The Diets of Young Children

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The survey recorded here was made because information was required on the amount of ascorbic acid supplied by the normal diet of young children. The survey could have been confined to the foods containing ascorbic acid, but to avoid directing the housewife's attention especially to those foods it was thought better to collect information on the whole diet. The only published values then available for the diets of young children were those presented by Widdowson (1947) which were, however, collected before the war from a relatively small number of subjects belonging mainly to middle-class families. Our survey gave the opportunity of getting more up-to-date information for a more widespread sample of children.

METHODS

Sample. A representative sample of children was obtained by using the reference leaves of ration books in Newcastle upon Tyne, Pudsey, St Helens, Kidderminster, Coventry, Bristol, Colchester, Bournemouth, Wembley and Bermondsey. One hundred and fifty children in each of the five age groups, from 6 to 12 months and 1, 2, 3 and 4 years, that is 750 children in all, were selected. The method of selection has been described by Gray & Corlett (1950). Children taking any meals at nurseries, those not fully weaned and those in institutions were excluded at the interview stage; they represented 9% of the original sample. A further 14% could not be interviewed, mainly because they had left the address given on the ration book. Five hundred and eighty-one mothers were interviewed and asked to co-operate. Sixty-seven were unwilling or unable to do so and fifty-three were willing but failed to keep the record for the whole of the survey week. Four hundred and sixty-one complete records were thus obtained. The survey was made in April 1951. The above figures show that about 40% of the children originally selected are not represented in the final data. Of these, 23% were deliberately excluded for a specific reason or had left the district in which the survey was being made. These exclusions from the sample are not likely to cause any bias in the results. The remaining 17% were asked to participate but either could not or would not do so. No estimate can be made of the extent to which these defections caused bias in the results. It can, however, be stated that the field workers made every effort to enlist co-operation and offered all possible help to the mothers. A further survey, limited to the kinds of foods eaten, was made of 368 of the same children during 1 week in November 1951, but the results from that survey are

not being presented, as they add little to those from the April survey. The survey of April 1951 was preceded by a pilot survey, which showed that a food survey of young children was practicable.

Method of survey. A record of food consumption was kept by the mother of each child for 1 week. The method was similar to that described by Widdowson (1936) and Beltram & Bransby (1950). Briefly, the mother was provided with a record book, scales weighing in ½ oz. up to 8 oz., a measuring glass measuring up to 10 fl. oz., two standard tablespoons and two standard teaspoons. A field worker called on the mother and explained that all the child ate or drank was to be weighed or measured and the amounts were to be recorded. Any food wasted or left over was to be weighed or measured and recorded. The field worker showed the mother how to use the equipment provided and helped her to make a specimen record of the child's last meal. The mother was handed a letter from the local Medical Officer of Health explaining the purpose of the survey and asking for her co-operation. The letter was much appreciated by the mothers. The field worker called on the mother a number of times during the survey week to inspect the record and give any help required.

During the week of the survey information was collected from the mothers about the father's income* and occupation, the size of the family, whether the mother was working or not and the frequency of her attendances at a welfare centre.

Method of calculating the amounts of calories and nutrients. The amounts of calories and nutrients in the diets were calculated from the values given in *Nutritive Values of Wartime Foods* (Medical Research Council: Accessory Food Factors Committee, 1945), in *Chemical Composition of Foods* (McCance & Widdowson, 1946) and from recipes compiled in accordance with present food habits. The energy values were calculated as recommended in *Nutritive Values of Wartime Foods*. The vitamin A and carotene values were calculated in terms of preformed vitamin A, and an allowance was made for the cooking losses of vitamins, both as recommended in *Nutritive Values of Wartime Foods*.

RESULTS

Food consumption

Table 1 shows the average weekly consumption by all the children surveyed of the principal foods together with the percentage of children taking them during the survey week. The average consumptions of all the foods listed increased with age except those of milk, sugar, green and other vegetables, soup and gravy. Thus, in the week the average consumption of potatoes was 9·0 oz. at under 1 year rising to 20·6 oz. at 4; the corresponding figures for bread were 8·0 oz. and 25·3 oz., for meat, bacon and sausages 1·2 oz. and 8·5 oz., and for eggs 3·5 oz. and 6·2 oz. For milk the trend was in the opposite direction, the consumption falling from 91 oz. at under 1 to 77 oz. at 4.

