FAMILY DIET COEFFICIENTS

BY

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Scales of family coefficients for use in dietary studies or for reckoning food allowances in institutions have been drawn up by many workers on problems of nutrition, and until recently no international standard has been proposed. This variation in scales has led to much difficulty in comparing studies undertaken at different times and in different countries, some thirty scales having been in use from time to time. One of the earliest was that of Atwater. During the war, when rationing became imperative, the scale proposed by the Inter-Allied Scientific Food Commission was adopted. In 1931 Cathcart and Murray put forward a scale which graded children more than had been attempted previously in this country. In September, 1932, the International Conference at Rome suggested a scale to be used in Europe generally. It is to be noted, however, that this international scale made no pretensions to absolute accuracy. The Conference explicitly stated in its report (*Quart. Bull. Health Organization, League of Nations, 1932, 3*) that "the main value [of the scale] lies, not in its accuracy, but in the fact that, by its use, comparisons of studies made in different parts of the world will be possible." In all scales the adult male is taken as the unit, the needs of women and children being expressed as decimals of that of the man. Table I shows the variation of these four scales.

TABLE I

Age (Years)	Atwater Scale	Inter-Allied Scale	Cathcart Scale*	International Scale
Child 0+	0.1	0.5	0.2	0.2
" 1+	0.4	0.5	0.3	0.2
" 2+	0.4	0.5	0.4	0.3
" 3+	0.4	0.5	0.5	0.3
" 4+	0.4	0.5	0.5	0.4
" 5+	0.4	0.5	0.5	0.4
" 6-7+	0.5	0.7	0.6	0.5
" 8+	0.5	0.7	0.7	0.6
" 9+	0.5	0.7	0.7	0.6
" 10-11+	0.6	0.83	0.8	0.7
" 12+	0.6	0.83	0.9	0.8
Male 13+	0.6	1.00	0.9	0.8
Female 11... ..	0.6	0.83	0.9	0.8
Male 14-15+	0.8	1.00	1.0	1.0
Female 14-15+	0.7	0.83	0.83	0.8
Male 16-59... ..	1.0	1.00	1.00	1.0
Female 16-59	0.8	0.83	0.83	0.8
Male 60 and over	1.0	1.00	1.00	0.8
Female 60 and over	0.8	0.83	0.83	0.8

* Medical Research Council Special Report No. 151, 1931.

The population of England and Wales (1921 census) was 37,886,699. That population on the Atwater scale would be equivalent to 29,686,971 men, or 78 men per 100 of the population; on the Inter-Allied scale the number would be 32,061,136 men, or 83 men per 100; on the Cathcart scale 31,456,040 men, or 83 men per 100; on the international scale 29,739,586 men, or 78 men per 100—very large differences when rationing a nation on the basis of 3,000 Calories per man per day. An institution with a population of sixteen boys aged 9+, 159 aged 10-11+,

132 aged 12+, and 101 aged 13+ would range from 60 men per 100 boys (Atwater scale) to 87 men per 100 boys (Inter-Allied scale), and the catering might be adequate or inadequate for the needs of the boys according to the scale adopted. Cathcart and Murray, in a study of individual diets in five families, have led the way to a consideration of "man-values" from the point of practical observations. In their five St. Andrews studies they found that the father in each case actually consumed some 12 per cent. more than he was entitled to from the "man-value" of the diet, his extra Calories being obtained from protein and fat, while the mother, instead of consuming 0.83 of the "man-values," actually obtained only 0.70. The individual consumption within the family differing in these five cases quite significantly from the accepted standards led to a further sample being studied in a London area.

