A SURVEY OF THE NUTRITIONAL STATUS OF SCHOOLCHILDREN

Relation between Nutrient Intake and Socio-economic Factors

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This study was designed to examine the dietary intake of schoolchildren, to investigate its relationship to health and socio-economic factors, and to explore the extent and nature of poor nutrition. The techniques employed were based on those used by the Ministry of Health (1968) in their study of pre-schoolchildren. The reliability and problems of these have been discussed previously (Topp, Cook, and Elliott, 1972).

The following information was sought for each child participating in the study:

(1) a one-week weighed diet record closely supervised by a trained fieldworker (Topp *et al.*, 1972);

(2) a socio-economic questionnaire* administered by the same fieldworker. This included information on family structure, father's occupation, mother's education and working status, the child's health history and eating pattern, and the parents' heights;

(3) a medical examination to assess clinically the nutritional status of the child, to look for clinical evidence of vitamin deficiency, and to obtain measurements of height, weight, triceps and subscapular skinfold thickness, arm circumference, and peak expiratory flow rate (PEFR). The medical assessments were carried out by one of two medical officers who were trained together and frequently discussed criteria in the field in order to minimize variation in both the measurement techniques and the clinical assessment.

This paper will not discuss the findings of the medical examination, which will be reported separately. But it should be mentioned here that no overt clinical evidence of nutritional deficiency was found in any child.

SAMPLE

The sample was drawn from children who had taken part in the Kent Schoolchild Respiratory Survey (Holland, Halil, Bennett, and Elliott, 1969). It consisted of 1,298 children residing in four areas of Kent and attending Local Authority schools in those areas. The areas presented a cross-section of urban and rural characteristics.

Children born in 1953-54 and 1958-60 were included in the sample which was stratified by social class, family size, and weight (as recorded in the earlier study). The sampling fractions were higher for children from larger families and from lower social classes, and also for children with no father, in order to have adequate numbers in those groups suspected of having the greatest likelihood of deficiency. Children were drawn randomly from each family size and social class group, and where the number in the cell was large enough half of the sample was taken from the 20% of children with the lowest weight (Table I), again to maximize the chances of detecting deficiencies.

Of the original sample, 1,017 were found to be eligible for inclusion in the study (Table II). Reasons for ineligibility included removal from the area or schools in the area, leaving school, the death of the mother (and no permanent mother substitute), attendance at a special or private school, illness at the time of the study, and, very rarely, the death of the child. The ineligible children were excluded from all the analyses.

FIELDWORK AND DATA PREPARATION

The study took place between September 1968 and March 1970. The diet recording and socio-economic questionnaire were completed during the same week and the medical examination was completed within a three-month period before or after this.

*Copies of this questionnaire may be obtained from the authors.

TABLE I

NUMBERS IN POPULATION AND STUDY SAMPLE BY AGE, SEX, SOCIAL CLASS, AND NUMBER OF SIBLINGS

(a) FEMALES 8-11 YEARS

No. of Siblings	Social Class I-II		Social Class III		Social Class IV-V		Fatherless		Total	
	Popn.	Sample	Popn.	Sample	Popn.	Sample	Popn.	Sample	Popn.	Sample
0	30	19	86	17	23	23	5	5	144	64
1,2	220	20*	585	20*	197	38*	13	13	1,015	91
3,4	55	19	151	30*	75	35	5	5	286	89
5+	9	9	51	39	31	31	—	—	91	79
Total	314	67	873	106	326	127	23	23	1,536	323

(b) MALES 8-11 YEARS

No. of Siblings	Social Class I-II		Social Class III		Social Class IV-V		Fatherless		Total	
	Popn.	Sample	Popn.	Sample	Popn.	Sample	Popn.	Sample	Popn.	Sample
0	29	19	74	16	25	25	6	6	134	66
1,2	265	20*	642	20*	216	38*	13	13	1,136	91
3,4	63	19	139	30*	75	35	7	7	284	91
5+	3	3	40	31	45	45	1	1	89	80
Total	360	61	895	97	361	143	27	27	1,643	328