There were great individual differences in the amount consumed. Thus, for children aged 4 the consumption during the week for those eating the food ranged, for bread

* Weekly income, less income tax, insurance payments and other deductions, excluding family allowances, including overtime, bonuses, pensions and other extra payments. The income used here is the net earnings of the head of the household and excludes income of any other members of the family and, for this reason, children's allowances.

from 6 to 61 oz., breakfast cereals from 1 to 42 oz., milk from 14 to 171 oz., cakes and biscuits from 2 to 47 oz., and potatoes from 1 to 40 oz.

Table 1. *Mean consumption during the survey week of various foods by* 461 *English children in April* 1951, *and the percentage of children eating the various foods during the week*

Food	Mean amount consumed in 1 week by children aged					Number eating the food during the week of children aged				
	6–12 months (oz.)	1 year (oz.)	2 years (oz.)	3 years (oz.)	4 years (oz.)	6–12 months (%)	1 year (%)	2 years (%)	3 years (%)	4 years (%)
Bread	8·0	17·2	20·6	21·1	25·3	87	100	99	100	100
Breakfast cereals	5·2	9·1	7·1	6·9	6·9	84	90	79	84	79
Cakes and biscuits	7·4	10·3	11·9	13·4	15·7	96	99	100	99	97
Cheese	0·2	0·6	0·6	0·9	1·1	19	36	41	49	54
Cheese dishes	0	0·2	0·3	0·3	0·3	3	5	9	8	10
Eggs	3·5	5·3	6·8	6·2	6·2	83	93	96	99	96
Fats	3·3	5·5	5·7	6·1	6·5	89	99	100	100	100
Fish	1·8	2·2	3·1	3·1	3·5	55	64	75	74	74
Fruits and nuts	5·7	11·6	15·2	19·0	20·0	84	94	96	96	100
Meat, bacon and sausages	1·2	4·4	7·8	7·7	8·5	41	89	97	98	100
Milk	91·0	84·3	82·8	83·9	77·0	100	100	100	100	100
Potatoes	9·0	15·3	17·6	16·7	20·6	85	100	100	100	100
Preserves	0·8	1·8	2·0	2·7	2·9	48	82	85	85	90
Soup (thin) and gravy	4·8	5·3	4·6	4·6	4·5	80	85	82	81	76
Stew, puddings, pies and rissoles	2·8	4·0	3·1	4·0	4·8	45	62	60	69	65
Sugar	7·5	5·5	4·8	5·5	5·0	93	97	100	100	100
Sweets, puddings and milk sauces	12·1	14·9	16·1	16·8	19·7	91	98	99	100	97
Sweets	2·1	4·2	8·8	8·2	9·2	71	93	94	97	99
Vegetables, green	2·2	3·1	3·0	2·7	3·5	71	79	82	81	79
Vegetables, other	5·5	6·9	5·7	5·6	6·0	88	94	92	96	94

Intake of calories and nutrients

The average daily intakes of calories and nutrients are shown in Table 2.

Calories. The intake of calories increased from a daily average of 1080 Cal. for children under 1 to 1730 for children aged 4. On average, the daily calorie intake of boys was 130 Cal. more than that of girls.

For children of 1 and under, milk was the greatest single source of calories, providing 33% of the total for children under 1, and 17% for children aged 1. For older children milk provided from 11 to 13% of the calories. Bread, cakes and biscuits between them provided 19% of the calories for those under 1 and from 28 to 32% for older children. Sugar (11%) was an important source of calories for children under 1.

The average calorie value of food eaten was 43, 44, 47, 47 and 49 Cal./oz. at ages from 6 to 12 months, 1, 2, 3 and 4 years, respectively.

Protein. The average daily intake of animal protein was much the same, from 25 to 28 g, for children of all ages; the daily intake of vegetable protein increased from 10 g for children under 1 to 23 g for children aged 4. Animal protein represented 74% of the total protein intake of children under 1, 61% for children aged 1, and 55% for children aged 4.

