1	11·6	11·5
Available iron (mg. per day)	8·2	8·1	8·1
Intake of milk (pints per day)	0·46	0·47	0·39
Intake of meat (oz. per day)	2·9	3·2	2·8
Intake of bread (oz. per day)	4·9	4·1	4·7
Calories per penny	113	108	104

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definite decrease in calorie intake with increasing age. This is not mathematically significant, since the numbers of individuals in each group were small, but the results obtained for the women are so similar to those obtained for the men (Widdowson, 1936) that there appears to be evidence that both men and women tend to eat less as they grow older.

The average body weight increases with increasing age, and expressed as calories per kg. body weight, the decrease in energy intake is more marked. The older women (Group III) are eating over 20 per cent. less food than the younger ones (Group I) in relation to their body weight.

This decrease in calorie consumption is due to a lower intake both of fat and of carbohydrate. The average intake of protein remains approximately the same at all ages. The amounts of the inorganic constituents of the diet do not vary greatly from one age group to another.

It must be emphasised, however, that when *individuals* are considered, age is no indication of food intake. Young people may eat very little, while older ones may eat a great deal more. The minimum calorie intake found in the present investigation (1453 per day) was that of a secretary aged 20, while a housewife aged 55 was taking 2588 calories per day.

Intake of individual foods

The average consumption of milk was less than ½ pint per day. In one case no fresh milk at all was taken, either in puddings, in tea or as a beverage, and no woman was consuming more than 0·86 pint. The amount of meat in the diets was only 60 per cent. of the amount of this foodstuff eaten by the men. The meat and total protein intakes showed a correlation coefficient of +0·51, while the correlation coefficient for meat and animal protein was +0·54. The relation of the amount of bread to the carbohydrate intake has already been discussed.

Alcohol

The consumption of alcohol was, on the whole, very much less for the women than the men. One individual (subject 48) recorded 33 cocktails, 1½ pints of whisky and soda, and 1 glass of beer during the course of the week, but apart from this the average intake of alcohol accounted for less than 1 per cent. of the total calories.

Cost

The costs of the diets have been calculated as in the case of the men (Widdowson, 1936). An average of 109 calories per penny was obtained. Omitting subject 48, the mean value was 110. The corresponding figure for men was 117. Thus the women tended to have rather more expensive foods than the men, but the difference is hardly significant.

A consideration of an individual diet

Subject 37. This subject is a cook in a hospital kitchen and her work is definitely of a strenuous nature. Her diet was so extraordinary in some respects that she was persuaded to weigh all her food for a second period of 1 week, some months after the original records were collected. Her consumptions of milk on the two occasions were 1–2 oz. per day. She had no vegetables whatever during the first week, and 3 oz. of spinach during the second. Her total meat intake consisted of 1 oz. of ham on the first occasion, though she had slightly more on the second. She appeared to live almost entirely on cakes, biscuits, puddings and fruit. A typical day's entries are as follows:

Breakfast:	5 prunes.
	1 cup of tea—no milk or sugar.
Lunch:	Milk pudding.
	Jam.
	1 apple.
Tea:	Dry toast.
	Plum cake.
	2 cups of tea—no milk or sugar.
Supper:	2 cups of black coffee—no sugar.
	1 mince pie.

(Weights of the various foods were recorded, but these have been omitted.)

On this she maintained apparently good health and strength, her physical energy was well above the average, and she remained 20 per cent. overweight. Her daily calorie intake was 1600–1700 on each occasion and her total protein consumption 20–30 g. of which 9 and 19 g. were of animal origin. Her intakes of calcium were 0·2 and 0·3 g. per day, phosphorus about 0·5 g., and iron 5·5 mg. on both occasions.

A STUDY OF THE INDIVIDUAL FOOD INTAKE OF SIX WOMEN, WIVES OF UNEMPLOYED MEN

In the previous paper (Widdowson, 1936) the results obtained from an investigation into the individual diets of six unemployed men living in Lincoln were given, and their home conditions were there described. A similar study was carried out on the wives of these men, and the results are shown in Table IV. Intakes of the various dietary constituents are given for each individual, the average values are shown and the mean intake expressed as a percentage of the middle-class women's intake. Further, the average intake expressed as a percentage of the intakes of the women's own husbands are given.