(c) FEMALES 13-15 YEARS

No. of Siblings	Social Class I-II		Social Class III		Social Class IV-V		Fatherless		Total	
	Popn.	Sample	Popn.	Sample	Popn.	Sample	Popn.	Sample	Popn.	Sample
0	20	20	34	17	10	10	4	4	68	51
1,2	82	21	253	16*	87	47	10	10	432	94
3,4	22	20	96	34	58	47	6	6	182	107
5+	2	2	37	37	26	26	5	5	70	70
Total	126	63	420	104	181	130	25	25	752	322

(d) MALES 13-15 YEARS

No. of Siblings	Social Class I-II		Social Class III		Social Class IV-V		Fatherless		Total	
	Popn.	Sample	Popn.	Sample	Popn.	Sample	Popn.	Sample	Popn.	Sample
0	14	13	44	16	13	13	8	8	79	50
1,2	88	22*	237	16*	79	48	9	8	413	94
3,4	27	20	83	32	54	47	4	4	168	103
5+	8	8	49	34	33	33	3	3	93	78
Total	137	63	413	98	179	141	24	23	753	325

*In these cells half of the sample was drawn from the lowest quintile by weight and the other half from the upper four quintiles

TABLE II
NUMBERS OF CHILDREN IN EACH AGE-SEX GROUP

			Male	Female	Total
Age 8-11	a	..	328	323	651
	b	..	258	244	502
	c	..	201	195	396
Age 13-15	a	..	325	322	647
	b	..	259	256	515
	c	..	191	191	382
Total	a	..	653	645	1,298
	b	..	517	500	1,017
	c	..	392	386	778

a=original sample; b=eligible for study; c=participating in study

The fieldwork was carried out by a team of 18 health visitors, district nurses, and midwives from the Kent County Council Health Department. Close supervision of the fieldwork and the standard of diet recording was maintained by the two dietitians. The methods of data preparation have been described (Topp *et al.*, 1972).

INVESTIGATION OF THE REFUSAL GROUP

The diet record was an essential part of the data required for the study. If the diet record had not been completed a child was considered to belong to the refusal group irrespective of whether or not the other parts of the study had been satisfactorily completed. Of 1,017 eligible children, 239 refused according to this criterion (Table III). Reasons given to the fieldworkers for refusal to cooperate in the study are given in Table IV.

The response rate of 76.5% (of those eligible) is high for a study of this nature. This is thought to be largely due to the enthusiasm and perseverance of the fieldworkers, and to the interest aroused among parents in the health and nutrition of their children. However, it is essential to examine the characteristics of the refusers as they may be an atypical group.

TABLE III
PERCENTAGE OF CHILDREN COOPERATING, PARTIALLY COOPERATING, AND REFUSING TO PARTICIPATE IN THE STUDY (NUMBERS IN PARENTHESES)

Complete cooperation*	72.0% (732)	} 76.5% (778) cooperated
Diet record and socio-economic questionnaire completed only	4.5% (46)	
Diet record not completed	14.3% (145)	} 23.5% (239) refused
No information obtained	9.2% (94)	

*Children for whom a diet record, socio-economic questionnaire, and medical examination were all obtained

TABLE IV
REASONS GIVEN TO FIELDWORKERS FOR REFUSAL TO PARTICIPATE IN THE NUTRITION STUDY

Mother too busy or could not cope	..	..	49 (20.5%)
Domestic or emotional problems	..	..	29 (12.1%)
Already taken part in a survey (either the earlier respiratory study or the pilot study) or already had a child in the nutrition study	..	..	23 (9.6%)
Refused specifically because of food record	..	..	17 (7.1%)
Child overweight	..	..	7 (2.9%)
No reason given	..	..	114 (47.7%)
Total	..	..	239 (99.9%)

For families refusing to participate an attempt was made to collect data on social class, family size, and mother's work status at the time of the fieldworker's visit. This information was obtained from 153 of the 239 who refused (64%). In addition, there was a large amount of data on participants and non-participants available from the earlier respiratory study carried out in 1964-65.

The distributions of sex, age, height, weight, PEFR, social class, number of siblings, and mother's work status were very similar in the two groups. None of the differences was statistically significant ($P > 0.05$).

NUTRIENT INTAKE COMPARED WITH RECOMMENDED ALLOWANCES

Means and standard deviations of daily intake were calculated for nutrients given in the Department of Health and Social Security's recommended intakes (DHSS, 1969) for the corresponding age-sex groups. Both sets of data are shown in Table V.