Milk contributed 21 of the 28 g of animal protein taken daily by children under 1. Above that age the amount supplied by milk decreased to from 10 to 12 g, but meat and bacon became more important, contributing between them from 4 to 7 g a day. Eggs and fish each provided from 2 to 3 g daily. Stews and meat puddings together provided from 1 to 2 g a day. At each age about 60% of the vegetable protein was derived from bread, cakes and biscuits.

Table 2. *Mean daily intakes of calories and nutrients by* 461 *English children during the survey week in April* 1951

		Mean daily intake of children aged					Standard deviation of daily intake of children aged				
Nutrient	Unit	6–12 months	1 year	2 years	3 years	4 years	6–12 months	1 year	2 years	3 years	4 years
Calories	Cal.	1080	1330	1540	1590	1730	290*	430	410	380	370
Animal protein	g	28	25	27	27	28	7*	9	8	9	8
Vegetable protein	g	10	16	19	20	23	5	7	8	7	7
Fat	g	46	59	69	70	76	15*	20	18	19	19
Carbohydrate	g	131	160	185	194	214	44	55	60	51	51
Calcium	g	0·97	0·75	0·72	0·73	0·76	0·22*	0·27	0·23	0·25	0·19
Iron	mg	6·7	7·8	8·3	8·3	9·0	3·5	4·1	3·4	2·3	2·3
Vitamin A	i.u.	2160	2340	2290	2320	2380	910	820	930	870	840
Thiamine	mg	0·58	0·65	0·69	0·70	0·77	0·16*	0·23	0·20	0·18	0·17
Nicotinic acid	mg	2·7	4·4	5·4	5·8	6·6	1·2	1·7	1·7	1·9	2·1
Riboflavin	mg	1·18	0·99	1·02	1·01	1·03	0·27*	0·32	0·29	0·31	0·26
Ascorbic acid	mg	14·2	20·8	24·3	26·4	28·2	8·3	12·3	16·4	14·8	17·6

* Excludes two children with abnormally high intakes.

Fat. The average daily intake of fat increased with age from 46 g by children under 1 to 76 g by children aged 4. At all ages between a quarter and a third of the total fat was derived from butter, margarine, cooking fat or dripping. Under 1 year, milk provided a further 46%. For children under 1, milk, butter and margarine between them provided 33 of the 46 g. Between 1 and 4, cakes and biscuits provided from 7 to 9 g, milk from 11 to 13 g, meat from 5 to 9 g and fats from 18 to 22 g.

Carbohydrates. The intake of carbohydrates increased with age from a daily average of 131 g for children under 1 to 214 g for children aged 4. Carbohydrates were obtained from many foods. The most important single source from a year old upwards was bread, which provided about a quarter of the total. Under the age of 1, milk and sugar were equally important, both giving about a fifth of the total intake. Cakes and biscuits were the next most important source, providing from 14 to 17% of the total intake at all ages. Sugar and sweets together provided from 19 to 25%. Under the age of 1 sugar provided six times as much carbohydrate as sweets, but the proportion from sweets increased with age until at 4 the amount from sweets was slightly more than from sugar.

Proportion of the calorie intake derived from fat, protein and carbohydrate. On the average children over 1 obtained 12% of their calorie intake from protein, 40% from fat and 48% from carbohydrate. Children under 1 year obtained slightly more calories from protein and correspondingly less from fat.

Calcium and iron. The average daily calcium intake was about 1 g for children under 1 and about 0·75 for older children. Milk accounted for most of the calcium. Together, the milk drunk and that used in made-up dishes provided over three-quarters of the calcium intake of children under 1 and about 60% of those aged 4. Calcium in bread and cakes provided 7% of the intake under 1, and the proportion increased steadily, reaching 22% at the age of 4.

The average daily intake of iron increased from about 7 mg at under 1 to 9 mg at 4. Breakfast cereals were the greatest single source of iron for children under 2, providing daily 3 mg for children under 1 and 2 mg for children aged 1. The large contribution made by cereals was due not so much to the amount eaten as to the use of special 'baby cereals' fortified with iron. After the age of 2, bread was the most important single source, providing about 20% of the total intake, followed by meat with about 15%. For the older children cakes and biscuits provided a further 9–12%. Eggs provided from 7 to 9% of the iron intake at all ages. Apart from these specific sources, iron was obtained in small amounts from many foods.