METHOD OF COLLECTING DATA

Families which had already kept budgets and diet sheets for a fortnight in connexion with an investigation into acute rheumatism in children were approached. This time the investigation lasted only two days. During the two days the mother entered in a note-book all the food-stuffs used in that time, exactly what was served at each meal, and how much of each item the various members of the family consumed. The notes as to individual consumption were made after each meal and unknown to any member of the family but the mother. For example, the mother entered at each meal the number of cups of tea, with the teaspoonfuls of sugar and tablespoonfuls of milk consumed by each member, and the number of spoonfuls of porridge served out, the amount of oatmeal used to make the porridge being also stated. The only point which might have differed from the ordinary home procedure was that the mother was asked to slice bread as evenly as possible, and, if one member of the family preferred thick or thin slices, to write down such variations. At the end of the two days the note-book was carefully scrutinized in the presence of the mother, and any points which had not been clearly stated were then written down accurately, queries as to any food left, etc., being answered and noted. When the sheets were prepared for working out, the total weight of bread bought in the two days, less any left over, was divided by the total number of slices and the appropriate weight assigned to each individual; similarly with margarine, sugar, milk, etc. Stews or puddings were given the total food value of the stated quantities of their various ingredients, the proportion of the whole eaten by each member of the family being worked out from the number of slices or spoonfuls taken. As such "made" dishes often contained both animal and vegetable protein and fat, it has not been possible to estimate the total amount of animal fat or protein consumed in each case.

The total Calories, absolute and percentage, amount of protein, fat, and carbohydrate, and percentage of Calories derived from bread have been calculated for each individual, the food values being taken mainly from Plimmer's analysis. In all, particulars were collected from seventeen families, totalling eighty-five persons, but in the summing up of results one family is omitted as the father was not at home. This leaves eighty-one persons in the sixteen families. In two cases the father was unemployed and the food distribution was probably not normal, the father eating distinctly less than the mother, who had to continue her usual household duties. The children, forty-nine in number, ranged in age from 16 years to 3 months, and were in normal health with the exception of the 3 months old infant.

RESULTS

In the 1930 fortnight's study the average Calorie consumption of the same sixteen families was 2,987, with a standard deviation of 510.16 Calories (C.). The figures for the 1932 two-day study were 3,152 C., standard deviation 744.06 C. Both series are reckoned on the Cathcart scale.

The difference between the average for the two studies is 165 C.; the probable error of that difference is 152, which shows that the two series are quite comparable in Calorie content. Table II shows the average percentage of the total Calories consumed by the various members of the families, and the percentage of the Calories derived from protein, fat, carbohydrate, and bread.

TABLE II

	Number of Samples	Per cent. of Calories	Per cent. of Calories from Protein	Per cent. of Calories from Fat	Per cent. of Calories from Carbohydrate	Per cent. of Calories from Bread
Father	16	25.7	12.5	37.5	50.0	21.7
Mother	16	19.8	12.3	35.7	52.0	23.1
Boy 14+	2	22.3	10.8	34.9	54.3	27.2
Girl 14+	3	19.8	11.4	34.5	54.1	20.8
Child 12+	7	23.0	11.0	30.4	58.6	28.9
" 10+	11	20.1	11.0	37.2	51.8	21.2
" 8+	5	17.9	10.7	32.9	56.4	22.3
" 6+	5	16.7	10.8	29.7	59.5	24.8
" 3+	11	15.0	12.2	31.2	56.6	21.1
" 2+	1	6.9	12.7	44.4	42.9	19.7
" 1+	3	12.1	9.8	35.1	55.1	18.9
" 0+	1	4.0	8.9	38.6	52.5	—
Average per man-value	—	—	11.7	34.9	53.4	22.3

It will be noticed that the father has more than the average man-value percentage of protein and fat, and less of carbohydrate and bread, while the children at two periods of rapid growth have high percentages of carbohydrate. Table III shows the consumption of the father expressed as a percentage over or under the average man-value consumption of each family on the Cathcart scale in total Calories, protein, fat, and carbohydrate.