For all groups the energy intake (kilocalories) was below the recommended level, notably for the older girls. Intake of vitamins A and C was much higher than that recommended. Intake of calcium was also high, particularly for the boys. Intake of the other nutrients quoted corresponds fairly closely to DHSS recommended levels. However, the suggestions of the Panel on Recommended Allowances were based partly on 1947 figures for energy intake and energy expenditure. As energy expenditure may well have diminished appreciably due to increased transport facilities and sedentary amusements (especially television) the recommended values may represent too high an energy intake for current conditions.

It should be noted that the study sample was stratified by social class, family size, and weight (Table I); in Table V no adjustment has been made for these weighting factors. In order to measure the bias in the figures in Table V study means and population

TABLE V
COMPARISON OF AVERAGE DAILY NUTRIENT INTAKE WITH DHSS RECOMMENDATIONS (1969)

		Energy (kcal)	Protein (g)	Thiamin (mg)	Riboflavin (mg)	Nicotinic Acid (mg)	Vit C (mg)	Vit A (i.u.)	Vit D (i.u.)	Calcium (mg)	Iron (mg)	Number of Children
Child 7-8	Rec.	2,100	53	0.8	1.0	11	20	1,333	100	500	10	8
	Mean	2,049	59	0.9	1.4	10	42	2,875	110	904	10	
	SD	286.1	12.1	0.14	0.31	2.7	17.5	890.7	103.6	160.1	2.1	
Boys 9-11	Rec.	2,500	63	1.0	1.2	14	25	1,917	100	700	13	198
	Mean	2,278	65	1.1	1.6	12	49	3,258	104	996	11	
	SD	411.5	13.3	0.30	0.47	3.6	26.5	1,630.6	111.8	244.3	2.8	
Boys 12-14	Rec.	2,800	70	1.1	1.4	16	25	2,417	100	700	14	124
	Mean	2,771	76	1.2	1.7	15	56	3,899	116	1,038	14	
	SD	567.0	15.6	0.30	0.58	4.3	27.3	2,795.5	82.6	298.5	3.2	
Boys 15-17	Rec.	3,000	75	1.2	1.7	19	30	2,500	100	600	15	67
	Mean	2,875	80	1.3	1.8	16	61	3,825	123	1,085	15	
	SD	478.3	14.5	0.27	0.57	3.6	26.0	2,337.1	91.0	280.5	3.2	
Girls 9-11	Rec.	2,300	58	0.9	1.2	13	25	1,917	100	700	13	190
	Mean	2,005	56	0.9	1.4	10	45	3,189	102	873	10	
	SD	384.0	12.1	0.29	0.48	2.7	21.8	1,779.8	125.1	243.4	2.7	
Girls 12-14	Rec.	2,300	58	0.9	1.4	16	25	2,417	100	700	13	110
	Mean	2,067	58	0.9	1.3	11	54	3,454	107	759	12	
	SD	432.5	12.7	0.22	0.43	3.0	52.2	2,138.0	130.9	215.3	8.9	
Girls 15-17	Rec.	2,300	58	0.9	1.4	16	30	2,500	100	600	14	81
	Mean	2,046	59	0.9	1.3	12	44	3,115	87	777	11	
	SD	432.9	14.0	0.56	0.60	4.1	16.3	2,403.9	72.6	238.3	2.6	

Rec. = DHSS recommended intake; SD = standard deviation
Note: Children in this study were in the age ranges 8-11 and 13-15 only

estimates were calculated for the four age-sex groups (as shown in Table I). The differences were of the order of 1%. Study means are given in Table V as the nature of the stratification prevents the calculation of population estimates for the small age ranges used by the DHSS.

NUTRIENT INTAKE AND SOCIO-ECONOMIC FACTORS

Analyses were undertaken to explore the influence of various factors on nutrient* intake using multiple regression so that the independent influence of each factor could be examined.

Factors considered were sex, age, weight, social class, number of siblings, and mother's work status. For these analyses the 8 to 11-year-olds were considered as one age group and the 13 to 15-year-olds as another: age was not treated as a continuous variable. Only 696 children were included in the regression as 82 children of unknown social class or with no father were excluded.