Vitamin A. The vitamin A intake from the normal diet, special vitamin supplements being excluded, varied little with age. Over the whole range, the average daily intake was about 2300 i.u. calculated as preformed vitamin A (see Medical Research Council: Accessory Food Factors Committee, 1945). Under 1, milk was the most important source and provided 40% of the vitamin intake, and fats provided about 25%. For older children, fats were the most important source, providing about a third of the intake, although milk provided about a fifth. Root vegetables (11–18%) and eggs (7–11%) were other useful sources.

Just over a quarter of the sample of children received Ministry of Food cod-liver oil during the survey week. The daily vitamin A intake from Ministry of Food cod-liver oil of those taking it increased on the whole with age, from 2500 i.u. at under 1 to 4050 i.u. at 4.

Thiamine. The average daily intake of thiamine increased with age from 0·58 mg at under 1 to 0·77 mg at 4. Under 1, milk was the most important source, but from 2 upwards bread was the most important. For 1-year-olds milk and bread were equally important. Nearly half the thiamine in the diet of those under 1, and between a fifth and a quarter of that of older children, came from milk. Children aged from 2 to 4 obtained over a quarter of their thiamine from bread. One-year-olds obtained about a quarter of their thiamine from bread. Children aged 1 and under obtained from 9 to 14% of their total thiamine from cereals, mainly from special baby cereals.

Nicotinic acid. The average daily intake of nicotinic acid increased from 2·7 mg at under 1 to 6·6 mg at 4. There was no outstanding source of nicotinic acid for children under 1. For children aged from 1 to 4 a quarter of the total intake came from bread and about a quarter from fruit. Meat provided from 12 to 18% and potatoes from about 8 to 10%.

Riboflavin. There was little variation with age in the average daily intake of about 1·0 mg. The most important dietary source at all ages was milk, which accounted for about three-quarters of the total intake of children under 1 and about half that of older children. Bread and eggs each accounted for about 10% of the intake of

children aged from 1 to 4, and meat gave nearly the same amount to children aged 2 and upwards.

Ascorbic acid. The average daily intake from the normal diet increased from 14 mg at under 1 year to 28 mg at 4. Children whose mothers went to work had an average intake about 7 mg a day greater than children whose mothers did not. On average about 5 mg a day were obtained from Ministry of Food orange juice and 2 mg a day from other vitamin preparations. The most important dietary source of ascorbic acid for children under 1 was milk, and for older children citrus fruit.

Social characteristics of children with high and low intakes of calories and nutrients

An attempt was made to assess roughly how far the individual diets were high or low in at least one nutrient. For this purpose the intakes of calories and each nutrient were graded according as they fell below the lower quartile, between the lower and upper quartiles or above the upper quartile. The appropriate quartiles were used for each age group, thus allowing for the increase of nutrient intake with age. The values for calories, protein, calcium, iron, vitamin A, thiamine, nicotinic acid, riboflavin and ascorbic acid were thus treated. Each child was then given a score according to the calorie and nutrient intakes in relation to the quartile position. A score of +1 was given for every intake, calorie or nutrient, that fell above the upper quartile and of −1 for every intake that fell below the lower quartile. Thus, if a child's intakes of all nine nutrients fell above the upper quartiles the score would be +9; if they fell below the lower quartiles the score would be −9. A child whose intakes of three nutrients fell above the upper quartiles and whose intakes of two nutrients fell below the lower quartiles would receive a score of +1, the other four nutrients that fell between the upper and lower quartiles contributing zero to the score.

On treating the data in this way it became apparent that the number of children with 'high' intakes or with 'low' intakes of several nutrients, including calories, was considerably more than would be expected by chance. Thus, the percentages of children expected by chance to have scores of from −4 to −9 or from +4 to +9 is 4·8 in each instance. The percentages found in these ranges were however 24·1 and 22·6, showing that there was a marked tendency for children's diets to be 'high' in calories and most nutrients or 'low' in calories and most nutrients.

The children in each age group were then divided into three groups, low, medium and high, according to their total score, the groups being so arranged as to give 25, 50 and 25%, respectively, of the children in them. The average scores obtained by children of different ages in the low, medium and high groups showed no differences, and the data for children of all ages were therefore considered together.