Results

With the exception of carbohydrate, the intake of each of the dietary constituents is lower than the corresponding intake for middle-class women. This higher carbohydrate intake is due to a larger consumption of bread (nearly 6 oz. a day). The difference in fat, calcium, phosphorus and iron are the most marked.

The whole question of course is whether these intakes are adequate for physiological requirements, *i.e.* whether the women's optimum requirements are being met. It is absolutely impossible to answer this without knowing their minimum requirements, and even then the margin of safety to be allowed is purely a matter of opinion.

Table IV. *Individual food intake of six women, wives of unemployed men*

	Subject							Intake as a percentage of middle class intake	Intake as a percentage of own husband's intake
	1	2	3	4	5	6	Average		
Calories per day	2060	2012	1282	1655	2227	2827	2010	92	70
Calories (per kg. body weight per day)	37	33	20	28	38	49	34	92	85
Protein (g. per day)	71	47	47	67	53	73	60	89	72
Animal protein (g. per day)	42	30	35	48	34	48	39	85	75
Fat (g. per day)	86	78	50	61	76	98	75	74	79
Carbohydrate (g. per day)	237	269	154	199	317	395	262	112	66
% calories from protein	14·1	9·6	15·0	17·7	9·7	10·5	12·8	100	—
% calories from fat	38·8	35·8	35·7	34·3	32·0	32·2	34·8	81	—
% calories from carbohydrate	47·0	54·5	49·0	49·2	58·2	57·2	52·5	120	—
Calcium (g. per day)	0·62	0·35	0·10	0·50	0·57	0·75	0·48	77	79
Total phosphorus (g. per day)	1·03	0·78	0·65	0·94	0·87	1·14	0·90	80	72
Available phosphorus (g. per day)	1·00	0·75	0·63	0·91	0·83	1·12	0·87	80	73
Total iron (mg. per day)	9·8	8·9	7·1	11·4	9·1	11·8	9·7	85	69
Available iron (mg. per day)	7·3	5·7	5·8	6·0	5·7	6·3	6·1	77	66
Fresh milk (pints per day)	0·27	0·36	0	0·27	0·33	0	0·21	47	95
Meat (oz. per day)	2·8	2·0	1·8	3·6	1·9	3·7	2·6	86	65
Bread (oz. per day)	8·5	4·9	4·4	6·3	4·4	7·0	5·9	131	66

It is, however, safe to say that on an average these women's intakes of calcium and phosphorus are nearer their minimum requirements for normal nutrition than those of the middle-class women, though there may still be a margin of safety. In the case of iron their intakes are probably even further below their requirements for optimum nutrition than are those of the subjects of the main investigation. It is impossible to say more.

As in the case of the previous paper (p. 288) the original records of this investigation are being deposited in the library of the National Institute for Medical Research, Hampstead.

SUMMARY

1. The food intakes of sixty-three women of the English middle class have been studied by the individual method and compared with those of men which were described in a previous paper.

2. The average calorie consumption was 2187 per day. Although it is not suggested that this is the optimum intake, it would appear from these results that the "man value" of a woman is 0·7, and not 0·8 as is usually supposed. The individual calorie consumptions varied from 1453 to 3110 per day.

3. The average daily protein intake was 67 g., and no subject was eating more than 90 g.

4. Fat and carbohydrate contributed almost equally to the calorie value of the diet. The proportion of total calories derived from fat (42·7 per cent.) is higher than any previously recorded figures in Europe or America.

5. The average amount of calcium in the diets was 0·63 g. per day. Fourteen individuals were having less than 0·5 g., and one only 0·23 g.

6. The mean intakes of total and available phosphorus were 1·32 and 1·09 g. respectively.

7. A study has been carried out on six women, whose husbands were unemployed. Their intake of all dietary constituents, except carbohydrate, were considerably lower than were found for the women of the middle class.