Sex, age, and weight were all found to be associated with highly significant differences in average daily nutrient intake for nearly all nutrients (Tables VI and VII). For all nutrients the boys had a higher

intake than the girls. The older children had a higher intake than the younger, and the heavier children had a higher intake than the lighter.

Social class, number of siblings, and mother's work status were not in general found to be associated with highly significant differences in average daily nutrient intake. However, animal protein and riboflavin intake fell significantly from the higher to the lower social classes and from smaller to larger families. This may have some link with the differences in height and weight of the same population of children by social class and family size found in the examination of data from the earlier respiratory survey (Topp, Cook, Holland, and Elliott, 1970).

The previous analyses were repeated replacing average daily nutrient intake by average daily nutrient intake/1,000 kcal. The results obtained were quite different (Tables VIII and IX). Sex and age differences were not marked and there was variation in the direction of differences in contrast to the consistent direction of variation shown in average daily nutrient intake (Table VI). In particular, calcium, thiamin, and riboflavin intake/1,000 kcal was higher for younger than for older children. Vitamin A intake/1,000 kcal was higher for the girls than for the boys. These differences were all highly significant. Also intake of fat/1,000 kcal was significantly higher for the older than for the younger age group, and intake of animal protein and carbohydrate/1,000 kcal was significantly higher for

*For convenience, added sugar is included in this group although it is not a nutrient. In this study added sugar was defined as 'any sugar as such added during cooking, preparation or manufacture, as distinct from the naturally occurring carbohydrate of the basic foods'.

A SURVEY OF THE NUTRITIONAL STATUS OF SCHOOLCHILDREN

TABLE VI
PREDICTED MEAN DAILY INTAKE OF NUTRIENTS BY SEX, AGE, WEIGHT, SOCIAL CLASS, NUMBER OF SIBLINGS,
AND MOTHER'S WORK STATUS, EACH ADJUSTED FOR THE OTHER FIVE VARIABLES IN THE FIRST COLUMN

Nutrient	Energy Value (kcal)	Animal Protein (g)	Total Protein (g)	Fat (g)	Carbo- hydrate (g)	Calcium (mg)	Iron (mg)	Vitamin A (i.u.)	Thiamin (mg)	Ribo- flavin (mg)	Nicotinic Acid (mg)	Vitamin C (mg)	Vitamin D (i.u.)	Pyri- doxin (mg)	Added Sugar (g)	Number of Children
Male	2543.4	44.33	70.90	106.50	344.4	1024.7	12.55	3483.7	1.156	1.690	13.62	52.53	111.35	1.328	113.19	355
Female	2024.5	36.05	56.82	86.56	269.6	811.9	10.45	3275.9	0.887	1.345	10.42	46.86	99.67	1.082	90.38	341
Age 8-11	2141.1	38.91	60.41	89.29	290.3	930.4	10.52	3219.0	0.998	1.526	11.06	46.24	104.07	1.117	97.35	352
Age 13-15	2440.7	41.67	67.67	104.34	325.6	910.2	12.54	3548.5	1.051	1.516	13.07	53.34	107.23	1.300	106.79	344
Lighter*	2179.2	38.68	60.72	92.31	292.7	868.3	11.17	3110.5	0.955	1.439	11.28	48.81	88.83	1.153	100.36	242
Heavier*	2347.8	41.12	65.74	99.09	315.8	948.2	11.70	3526.6	1.061	1.564	12.47	50.25	114.59	1.237	102.90	454
Social Class																
I-II	2316.5	42.89	65.80	101.67	300.9	930.4	11.73	3791.9	1.043	1.598	12.32	52.70	120.25	1.256	99.37	134
III A	2327.0	41.93	65.85	100.09	307.6	969.7	11.48	3507.7	1.096	1.730	12.32	47.60	93.69	1.194	99.87	50
III B	2273.2	39.41	63.38	95.31	307.6	908.7	11.66	3373.4	1.014	1.479	11.92	48.88	98.99	1.191	101.89	243
IV-V	2282.8	39.42	63.31	94.90	311.4	916.8	11.30	3160.4	1.010	1.481	12.04	49.46	106.48	1.199	103.85	269
No. of siblings																
0	2288.8	44.51	66.78	101.17	293.4	955.8	11.86	3929.7	1.037	1.678	12.36	56.90	107.86	1.285	98.68	93
1	2290.1	41.26	64.47	98.20	303.9	925.7	11.39	3280.5	1.009	1.509	11.99	52.07	104.69	1.214	100.86	132
2 or 3	2307.4	40.89	64.62	96.91	311.5	941.7	11.47	3332.5	1.032	1.534	12.06	47.91	99.17	1.212	103.93	222
4+	2272.6	37.61	62.15	94.13	311.8	885.4	11.51	3276.2	1.021	1.456	11.97	47.49	111.06	1.170	102.16	249
Mother's work status																
Not working	2303.0	39.82	63.53	97.22	310.8	930.7	11.45	3306.8	1.013	1.488	11.79	49.29	117.31	1.192	103.79	324
Part-time	2296.6	40.42	64.37	97.07	308.4	923.7	11.66	3536.1	1.049	1.563	12.33	49.72	95.15	1.225	98.02	257
Full-time..	2233.6	41.33	64.48	94.57	297.8	883.8	11.40	3248.7	1.005	1.518	12.19	51.11	96.14	1.212	101.56	115

