

## Energy and nutrient intakes in a sample of 136 Edinburgh 7–8 year olds: a comparison with United Kingdom dietary reference values

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Energy and nutrient intakes were assessed in 136 children, aged 7–8 years and living in and around Edinburgh, using the 7 d weighed inventory technique. The results were compared with UK dietary reference values (DRV) for energy, macronutrients and micronutrients. NSP intakes were compared with a calculated reference value (CRV). Mean energy intakes were close to the estimated average requirement for both boys and girls. Mean percentages of food energy derived from fat and saturated fat were high in relation to DRV (37 and 14 compared with 35 and 11 respectively). Mean percentage of food energy derived from total carbohydrate was close to the DRV of 50 but intakes of starch appeared to be low and intakes of total sugars high (23 and 26 % food energy respectively). Superficially, this suggests that there is a need to alter the balance of carbohydrate in favour of increasing starch and lowering total sugar. There was, however, a clear ‘fat–sugar seesaw’, i.e. children with a high percentage energy from total sugars had a low percentage energy from fat, and vice versa. In view of this finding, it is possible that efforts to reduce total sugar intake in children may result in a further increase in percentage energy from fat. Mean intakes of NSP were only 50 % of the CRV, but this guideline may be set too high. Mean intakes of most micronutrients were above reference nutrient intakes. Reported low intakes of Zn and Se were treated with caution due to the perceived incompleteness of the data for these in the nutrient database. The authors concluded that targeting high intakes of total fat and saturated fat should be the health priorities in this age-group.

### Dietary intake: Schoolchildren

*‘Clearly, Scotland’s eating habits are established inappropriately from birth onwards and a dramatic change in public health strategy is needed’ (Scottish Office, 1993)*

The Scottish Office (1993), in a recent report on Scotland’s health, has observed that ‘The usual Scottish diet consumed by children is also that which we would now expect to be conducive to the development of adult chronic diseases’. However, in order to identify priorities for health promotion, recent data on a range of different age-groups is required. Notable dietary studies on children carried out over the last 10 years include those by Hackett *et al.* (1986), Benton & Roberts (1988), Department of Health (1989), Nelson *et al.* (1990), McNeill *et al.* (1991), Payne & Belton (1992) and Adamson *et al.* (1992). A description of the subjects and methods used in these studies is given in Table 1. However, only the studies of McNeill *et al.* (1991), Payne & Belton (1992) and Department of Health (1989) included data on Scottish children. Most of these dietary surveys appear to

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Table 1. *Dietary surveys on children published between 1984 and 1994*

Source	Location	Age-range (years)	Sample size	Methods
Hackett <i>et al.</i> (1986)	Newcastle	11-12	405	3 d estimated inventory
Benton & Roberts (1988)	London	12-13	90	3 d estimated inventory
Department of Health (1989)	Nationwide	11-12, 14-15	2697	7 d weighed inventory
Nelson <i>et al.</i> (1990)	London	7-12	227	7 d weighed inventory
McNeill <i>et al.</i> (1991)	Dundee	12	61	7 d weighed inventory
Payne & Belton (1992)	Edinburgh	2-5	153	7 d weighed inventory
Adamson <i>et al.</i> (1992)	Newcastle	11-12	379	3 d estimated inventory

concentrate on adolescents, leaving a 'gap' between the ages of 5 and 9 years. Apart from data on forty-nine 7-10 years old from the Nelson *et al.* (1990) study (the number of 7-8 year olds is not specified), to the authors' knowledge there has not been a focused dietary survey on this age-group since the work of Cook *et al.* (1973). Therefore, it is the aim of the present paper to present data on 7-8 year olds, relating energy and nutrient intakes to UK dietary reference values (DRV; Department of Health, 1991). This exercise includes a comparison with DRV for carbohydrate and fat. Although it is acknowledged that these DRV were aimed primarily at the adult population, the authors contend that their use in childhood may be justified given the probability that eating habits are formed during this time and that nutrition-related adult diseases may have their origins in childhood.

#### SUBJECTS AND METHODS

Ethical approval for the study was given in June 1989 by the Research Evaluation Committee of Lothian Region's Education Department. Five primary schools in the Edinburgh and South Queensferry area were selected at random by the Research Evaluation Committee, three of which were in areas with a mixed social class population, while two schools were in an area of multi-deprivation. Schools were contacted in October 1990 and data collection took place between February 1991 and March 1992 (excluding school holidays).