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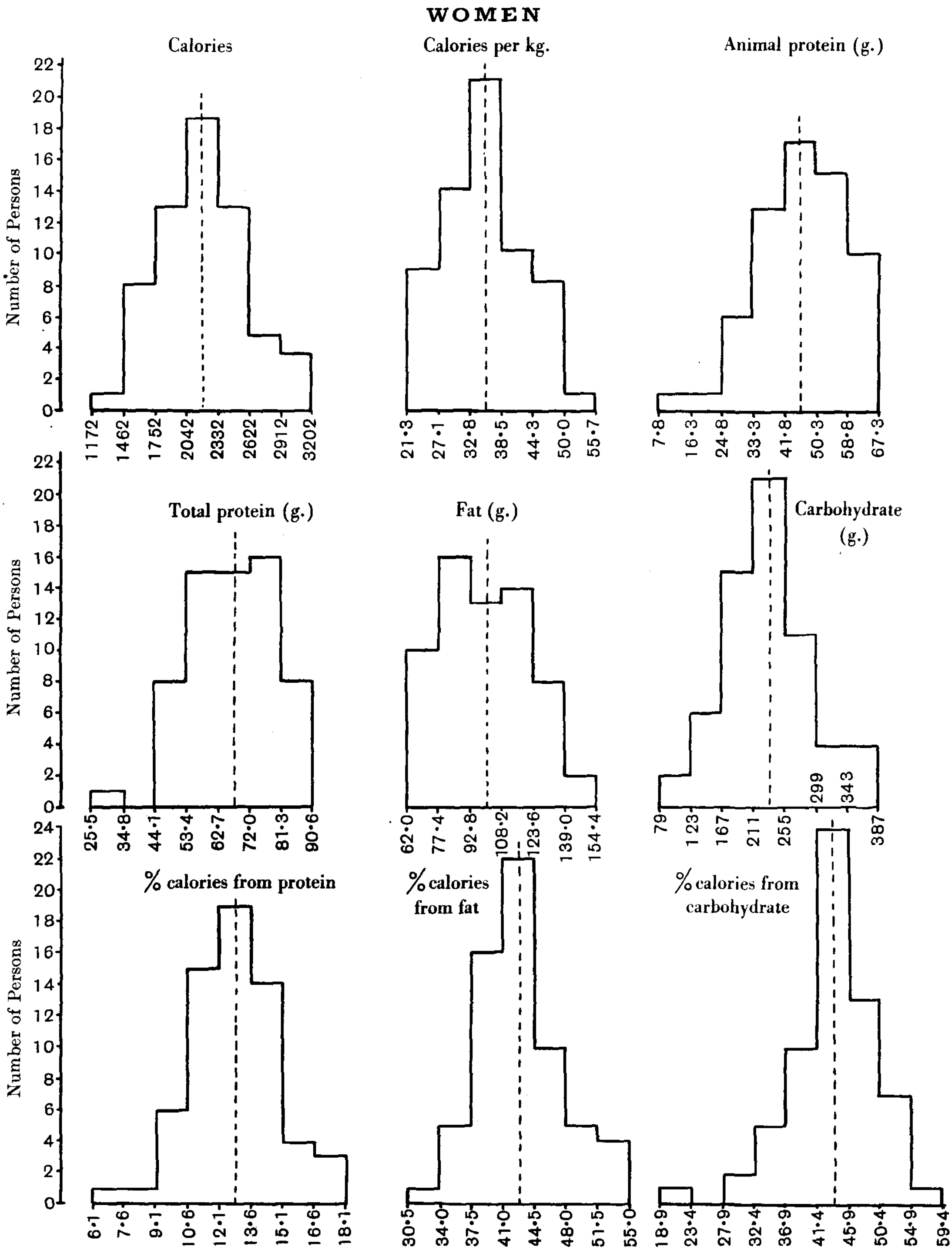

Fig. 1. Frequency distribution diagrams of women's daily intakes of various dietary constituents.