*Lighter=children in the lowest quintile by weight; Heavier=children in the upper four quintiles by weight

TABLE VII
AVERAGE DAILY NUTRIENT INTAKE: SIGNIFICANCE OF DIFFERENCES BETWEEN AGE, SEX, WEIGHT, SOCIAL CLASS,
NUMBER OF SIBLINGS, AND MOTHER'S WORK STATUS GROUPS
(Children of unknown social class or with no father excluded from the regression)

Nutrient	Energy (kcal)	Animal Protein (g)	Total Protein (g)	Fat (g)	Carbo- hydrate (g)	Calcium (mg)	Iron (mg)	Vitamin A (i.u.)	Thiamin (mg)	Ribo- flavin (mg)	Nicotinic Acid (mg)	Vitamin C (mg)	Vitamin D (i.u.)	Pyri- doxin (mg)	Added Sugar (g)
Sex..	***	***	***	***	***	***	***	—	***	***	***	—	—	***	***
Age	***	***	***	***	***	***	***	—	***	***	***	—	—	***	—
Weight	***	***	***	***	***	***	***	—	***	***	***	—	—	***	—
Social Class	—	***	—	—	—	—	—	—	—	—	—	—	—	—	—
No. of siblings	—	***	—	—	—	—	—	—	—	—	—	—	—	—	—
Mother's work status	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

—=not significant; * = 0.05 > P > 0.01; *** = P < 0.001

TABLE VIII
PREDICTED MEAN DAILY INTAKE OF NUTRIENTS/1,000 kcal BY SEX, AGE, WEIGHT, SOCIAL CLASS, NUMBER OF SIBLINGS,
AND MOTHER'S WORK STATUS, EACH ADJUSTED FOR THE OTHER FIVE VARIABLES IN THE FIRST COLUMN