All children attending Primary 3 (i.e. those aged 7-8 years) in the selected schools formed the target population. The criteria for selection excluded any children suffering from chronic conditions which might affect dietary intakes, but this subsequently amounted to zero. Children from ethnic groups other than Caucasian were also excluded ( $n$  1), since it was believed that the traditional foods eaten by these children would not be represented adequately in the nutrient database. This resulted in a target population of 269 children. After a list of names was obtained from school records, a personalized letter was sent to each family outlining the aims of the study and asking for support. In total, 157 affirmative replies were received and these families were followed up with a visit to explain the study further. Subsequently 146 agreed to participate and, of these, seven failed to complete the study period. One subject's diary was discarded due to the child becoming ill during the study and the mother refusing to repeat the days during which little food was eaten, while the diaries of two subjects were discarded due to a poor standard of record keeping (identified because drinks were consistently omitted and items were recorded with highly unlikely weights). Thus, 133 diaries which contained seven complete days (including two weekend days) and three diaries which contained six complete days (including one weekend day) were finally accepted.

The 7 d weighed inventory was used to estimate usual dietary intake. Following training (by C. H. S. R.), parents weighed and recorded all food and drink consumed by the children using Salter electronic scales weighing up to 2 kg in 2 g intervals. Leftovers were also measured in this way. During the study period, three visits were made to each participating family to provide encouragement, complete a questionnaire to ascertain social class and check the accuracy and completeness of dietary diaries. This latter task was done by assessing whether or not food weights were reasonable, checking for incomplete food descriptions and questioning the parents about possible omissions. School meals and leftovers were weighed by a trained research assistant each lunchtime, while snacks eaten by the children outside the home or school were recorded in a notebook, either by the responsible adult or by the child himself/herself.

Height was measured to 10 mm using a Minimetre portable stadiometer (Child Growth Foundation, London), while weight was measured to 0.5 kg using Soehne floor scales. Height and weight were expressed as standard deviation scores of 1990 British population standards (Freeman *et al.* 1995) after correcting for skewness in the weight standards using the LMS method (Cole, 1990).

Data were analysed using COMP-EAT 4.0 (Nutrition Systems Ltd, London) which uses the Royal Society of Chemistry database. The program was adapted to include 174 new foods; 150 used in a previous study by Payne (1991) and twenty-four added by the author. Composition data on the twenty-four new foods, mainly sweets and drinks, were obtained from manufacturers who were contacted by letter. Statistical analyses were carried out using SPSS for Windows (Statistical Package for Social Sciences, 1993) and Student's *t* test was used to investigate differences between subgroups, a probability level of  $P < 0.05$  being accepted as significant. The Mann Whitney U test was used where nutrient intakes did not follow a normal distribution (ascertained using the Kurtosis test). Pearson's correlation coefficient was used to investigate relationships between nutrients.

## RESULTS

The final sample of 136 was made up of seventy-one girls and sixty-five boys. The social-class distribution of the sample was close to that described by the Registrar General classification for Caucasians in Edinburgh (Office of Population Censuses and Surveys, 1990). Sixty-four children (47%) came from non-manual families (social classes I–IIIa), while sixty-four (47%) came from manual families (social classes IIIb–IV). Eight children (6%) could not be classified in this manner as their mothers, who were single parents, did not have either a present or a previous occupation.

Mean heights and weights were close to the fiftieth percentile (Child Growth Foundation, London). Mean height in boys was 1.251 m and 1.245 m in girls. Mean weight was 25.3 kg for boys and 24.7 kg for girls. Mean BMI for both boys and girls were in excess of standards for children of this age-group (Rolland-Cachera *et al.* 1991) at 16.2 and 15.9 respectively.

It was believed that the energy intake results obtained from the 7 d weighed inventory method were suitably representative of the sample, since reported energy intakes were close to predicted energy intakes (PEI) calculated according to the equation of Livingstone *et al.* (1991) which was based on estimates of predicted energy expenditure. Mean energy intake in boys was 7.78 MJ (106% PEI), while mean energy intake in girls was 7.16 MJ (108% PEI).

Table 2 presents mean energy and nutrient intakes for boys and girls. Boys' diets were higher in energy ( $P < 0.005$ ), protein ( $P < 0.05$ ), fat ( $P < 0.05$ ), carbohydrate ( $P < 0.001$ ), starch ( $P < 0.005$ ), resistant starch ( $P < 0.05$ ), dietary fibre ( $P < 0.05$ ), nicotinic acid equivalent ( $P < 0.05$ ), Fe ( $P < 0.05$ ) and Zn ( $P < 0.05$ ) than girls' diets. However, when

Table 2. Mean daily energy and nutrient intakes of 7-8-year-old school boys and girls living in Edinburgh\*

(Mean values and standard deviations)