The children in the low, medium and high groups were then grouped according to certain social characteristics, and it became possible to compare the percentage of children with particular social characteristics falling into the high, medium and low groups.

Table 3 shows the results of the analysis. Compared with expectations based on chance, a larger proportion of children in the group with a family income under £5 a week and a smaller proportion of those in the group with a family income of £10

a week were graded high. The converse was not true, however, as slightly fewer of the high-income groups and slightly more of the low-income groups than would be expected were graded into the low group. In other words, the lower income groups tended to the extremes while the high-income groups tended towards the mean. More only children were graded low and almost the same proportion was missing from the high group. Children with one brother or sister tended towards the medium group, whereas those with more than one brother or sister tended to be in the high group. Boys tended to be graded high and girls low. Those whose mothers went out to work tended to be graded high.

Table 3. *Relationship between some social characteristics and low, medium and high intakes of calories and nutrients for* 461 *English children during the survey week in April* 1951

Social characteristic	No. of children	Proportion of the children whose intake was: Low (%)	Medium (%)	High (%)
Weekly income of father				
Up to £5	30	30	22	48
£5 to £7. 10s.	229	28	46	26
£7. 10s. to £10	131	21	58	21
£10 or more	40	23	64	13
No. of children under 16 in family				
1	142	31	50	19
2	196	21	54	25
3 or more	123	26	42	32
Sex				
Boy	234	22	49	29
Girl	227	28	51	21
Mother working				
Yes	36	18	42	40
No	425	26	50	24
Occupation of father				
Unskilled operative	93	27	41	32
Skilled operative	193	28	50	22
Non-manual worker	129	22	55	23
Mother attends a welfare clinic				
Yes	169	27	52	21
No	292	24	49	27

For definition see p. 200. The low, medium and high groups were so arranged as to give 25, 50 and 25 % respectively, of all the children in them.

On the whole, therefore, boys, those in large families and those whose mothers went out to work tended to have an intake of calories and nutrients higher than average. Also those in the lower income groups tended to have an intake of most nutrients higher than average, although a substantial proportion had an intake of most nutrients lower than average. Girls, only children and those whose mothers did not go out to work tended to have an intake of most nutrients lower than average, and there was a tendency for children's intakes of most nutrients to become similar to the average as the family income increased.

Analysis of the results for food consumption showed that the amounts of bread, cakes and special baby cereals eaten increased similarly with declining family income

and increasing number of children in the family. If the additional intakes of calories and nutrients from these three sources are subtracted from the total intakes, the remaining intakes of calories and nutrients vary little with either income or number of children in the family, although there is still a tendency for only children to take slightly less of most of the other foods with a correspondingly smaller intake of calories and nutrients. In general, boys had a greater consumption of most foods than girls, which accounted for their greater intake of calories and nutrients.

DISCUSSION

The present survey provides information on the food consumption and food habits of a sample of young children in England. As is found in all food surveys, there were great individual variations between children for which no adequate explanation can be given. The children included in the study appeared to be normal healthy children, most of whom had attended welfare centres, and the standard of parental care appeared to be generally high.

There is little to be gained by commenting in detail on the various tables. A striking feature, however, is the importance of milk as a source of calories and nutrients, especially for the younger children. Between the ages of 1 year and 5 there is a change in dietary pattern, which up to the age of 3 is rapid; later the pattern tends to conform with that of older children and adults.

Comparison of the calorie and nutrient intakes with those found by Widdowson (1947) before the war for a group of mainly middle-class children shows that the intake of calories by children aged 1 and 2 was higher in the present than in the prewar survey, whereas for the other ages it was much the same. The intakes of protein were also much the same in the two surveys. The intake of iron of those aged from 1 to 2 was higher in the present survey, but iron intakes for the other ages were similar. The intakes of fat and thiamine were somewhat greater in the present survey, that of calcium was slightly less and those of vitamin A and ascorbic acid substantially less. The prewar consumption of milk was somewhat greater than that found in the present survey.