Nutrient/1,000 kcal	Energy Value (kcal)	Animal Protein (g)	Total Protein (g)	Fat (g)	Carbo- hydrate (g)	Calcium (mg)	Iron (mg)	Vitamin A (i.u.)	Thiamin (mg)	Ribo- flavin (mg)	Nicotinic Acid (mg)	Vitamin C (mg)	Vitamin D (i.u.)	Pyri- doxin (mg)	Added Sugar (g)	Number of Children
Male	2543.4	17.63	28.07	41.73	135.6	406.2	4.96	1368.0	0.458	0.671	5.37	20.99	43.64	0.527	44.48	355
Female	2024.5	17.91	28.20	42.63	133.3	401.3	5.19	1624.8	0.440	0.668	5.20	23.33	49.03	0.538	44.34	341
Age 8-11	2141.1	18.20	28.26	41.65	135.7	434.8	4.93	1509.0	0.466	0.713	5.17	21.73	47.94	0.523	45.46	352
Age 13-15	2440.7	17.33	28.01	42.71	133.2	372.0	5.22	1478.2	0.432	0.625	5.40	22.55	44.58	0.542	43.54	344
Lighter*	2179.2	17.81	27.93	42.21	134.6	399.5	5.15	1434.2	0.440	0.665	5.20	22.75	41.63	0.532	46.18	242
Heavier*	2347.8	17.75	28.25	42.15	134.4	406.0	5.03	1525.5	0.454	0.672	5.33	21.81	48.76	0.535	43.62	454
Social Class																
I-II	2316.5	18.64	28.55	43.77	130.1	404.4	5.09	1639.2	0.453	0.696	5.29	23.02	52.35	0.547	42.87	134
III	2327.0	18.22	28.51	42.98	132.0	418.5	4.94	1555.1	0.475	0.749	5.37	20.81	40.60	0.517	42.77	50
IIIB	2273.2	17.53	28.07	41.85	135.3	401.1	5.17	1492.1	0.446	0.653	5.27	21.90	42.94	0.530	44.75	243
IV-V	2282.8	17.46	27.91	41.50	136.4	403.2	5.00	1411.1	0.444	0.656	5.28	22.15	47.29	0.531	45.44	269
No. of siblings																
0	2288.8	19.62	29.34	44.15	128.2	418.0	5.21	1737.9	0.453	0.737	5.40	25.43	49.07	0.564	43.10	93
1	2290.1	18.15	28.27	42.89	132.6	404.9	5.01	1441.9	0.441	0.662	5.25	23.04	45.44	0.536	44.01	132
2 or 3	2307.4	17.95	28.22	41.97	134.8	409.7	5.01	1467.3	0.447	0.670	5.24	20.94	42.70	0.530	44.87	222
4+	2272.6	16.71	27.54	41.23	137.5	392.6	5.11	1454.0	0.452	0.648	5.29	21.49	48.88	0.521	44.98	249
Mother's work status																
Not working	2303.0	17.50	27.78	42.17	134.9	405.9	5.01	1454.8	0.442	0.652	5.13	21.85	51.64	0.523	44.91	324
Part-time	2296.6	17.74	29.01	42.14	134.5	403.8	5.11	1550.9	0.457	0.685	5.40	21.99	41.14	0.538	44.31	257
Full-time..	2233.6	18.59	28.20	42.24	133.4	397.7	5.16	1476.0	0.451	0.682	5.45	23.25	42.68	0.545	43.85	115

* Lighter = children in the lowest quintile by weight; Heavier = children in the upper four quintiles by weight

TABLE IX
AVERAGE DAILY NUTRIENT INTAKE/1,000 kcal: SIGNIFICANCE OF DIFFERENCES BETWEEN AGE, SEX, WEIGHT, SOCIAL
CLASS, NUMBER OF SIBLINGS, AND MOTHER'S WORK STATUS GROUPS
(Children of unknown social class or with no father excluded from the regression)

Nutrient/1,000 kcal	Animal Protein (g)	Total Protein (g)	Fat (g)	Carbo- hydrate (g)	Calcium (mg)	Iron (mg)	Vitamin A (i.u.)	Thiamin (mg)	Ribo- flavin (mg)	Nicotinic Acid (mg)	Vitamin C (mg)	Vitamin D (i.u.)	Pyri- doxin (mg)	Added Sugar (g)
Sex ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Age ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Weight ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Social Class ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
No. of siblings ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Mother's work status ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

— = not significant; * = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$

the younger than for the older children. Weight was a significant factor only for added sugar intake/1,000 kcal for which the heavier children had a lower intake than the lighter children.

Of the three socio-economic factors considered, mother's work status had little influence on the average daily intake/1,000 kcal, agreeing with the finding for average daily nutrient intake. However, family size and social class differences were more marked than those found for average daily nutrient intake.

Children from small families had a higher intake of all nutrients/1,000 kcal except for carbohydrate and added sugar. These differences were significant for about half of the nutrients.

In general, children from the higher social classes had a higher intake of nutrients/1,000 kcal than those from the lower social classes. The differences were less striking for minerals and vitamins. The exceptions were again carbohydrate and added sugar intake/1,000 kcal which were higher in the lower social classes.

Fatherless children can be considered as an 'at risk' group with respect to nutrition. In order to investigate this group, the previous analysis was repeated comparing the fatherless group of 69 children with the 696 children with fathers whose social class was known (there were 13 children of unknown social class). Except for carbohydrate and added sugar intake/1,000 kcal the fatherless group had a higher intake of all nutrients/1,000 kcal although they had a lower average daily intake. Few of these differences were significant, but the consistent pattern can be taken to demonstrate a higher quality of diet among the fatherless children (Table X).