TABLE III

Family Reference Number	Percentage Over or Under Man-value			
	Total Calories	Protein	Fat	Carbohydrate
2	-17.14	-15.18	-21.83	-15.82
3	-38.17	-38.88	-38.16	-38.06
4	-6.55	-9.39	+0.97	-8.83
5	-11.99	+2.32	+10.45	-33.30
6	+3.41	+16.96	+14.28	-8.18
7	-2.22	+1.19	-6.83	-0.32
8	-1.52	+0.93	+1.79	-4.44
9	-2.33	+8.32	-2.89	-4.04
10	-13.27	+5.19	+20.31	-34.98
11	-1.87	+30.13	+26.22	-28.21
12	+11.92	-1.09	+13.48	+13.02
13	-2.00	-6.21	+10.34	-8.03
14	-2.53	+16.22	+3.47	-10.38
15	+27.68	+23.75	+30.36	+26.80
16	+18.44	+19.98	+25.95	+11.67
17	+18.87	+29.54	+7.62	+27.20
Average of 16 Fathers	-1.20	+5.24	+5.97	-7.24

Though the sixteen fathers fall slightly below the average man-value consumption of total Calories, owing to Nos. 2

and 3 being unemployed, yet their consumption of both protein and fat is over 5 per cent. above the average man-value consumption. Table IV gives the same facts for the sixteen mothers.

TABLE IV

Family Reference Number	Percentage Over or Under Man-value			
	Total Calories	Protein	Fat	Carbohydrate
2	+8.30	+2.40	+15.95	+6.77
3	-16.63	-17.00	-24.92	-10.82
4	-16.96	-24.22	-17.29	-15.46
5	-19.12	-22.41	-19.89	-17.82
6	-17.42	-8.43	-10.45	-24.97
7	-24.09	-20.74	-19.31	-27.47
8	-26.70	-29.83	-29.84	-26.56
9	-28.33	-18.02	-25.74	-36.88
10	-34.29	-32.72	-34.69	-34.41
11	-29.40	-28.62	-24.25	-33.02
12	-19.55	-30.74	-3.37	-28.74
13	-30.43	-19.51	-36.13	-29.57
14	-32.58	-21.13	-16.21	-43.90
15	-14.81	-1.73	-18.43	-15.64
16	-38.89	-35.33	-39.83	-38.92
17	-41.48	-28.95	-47.35	-39.40
Average of 16 mothers	-23.90	-21.25	-21.93	-26.07

The average Calorie consumption of the sixteen mothers instead of being 17 per cent. below the average man-value is practically 24 per cent., the consumption of carbohydrate being 26 per cent. below the man-value average. Comparing the sixteen families as to Calorie consumption per man-value, per father and per mother, we have Table V, column (b) showing the proportion each parent consumed of the man-value amount.

TABLE V

Family Reference Number	Calories per Man-value (Cathcart Scale)	Father		Mother	
		(a) Calories consumed	(b) Proportion of Man-value	(a) Calories consumed	(b) Proportion of Man-value
2 } Father unemployed	3,179	2,634	0.83	3,443	1.08
3 }	2,135	1,320	0.62	1,780	0.83
4	2,441	2,281	0.93	2,027	0.83
5	2,510	2,209	0.88	2,030	0.81
6	3,456	3,574	1.03	2,854	0.83
7	2,706	2,646	0.98	2,054	0.76
8	3,229	3,180	0.98	2,367	0.73
9	5,454	5,327	0.98	3,909	0.72
10	2,893	2,509	0.87	1,911	0.66
11	2,833	2,780	0.98	2,000	0.71
12	3,667	4,104	1.12	2,950	0.80
13	3,342	3,275	0.98	2,325	0.70
14	2,376	2,316	0.97	1,602	0.67
15	3,450	4,405	1.28	2,939	0.85
16	3,227	3,822	1.18	1,972	0.61
17	3,529	4,195	1.19	2,065	0.59
Average ...	3,152	3,161	0.99	2,389	0.76
Standard deviation	744	991	—	627	—
Coefficient of Variation	23.61	31.35	—	26.25	—

If we neglect families 2 and 3, where the father is unemployed and the food distribution is abnormal, we find the percentage of the total Calories consumed by father and mother as in Table VI.

