Nutritional Value of Midday Meals of Senior Schoolchildren

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Summary

A survey of 565 senior schoolchildren showed that 41% took the school meal. It provided 27% of the daily recommended energy intake and 35% of the daily protein intake set by the Department of Health and Social Security. Of the children who did not take the school meal 4% had a meal which compared favourably with it, though an equal number ate no lunch at all. The remainder either brought snacks from home or bought foods which were found to be both low in protein, iron, and calcium, and high in sugar. Sweets and chips provided the main source of energy for 9% of the subjects.

Introduction

The survey was undertaken during January and February 1972 at a large comprehensive school in London. The purpose was to find the source, the nutritional value, and the cost of the midday meal of senior schoolchildren.

Methods

On three separate visits a total of 565 children at a large comprehensive school in London were asked to complete a questionnaire. They were asked to state in some detail exactly what they had eaten during the lunch break, where it had been obtained, and how much it had cost. They completed the questionnaires immediately after the lunch break under the supervision of experienced teachers during their house meetings. All the children responded very intelligently, and excellent co-operation was obtained from the teaching staff. Of the total school population aged between 11 and 18 years, 29% filled in the questionnaire.

The school provides a choice of meals. At least three main dishes and two puddings are normally available as well as salads. The children select and pay for their meals on a day-to-day basis. On each of the three survey days samples of the school meal available were taken for analysis of energy, protein, and fat. Total energy was found using the bomb calorimeter (Miller and Payne, 1959). Total nitrogen was measured by the Kjeldahl method and fat was determined by the Soxhlet extraction.

Representative samples of all the foods which the children obtained from sources outside the school were collected and weighed. Their energy and nutrient contents were calculated from the food composition tables (McCance and Widdowson, 1960) programmed on the Queen Elizabeth College computer, and the nutrient content of the school meal was also estimated by computer.

Results

Information was obtained from the questionnaire on the source of the midday meal. The results are shown in Table I. Alto-

TABLE I—Source of Midday Meal of 565 Schoolchildren Aged 11-18 years

Source of Food	No. of Schoolchildren		Total (%)
	Boys	Girls	
School meal	138	94	41
Meal at home	8	13	4
Food bought	90	86	31
Food brought from home	37	75	20
Nothing	16	8	4

gether, 41% of the subjects took the school meal, 31% bought food outside the school, 20% brought food from home, 4% lunched at home, and 4% ate nothing at all. Fewer girls than boys had a school meal and twice as many girls as boys brought food from home. In the school as a whole an average of 31% of the children had the school meal during January and February.

Although most schoolchildren took the school meal, further analysis of the data showed a change in lunch time habits with increasing age (see Chart). There is a definite fall in the uptake of school meals from nearly 60% at the age of 11 to below 20% at the age of 16. A reciprocal upward trend is shown in the consumption of food bought outside the school.

Uptake of school meal with age and percentage of children buying food.

The median (and range) of energy, protein, and sugar intakes obtained from the different sources are given in Table II.

It can be seen that of all the meals available the school meal provided the most energy and protein. Children who ate at home had a meal which compared favourably with the school meal though contributing fewer calories.

Although concern is expressed here for those who ate no lunch, attention was concentrated on the large proportion of children who either brought snacks from home or bought food

TABLE II—Mean Energy, Protein, and Sugar Consumption (Range in Parentheses)

Source of Food	Energy (kcal)	Protein (g)	Sugar (g)
School meal	680 (400-1,120)	20 (8-39)	19 (13-66)
Meal at home	555 (260-1,160)	19 (10-47)	19 (0-130)
Food bought	680 (90-2,980)	15 (2-76)	29 (0-160)
Brought from home	440 (150-1,250)	11 (3-40)	12 (0-150)

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outside the school. In the last two categories the protein intake was much lower than that available from the school meal.

The energy consumption varied enormously, and analysis of the results showed that children who bought their midday meal had excessive sugar intakes associated with the less nutritious high carbohydrate snacks and beverages.

Iron and Calcium Intakes.—The intakes of iron and calcium (median and range) are given in Table III. Daily recommended intakes for children 12-18 years are 14-15 mg of iron and 600-700 mg of calcium. The school meal provided 4.3 mg of iron and 170 mg of calcium, representing 30% and 26% respectively of the daily recommended intakes. The children who brought food from home obtained the least amount of iron and also low intakes of calcium.

TABLE III—Mean Iron and Calcium Intakes (Range in Parentheses)

Source of Food	Iron (mg)	% of Recommended Daily Allowance*	Calcium (mg)	% of Recommended Daily Allowance*
School meal ..	4.3 (2.5-5.7)	30	170 (90-490)	26
Meal at home ..	4.2 (0.8-11.1)	29	200 (80-720)	30
Food bought ..	3.1 (0.2-4.2)	21	110 (20-690)	17
Brought from home	2.1 (0.2-7.1)	14	120 (0-930)	18

*Recommended Daily Allowance for boys and girls 12-15 years (Department of Health and Social Security, 1969).