TABLE X
MEAN INTAKE OF NUTRIENTS/1,000 kcal: COMPARISON BETWEEN FATHERLESS CHILDREN AND CHILDREN OF KNOWN SOCIAL CLASS ADJUSTED FOR EFFECTS OF AGE, SEX, WEIGHT, NUMBER OF SIBLINGS, AND MOTHER'S WORK STATUS
(Excluding 13 children of unknown social class)

Nutrient/1,000 kcal	Fatherless Children	Social Classes I-V	Significance
Energy value (kcal) ..	2262.1	2286.6	—
Animal protein (g) ..	18.69	17.78	—
Total protein (g) ..	29.32	28.15	*
Fat (g) ..	43.15	42.17	—
Carbohydrate (g) ..	130.88	134.45	*
Calcium (mg) ..	419.5	404.0	—
Iron (mg) ..	5.25	5.08	—
Vitamin A (i.u.) ..	1592.0	1496.9	—
Thiamin (mg) ..	0.515	0.450	*
Riboflavin (mg) ..	0.732	0.670	*
Nicotinic acid (mg) ..	5.81	5.19	**
Vitamin C (mg) ..	24.07	22.15	—
Vitamin D (i.u.) ..	46.92	46.29	—
Pyridoxin (mg) ..	0.571	0.533	*
Added sugar (g) ..	39.40	44.49	***

— = $P > 0.05$; * = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$

DISCUSSION

There have been few recent studies of nutritional status in children in Great Britain. One such study in young children was carried out by the Ministry of Health in 1963 (Ministry of Health, 1968). In this, for each child a weighed diet record was kept, a socio-economic questionnaire completed, and medical and dental examinations were carried out. A survey of the health and nutrition of Swedish children (Samuelson, 1971a and 1971b; Samuelson, Grahnén, and Arvidsson, 1971) comprised a 24-hour recall of food intake, a food habit history, a socio-economic questionnaire, and a detailed medical examination with anthropometric measurements, haematological tests, and an assessment of oral health.

This paper gives the first results of a study of Kent schoolchildren for which the data comprise a one-week weighed diet record, a socio-economic questionnaire, and a medical examination.

Analyses presented show the relationship of average daily nutrient intake (and intake/1,000 kcal) to basic socio-economic factors (age, sex, weight, social class, number of siblings, and mother's work status).

Older children, with a larger body size, have higher energy requirements and thus greater appetites than younger children. In this study older children were found to have a higher intake than younger children. Also, in both age groups, boys were found to have a higher intake than girls. This difference in intake between the sexes will be discussed later.

Heavier children were found to have a higher average daily nutrient intake than lighter children, which may be due in part to their larger body size. Added sugar was the only nutrient for which there was a difference in intake/1,000 kcal between different weight groups, the heavier children having a lower intake than the lighter children. This finding is similar to that of an earlier study (Johnson, Burke, and Mayer, 1956) in which obese girls had a lower energy intake than the non-obese. The explanation for this may be partly in voluntary restriction of sugar among children who are aware of being overweight. Some children in the study were following diets to reduce their weight.

Since energy intake varies widely between individuals it is more meaningful to examine average daily nutrient intake per thousand kilocalories when quality of diet is considered to be of importance. The use of nutrient intake expressed as a value/1,000 kcal eliminates the possible effects of body size and activity. These can affect the absolute intakes of nutrients merely because more or less food is eaten. Further, an individual's diet may well be adequate

as regards energy intake but may, for example, be inadequate as regards protein intake. A diet low in protein is also likely to be low in a number of other nutrients and vitamins, and individuals with a higher protein intake/1,000 kcal will tend to be better nourished than those with a lower intake. However, this is not always true as a high protein intake combined with an inadequate energy intake results in part of the protein being used for energy.

The differences between the two age groups seen in average daily nutrient intake were not present for intake/1,000 kcal. This suggests that these age differences in average daily nutrient intake are a function of greater body size with resultant increased appetite in the older children. The quality of diet of the older children is similar to that of the younger children.

The absence of differences between the average daily intake/1,000 kcal of the two sexes is harder to interpret. It suggests that the quality of diet in the two sexes is similar, although boys have a higher average daily nutrient intake than girls. The differences in total intake are unlikely to be due to body size differences between the sexes as boys in the younger age group are only slightly heavier and taller than girls (London County Council, 1961). As girls reach the pubertal growth spurt earlier than boys they temporarily overtake boys in body size. However, the lower proportion of body fat to body mass in boys and their higher expenditure of energy in physical activity are factors which contribute to a greater total nutrient intake.