	Boys			Girls		
	Mean	SD	% DRV	Mean	SD	% DRV
Percentage energy from:						
Fat	37.4	3.72	—	37.8	4.22	—
SFA	13.7	2.15	—	14.2	2.23	—
MUFA	11.1	1.82	—	11.4	1.91	—
PUFA	5.1	1.35	—	5.5	1.53	—
Protein	11.8	1.89	—	11.9	1.79	—
Carbohydrate	50.8	4.28	—	50.3	4.82	—
Starch	23.1	4.51	—	22.6	3.33	—
Sugars	25.5	5.72	—	25.9	5.21	—
Energy:						
MJ	7.78	0.98	94.4	7.16	1.00	98.3
kcal	1860	230	—	1700	234	—
Protein (g)	54.2	10.8	191	50.0	11.1	177
Fat (g)	77.5	13.6	—	72.2	13.4	—
Total SFA† (g)	28.1	5.59	—	26.9	5.52	—
Total MUFA† (g)	23.2	5.02	—	21.8	5.09	—
Total PUFA† (g)	10.5	2.98	—	10.4	3.11	—
Carbohydrate (g)	251	33.6	—	227	36.4	—
Total sugars (g)	126	30.4	—	118	30.2	—
Sucrose (g)	29.3	13.0	—	26.8	11.8	—
Starch (g)	113	25.4	—	101	18.8	—
NSP (g)	8.15	2.90	54.8	7.95	2.24	59
Vitamin A (µg)	504	288	101	556	268	111
β-carotene (µg)	345	481	—	537	709	—
Vitamin B <sub>1</sub> (mg)	1.05	0.28	151	1.04	0.32	149
Vitamin B <sub>2</sub> (mg)	1.64	0.61	164	1.51	0.47	151
Vitamin B <sub>6</sub> (mg)	1.43	0.47	143	1.34	0.36	134
Vitamin B <sub>12</sub> (µg)	3.47	1.42	347	3.25	1.12	325
Nicotinic acid equivalent (mg)	24.2	5.54	202	22.4	4.73	187
Folate (µg)	173	59.6	116	167	45.6	111
Vitamin C (mg)	55.4	31.8	184	60.0	43.6	200
Vitamin D (µg)	1.95	0.89	—	2.16	1.03	—
Vitamin E (mg)	5.89	2.57	—	5.93	2.88	—
Ca (mg)	819	216	149	800	273	145
Fe (mg)	10.0	4.30	115	8.53	2.09	99
Zn (mg)	6.46	1.80	92.3	5.90	1.44	84
Se (µg)	27.3	13.0	91.0	24.2	8.00	81

SFA, MUFA, PUFA, saturated, monounsaturated and polyunsaturated fatty acids respectively; DRV, dietary reference values (Department of Health, 1991).

\* For details of subjects and procedures, see pp. 152-153.

† The fatty acid data do not add up to the value for total fat since values for glycerol are not shown.

nutrient density was examined there were no significant differences between the composition of the diets, suggesting that the differences between boys and girls were merely a function of total food intake.

#### Comparison with dietary reference values

*Energy and macronutrients.* Mean energy intakes in the present study were expressed as a percentage of estimated average requirement (EAR; Department of Health, 1991), while mean protein and micronutrient intakes were expressed as a percentage of reference

Table 3. *Percentage of 7-8-year-old school boys and girls living in Edinburgh whose micronutrient intakes were below and above dietary reference values (Department of Health, 1991)\**

	< LRNI		≥ LRNI and < EAR		≥ EAR and < RNI		≥ RNI	
	n	%	n	%	n	%	n	%
<b>Girls (n 71)</b>								
'Expected'	2	2.5	34	47.5	34	47.5	2	2.5
Vitamin A	4	5.6	9	12.7	19	26.8	39	54.9
Vitamin B <sub>1</sub>	0	0	1	1.4	3	4.2	67	94.4
Vitamin B <sub>2</sub>	0	0	3	4.2	8	11.3	60	84.5
Vitamin B <sub>6</sub>	0	0	1	1.4	6	8.5	64	90.1
Vitamin B <sub>12</sub>	0	0	0	0	0	0	71	100
Nicotinic acid equivalent	0	0	0	0	1	1.4	70	98.6
Folate	0	1.4	5	7.0	23	32.4	42	59.2
Vitamin C	0	0	2	2.8	11	15.5	58	81.7
Ca	0	0	1	1.4	10	14.1	60	84.5
Fe	0	0	8	11.3	38	53.5	25	35.2
Se	10	14.1	45	63.4	16	22.5	0	0
Zn	3	4.2	30	42.3	21	29.6	17	23.9
<b>Boys (n 65)</b>								
'Expected'	2	2.5	31	47.5	31	47.5	2	2.5
Vitamin A	3	4.6	14	21.5	25	38.5	23	34.5
Vitamin B <sub>1</sub>	0	0	1	1.5	4	6.2	60	92.3
Vitamin B <sub>2</sub>	0	0	2	3.1	7	10.8	56	86.2
Vitamin B <sub>6</sub>	0	0	1	1.5	3	20.0	51	78.5
Vitamin B <sub>12</sub>	0	0	0	0	0	0	65	100
Nicotinic acid equivalent	0	0	0	0	1	1.5	64	98.5
Folate	1	1.5	9	13.8	17	26.2	38	58.5
Vitamin C	0	0	5	7.7	12	18.5	48	73.8
Ca	0	0	0	0	7	10.8	58	89.2
Fe	0	0	11	16.9	15	23.1	39	60
Se	10	15.4	32	49.2	23	35.4	0	0
Zn	4	6.2	11	16.9	30	46.2	20	30.8