TABLE IV—The School Meal

	Mean Energy and Protein Content		
	Energy (kcal)	Protein (g)	Fat (g)
Analysed	700	23	29
Computed	730	14	32

The analysed and computed values for energy and protein are given in Table IV. The amount of protein was found to differ because coding of the school meal for the computer did not allow for the amount of dried milk added to the custard. About one-third of the protein content of the school meal is supplied in this way. Those children getting the dried milk would also receive a supplement providing over a third of the daily recommended intake of calcium.

The present standards for the school meal are laid down by the Department of Education and Science (1966). School meals are intended to provide 880 kcal, 29 g of protein and 32 g of fat. The average analysed values for the school meal reached 80% of the energy and protein targets and 90% of the fat target set by the Department of Education. Expressed in terms of daily recommended allowances this represents 27% of the recommended energy intake and 35% of the protein intake.

In an attempt to trace any vulnerable groups by their nutrient intake it was found that sweets or chips provided the main source of energy for 9% of the subjects. The nutrient intakes of these children are given in Table V.

TABLE V—Nutrient Intakes (Median and Range) of Children Whose Energy Source was Predominantly Sweets and Chips

	Nutrient Intake				
	Energy (kcal)	Protein (g)	Sugar (g)	Iron (mg)	Calcium (mg)
Sweets	300 (110-800)	3 (0-11)	46 (16-90)	0.9 (0.4-2)	90 (0-290)
Chips	450 (90-1,500)	8 (0-11)	18 (0-120)	2.8 (1-11.5)	65 (20-370)

Carbohydrate supplied over 60% of the energy intake of these children, with protein contributing on average less than 6%. Iron and calcium intakes were correspondingly low.

In addition to the children who ate nothing at all (4%) a further 2% had only fruit or a drink. In each case such foods provided less than 100 kcal.

Cost.—A school meal cost 12 pence at the time of the study.

The children who bought their own food spent on average 19 pence. No attempt was made to cost the meals taken at home or the snacks brought from home. The average additional expenditure during lunch time—that is, the amount spent on ice-creams, sweets, etc.—was in the case of a school meal 5.2p, a meal at home 5.5p, and food brought from home 6.7p.

Discussion

The survey indicates that most of the children obtained a satisfactory midday meal, but attention is drawn to those who were eating inadequate lunches and in particular those who bought food. The diets recorded by these children often showed excessive intakes of sweets, cakes, and soft drinks.

During adolescence the nutrient requirements are conditioned by a period of rapid growth and development beginning at puberty. At a time when the physical and mental demands of the individual are sharply increased, the provision of sufficient of the necessary foods at meal times becomes more critical. In particular, the children bringing food from home or buying food obtained relatively little protein, calcium, or iron from their midday meal. Protein and calcium have a special significance for the adolescent as components of new body tissue and developing bones. The iron intakes suggest that iron deficiency anaemia may occur in some cases, but clinical evidence would have been required to confirm these suspicions.

No information was obtained on the adequacy of the children's other meals or whether the type of midday meal reflected the usual pattern of eating. From the results there was no indication of undernutrition but it is possible that mineral deficiencies may occur if the requirements are not met from other sources. Many young people are apt to skip meals. Bender *et al.* (1972) found that 7% of the children went to school without breakfast, and G. W. Lynch (1972, personal communication) indicated the figure to be as high as 1 in 5. This survey found 4% of the children went without food at lunch time and that it is relatively simple for those habitually skipping meals and eating poor lunches to have excessive sugar intakes through the consumption of high carbohydrate snacks and beverages.

The children showed enormous variation in their energy consumption. Nine of them had, at lunch time, estimated calorie intakes of above 1,500 kcal. Whether the energy output of these children was in balance cannot be judged without measuring their individual energy requirements. No information on heights and weights of the children was obtained, nor whether they regarded themselves overweight or underweight.

A survey in a London secondary school by Mortimer (1968) showed that 8% of the girls aged between 11-16 years were in need of treatment for obesity. In a Californian study of teenagers, Hampton *et al.* (1967) found that the energy consumption of the obese was less than average though they ate less frequently and were more likely to miss meals. In the present survey nearly half the girls were interested in slimming, and 27% were actively seeking to lose weight.

Sugar.—Sugar is a source of "empty calories" and a factor in promoting tooth decay. Its use is therefore discouraged, particularly among children. Excessive intakes of sugar were found among the children who bought food, nearly half of whom chose sweets. The median sugar intake from the school meal was 19 g, which compares closely with 18 g suggested by the Department of Education and Science—that is, sugar provides 11% of the calories. The children who bought food obtained 17% of their energy from sugar, whereas for 25 children eating mostly sweets, sugar supplied 61% of their energy intake. Bender *et al.* (1972) in a survey of 48 schools in South-east England showed that the energy and protein content of the school meals fell short of the standards set by the Department of Health and Social Security. This survey has shown that improvements in the school meal itself would be justified, but from the nutritional point of view it still offers the best value for money.