The negligible influence of social class, family size, and mother's work status on total nutrient intake is interesting. Many studies have demonstrated the influence social class, family size, and mother's work status have on the height and weight of children (Berry and Cowin, 1954; Topp *et al.*, 1970; Davie, Butler, and Goldstein, 1972) and these differences have been attributed in part to differences in nutrition. It may be that quality of diet, as assessed by nutrient intake/1,000 kcal, is of more importance in relatively prosperous countries than total nutrient intake in its influence on growth. Certainly between individuals the proportion of energy derived from carbohydrate, fat, and protein varies. The higher the proportion of protein in the diet the greater will be its body-building potential. The relative proportions of nutrients other than carbohydrate, fat, and protein may also be of importance here. These more complex variables have not yet been studied in this group of children.

The variation in intake of nutrients/1,000 kcal between different social class and family size groups parallels the height and weight differences found

between social class and family size groups in the analyses of data from the earlier respiratory study (Topp *et al.*, 1970). The finding that children from lower social classes and larger families had a lower intake of all nutrients/1,000 kcal except carbohydrate and added sugar indicates that these children have diets that rely on cheaper nutrients as sources of energy rather than more expensive protein and fats. That the nutrient intake/1,000 kcal did not differ by mother's work status suggests that the differences in height and weight previously found (Berry *et al.*, 1954; Leys *et al.*, 1963; Topp *et al.*, 1970) are unlikely to be due to differences in intake or quality of nutrition. However, a study by Metheny, Hunt, Patton, and Heye (1962) found that children of mothers who worked had a slightly better diet than those whose mothers did not work.

The study sample contained a higher proportion of fatherless children than did the sampling frame because these children were considered to be vulnerable in socio-economic terms and possibly in their nutrition. The unexpected finding was that, although they had a lower energy intake than children with fathers, the fatherless children had a better quality of diet. Possible explanations for this finding are that within a fatherless family the mother may lay more stress on the feeding of her children than when a husband is present.

In a family where there is difficulty in meeting expenses the outlay on foods may be considered much more carefully, in particular with respect to the relative nutritional value of various foods. Further, the father's likes and dislikes have been found to predominate in the choice of foods within a family (U.K. Margarine and Shortening Manufacturers' Association, 1969). When no father is present this role may be transferred to the child or children. This might help to explain why the fatherless children had a higher intake/1,000 kcal than children from the lower social classes (see Tables VIII and X). Further examination of data on the income of the fatherless families and their pattern of intake of different foods may help to illuminate these differences. The anthropometric data are also being examined to see if the better quality of diet of the children of fatherless families can be linked with greater attained height and weight.

SUMMARY

A survey of the nutritional status of schoolchildren aged 8-11 and 13-15 years was carried out in Kent between September 1968 and March 1970. A one-week weighed diet record, a medical examination including anthropometric measurements, and a

detailed socio-economic questionnaire were obtained from each child taking part.

The aims of the study were to examine the dietary intake of schoolchildren, to investigate its relationship to health and socio-economic factors, and to explore the extent and nature of poor nutrition.

Of 1,017 children asked to participate, 778 cooperated, a response rate of 76.5%. The families who refused to take part were compared with those who cooperated using data from an earlier study. No differences were found.

In this paper the relationship between average daily nutrient intake and some basic socio-economic factors is explored. Sex, age, and weight were all found to be independently associated with highly significant differences in intake of most nutrients. Social class, number of siblings, and mother's work status were not in general associated with significant differences in intake. However, these relationships showed different trends when average daily nutrient intake/1,000 kcal was considered. Sex and age differences were not consistently present and weight differences were only apparent for added sugar intake/1,000 kcal. Mother's work status had little influence on intake. Children from the higher social classes had a higher intake of all nutrients/1,000 kcal except carbohydrate and added sugar, and those from smaller families had a higher intake of all nutrients/1,000 kcal except carbohydrate.

The children from fatherless families, when considered as a separate group, had a higher intake of nutrients/1,000 kcal than the other children despite a lower energy intake.

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