Recently the British Medical Association (1950) has made recommendations on the requirements of calories and nutrients, and the Food and Agriculture Organization of the United Nations: Committee on Calorie Requirements (1950) on calorie requirements. The recommendations by the two authorities on the calorie requirements of children are in close agreement.

For children aged from 6 to 12 months, 1, 2, 3 and 4 years in our study the intakes of calories, iron, vitamin A (including supplements), thiamine, riboflavin and ascorbic acid (excluding supplements) exceeded, on average, the amounts recommended by the British Medical Association. The intakes of protein by children aged from 2 to 4 were from 9 to 18% below the recommended amounts, the intake of calcium by children aged from 1 to 4 was about 25% below, and the intake of nicotinic acid was about 15% below for children under 1, the extent of the deficiency falling to about 5% at age 1. For children over 1, the average intake of nicotinic acid exceeded the recommended level. Whether or not any improvement in nutritional state would result from greater

intakes of those nutrients whose amounts are below the British Medical Association's standards is open to question. It is, however, important to ensure that the consumptions of protein and calcium by these young children is not decreased.

The survey showed that, even at the young ages studied, boys had more food and greater calorie intakes than girls. The observation is consistent with the finding of Gore & Palmer (1949) that among London pre-school children the weights of boys were greater than of girls, the difference having developed at least by the age of from 2 to 5 weeks. The present finding that children whose mothers went to work consumed more calories and other nutrients than those whose mothers did not also is of interest in view of the report by the Chief Medical Officer of the Ministry of Health (1953) that schoolboys whose mothers went to work were on average heavier than those whose mothers did not. In that study no data were collected on the actual intakes of calories and nutrients.

The finding that intakes of calories and nutrients tended to be higher for children belonging to large families and to low-income groups is unexpected. The differences were due mainly to greater consumptions of bread, cakes and cereals. Unfortunately, there are no figures for heights and weights. No explanation can be offered for the findings. It may be noted that a survey of the diets of schoolboys made in 1949 (Beltram & Bransby, 1950) showed the consumption of bread and breakfast cereals to be greater, but that of cakes to be less, by children belonging to families with other children than by only children.

In retrospect, it is regretted that the body-weights of the children were not measured. The question cannot, therefore, be answered how far the individuals who ate less may have had a lower requirement because of their smaller body-weight, so that their low intake of all nutrients was not necessarily to be regarded as insufficient.

SUMMARY

1. A survey was made in April 1951 of the diets of 461 children aged over 6 months and under 5 years living in ten localities in England.

2. There were considerable differences between the food consumptions by individual children, but for all the principal foods except milk, sugar, green and other vegetables, soup and gravy, the average consumption increased with age.

3. The average daily intake of calories increased from 1080 Cal. for children aged under 1 to 1730 for children aged 4. The corresponding figures for protein were 38 and 51 g, for fat 46 and 76 g, calcium 0·97 and 0·76 g, iron 6·7 and 9·0 mg, vitamin A 2160 and 2380 i.u., thiamine 0·58 and 0·77 mg, nicotinic acid 2·7 and 6·6 mg, riboflavin 1·18 and 1·03 mg, and ascorbic acid 14·2 and 28·2 mg.

4. Generally, boys, those in large families, those whose mothers went out to work and those in the lower income groups tended to have intakes of calories and nutrients higher than average. Girls, only children and those whose mothers did not go out to work tended to have intakes of most nutrients lower than average. For individual children there was a tendency for the weight of food eaten and the intakes of calories and all nutrients generally to be high or low and not for high intakes of some nutrients to be associated with low intakes of others.

5. For children aged from 6 to 12 months, 1, 2, 3 and 4 years, intakes of calories, iron, vitamin A (including supplements), thiamine, riboflavin and ascorbic acid (excluding supplements) exceeded on average the intakes recommended by the British Medical Association. The intake of protein by children aged from 2 to 4 years was below the recommended amount by from 9 to 18%, the calcium intake of children aged from 1 to 4 by about 25%, and the nicotinic-acid intakes for children aged under 1 by about 15%; the extent of this last deficiency fell to about 5% at age 1.

We are glad to express our appreciation to the field workers and office staff of the Government Social Survey for their valued help and to the Medical Officers of Health of the localities where the survey was made for sending a letter to the mothers of the selected children to explain the purpose of the survey.

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