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Effects of Oestrogen on Urinary Thyroxine Excretion

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Summary

The day to day variation and the effects of oestrogen on the urinary excretion of thyroxine (T-4) were studied in euthyroid women and men. Serial urinary T-4 values over a period of 28 consecutive days were found to lie within relatively narrow limits except for a transient increase during menstruation in women. During oestrogen therapy urinary T-4 was unchanged, but an appreciable rise was seen after stopping oral ovulation inhibitors in women. A similar effect was seen in men after three days' treatment with 20 µg/day of ethinyloestradiol. The increased urinary T-4 excretion on oestrogen withdrawal reached a maximum in one to three days. This response contrasted with that produced by phenytoin, a drug known to bind to thyroxine binding globulin, and which resulted in increased urinary T-4 excretion during the period that it was being administered.

Introduction

Increased levels of oestrogen in the blood, whether of exogenous or endogenous origin, have profound effects on thyroid function tests. Heinemann *et al.* (1948) were the first to report that serum protein bound iodine (P.B.I.) increased in pregnancy and Engstrom and his colleagues (1952) found that this could be induced in non-pregnant women by oestrogen administration. The rise in P.B.I. levels is accompanied by a shift in the uptake of triiodothyronine (T-3) by the patient's serum or red cells into the hypothyroid range (Hollander *et al.*, 1963; Winikoff and Taylor, 1966). Both effects can be attributed to an increase in certain serum proteins and their capacity to bind thyroid hormones (Dowling *et al.*, 1956; Engbring and Engstrom, 1959; Tata, 1960; Florsheim and Faircloth, 1964). Clark and Horn (1965) introduced the free thyroxine (T-4) index, calculated from the P.B.I. and T-3 uptake results, to correct for changes in these serum levels. Circulating T-3 levels also increase during pregnancy (Hotelling and Sherwood, 1971) despite the fact that it is less avidly bound by thyroxine binding proteins as compared with T-4. Other thyroid parameters which are influenced by the administration of oral ovulation inhibitors include the

secretion of thyroid stimulating hormone (Fisher and D'angelo, 1971; Galton, 1971), thyroidal ¹³¹I uptake (Kennedy *et al.*, 1964; Boccabella and Alger, 1964), the T-4 half-life (Engbring and Engstrom, 1959), and circulating free T-4 concentration (Arango *et al.*, 1968; Rosenbaum *et al.*, 1968; Fang and Selenkow, 1970; Malkasian and Mayberry, 1970). The latter is of particular interest as it is regarded as the biologically active fraction, and thus reflects the true thyroid status of the individual.

The present study was undertaken to assess the effects of oestrogen on urinary T-4 excretion, as it has been suggested that the latter relates directly to the serum free T-4 concentration (Chan and Landon, 1972). Serial urinary T-4 values over a period of 28 days were studied in euthyroid men and women, and compared with those in women receiving oral contraceptives. The effects of ethinyl oestradiol and of phenytoin administration on urinary T-4 excretion in healthy euthyroid men were also investigated.

Subjects and Methods

A total of 66 volunteers were studied, comprising 34 healthy ambulant subjects, 20 euthyroid inpatients, and 12 women receiving oral ovulation inhibitors.

Urine was collected from each subject over a single 24-hour period, together with a 12-ml blood sample. Further urine collections were made for 28 consecutive days in three groups of healthy volunteers aged 20 to 30. The groups comprised five men, five women, and five women who had been receiving oral ovulation inhibitors containing either 50 µg per tablet of ethinyl-oestradiol or mestranol for periods of four to 36 months.

A further nine healthy euthyroid male volunteers were studied to determine the effect of ethinyloestradiol on urinary T-4, serum total T-4, and T-3 uptake. Samples were collected for a three to five-day control period during the three days they received ethinyloestradiol (20 µg daily) and for four to six days afterwards.

The effects of phenytoin on thyroid function were also studied in one healthy euthyroid man. Samples were collected for a three-day control period during the four days of phenytoin medication and for a further two days after cessation of therapy.

Blood samples were separated within two hours of venepuncture and the serum stored at -20°C until required for assay. The determination of serum P.B.I. by a Technicon automated method, and a total T-4 and T-3 uptake by a Sephadex equilibration technique, was performed as described previously (Chan and Landon, 1972; Chan *et al.*, 1972).

Urinary T-4 estimations were made using duplicate 3-ml aliquots of urine according to the method described previously (Chan and Landon, 1972). This involved acidification of the urine sample, solvent extraction, and determination of T-4 content of the extract by saturation analysis.

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