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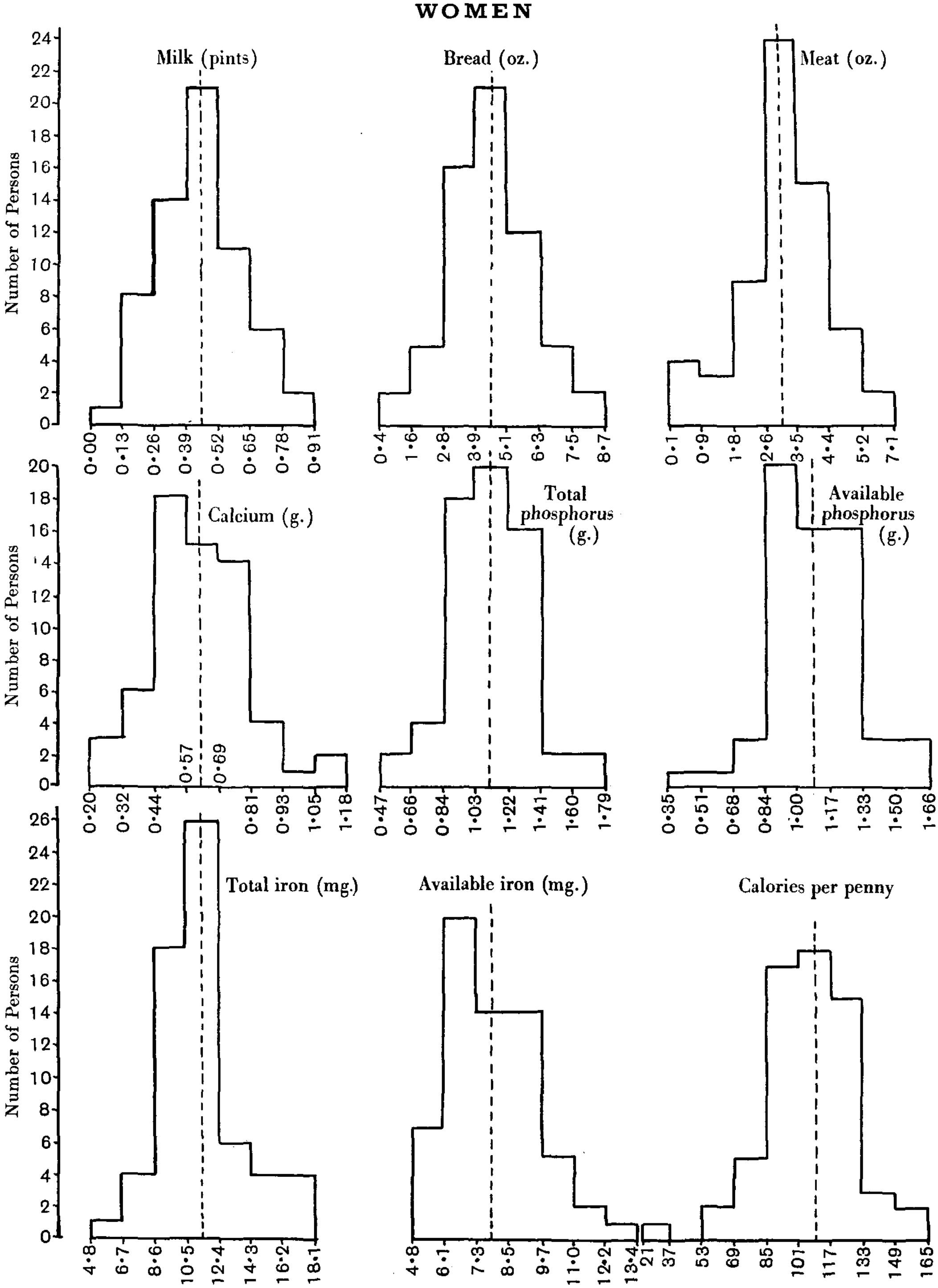

Fig. 1 (*continued*).

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