TABLE VI

Family Reference Number	Number in Family	Percentage of Total Calories Consumed by	
		Father	Mother
4	4	28.9	25.7
5	4	24.9	22.9
6	4	23.9	19.1
7	5	22.6	17.5
8	5	24.4	18.1
9	5	26.0	19.1
10	7	22.6	17.2
11	6	20.7	14.9
12	6	25.1	18.0
13	4	33.5	23.7
14	5	22.5	15.6
15	5	29.3	19.5
16	6	34.2	17.7
17	4	34.6	17.1
Average	...	26.66	19.01
Standard Deviation	...	4.50	2.97
Coefficient of Variation	...	16.87	15.62

These fourteen families have the average man-value figure of 3,222 C. The percentage of the food consumed by the different members, and that in turn expressed as a proportion of the father's percentage, is shown in Table VII.

TABLE VII

Member	Fourteen Employed Families		
	Number of Samples	Percentage of Total Food	Father as Unit
Father	14	26.66	1.00
Mother	14	19.01	0.71
Boy 14+	1	23.90	0.90
Girl 14+	3	19.83	0.74
Child 12+	6	23.12	0.87
„ 10+	11	20.11	0.75
„ 8+	5	17.86	0.67
„ 6+	5	16.66	0.62
„ 3+	8	15.21	0.57
„ 2+	1	6.90	0.26
„ 1+	1	12.20	0.46
„ 0+	1	4.00	0.15
	70		

This shows the consumption of the adult woman to be 0.71 of the man, a figure which tallies with that actually found by Cathcart and Murray, not 0.83, as is usually accepted. The figures for the children are very near to the Cathcart scale at the ages when there are more than one or two samples. In Table VIII the individuals in each family have also all been expressed as proportions of the father, and each family added up on this scale,

as well as on the Atwater, Inter-Allied, Cathcart, and 1932 international scales.

TABLE VIII

	Man-value				
	Atwater Scale	Inter-Allied Scale	Cathcart Scale	International Scale	Found
No. of persons, 81	55.00	63.71	62.33	57.00	64.85
Man-value per 100 persons	68	79	77	70	80

The sixteen families were tested on three of these scales to see whether the difference shown was of any significance, with the following result:

TABLE IX

	Cathcart Scale (1)	International Scale (2)	Found (3)
Average man-value	3.898	3.563	4.053
Percentage of Error	±0.084	±0.075	±0.149
Standard Deviation	0.497	0.443	0.885

The difference between (1) and (2) and between (2) and (3) is just three times the error of the difference; between (1) and (3) the difference is quite insignificant.

In working out the above results no notice has been taken as to the nature of the father's work in assigning proportions of the "father-value" to the various members of the family. But that the father's food consumption does vary very widely with his work is shown when one expresses his consumption as a proportion of his wife's, the woman's work throughout being approximately equal.

TABLE X

Family No.	Occupation of Father	Proportion of Wife's Consumption
2	Unemployed	0.77
3	Unemployed	0.74
4	Casual labourer (unemployed one day)	1.13
5	Casual labourer (unemployed one day)	1.09
6	Hairdresser	1.25
7	Clerk	1.29
8	Bus conductor	1.34
9	Van driver	1.36
10	Blacksmith (little work)	1.32
11	Lavatory attendant	1.39
12	Labourer	1.39
13	Meat foreman	1.41
14	Leather dresser	1.45
15	Policeman	1.50
16	Engineer	1.94
17	Printer	2.03

These results are all worked out during what is admittedly a very short period of investigation, but they may be of sufficient value to form with the Cathcart and Murray results the basis of a new set of family coefficients based on actual observations. As already mentioned the data which formed the basis from which the above tables and scales have been worked out were collected in connexion with an investigation on the nutrition of children in rheumatic and non-rheumatic families in London for the Nutrition Committee under a grant from the Medical Research Council.