\* For details of subjects and procedures, see pp. 152-153.

nutrient intake (RNI; Department of Health, 1991). Intakes of fat and carbohydrate were compared directly with DRV. The results presented in Table 2 show that mean energy intake in boys was 94% of the EAR, while the mean energy intake in girls was 98% of the EAR. Mean protein intake was almost double the RNI in boys (192%) and slightly lower than this in girls (177%).

Percentage food energy from fat (37) was in excess of DRV (35) for both boys and girls, as was the mean percentage energy from saturated fat at 14 (DRV 11). Percentage energy from carbohydrate met the DRV of 50, however, percentage energy from starch appeared low at 23, while percentage sugars appeared too high at 26. It was not possible to calculate non-milk extrinsic sugars.

Mean NSP intakes were expressed as a percentage of the calculated reference value (CRV) of 8 g NSP/4.2 MJ (The Caroline Walker Trust, 1991) since, at present, there is no DRV for NSP intake in children. Thus, the CRV for NSP (g) for this age, using EAR for energy intakes in the calculation, were 15.2 for boys and 13.5 for girls. Mean NSP intake was just over half the CRV at 55% in boys and 59% in girls.

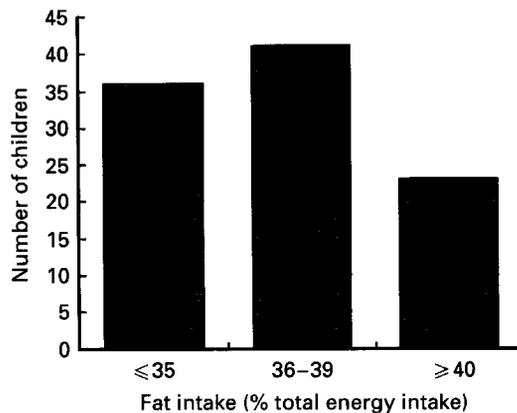


Fig. 1. Distribution of intakes for fat (% total energy intake) of 7-8-year-old schoolchildren living in Edinburgh. For details of subjects and procedures, see pp. 152-153.

*Micronutrients.* Mean intakes of micronutrients were expressed as a percentage of the RNI. From Table 2 it can be seen that the majority of children in the present study had intakes in excess of the RNI for most nutrients, the exceptions being Zn and Se in the total sample and Fe in girls. However, group mean intakes can mask low intakes of individuals or subgroups. This was investigated by calculating the percentage of children with intakes below lower RNI (LRNI), above LRNI but below EAR, above EAR but below RNI and, finally, above RNI. Thus, if the distribution of nutrient intakes corresponds to the distribution of nutrient requirements indicated in the DRV report (Department of Health, 1991), the expected percentage of individuals falling into these groups would be 2.5, 47.5, 47.5 and 2.5 respectively. The actual distribution for both boys and girls is shown in Table 3 and clearly demonstrates that very few children had intakes less than the LRNI. Exceptions to this were the nutrients vitamin A, Se and Zn, since more than the expected 2.5% of children fell below the LRNI.

*Relationship between percentages of energy derived from total fat and total sugar*

The DRV report (Department of Health, 1991) suggests that, in the adult diet, the population average for percentage food energy derived from carbohydrate and fat should be 50 and 35% of total energy respectively. We consider that it is appropriate to apply these DRV to the diets of school-age children. Mean intakes of carbohydrate and fat, expressed as percentage food energy, were 50 and 37 respectively which suggests that, while intakes of total carbohydrate were satisfactory, intakes of total fat were too high. This is shown further when the distribution of percentage energy from fat intakes is considered (Fig. 1). Although mean percentage energy from fat was 37, eighty-seven (64%) children had fat intakes in excess of 35% energy from fat, while thirty-one (23%) children had intakes in excess of 40% energy from fat.

Mean intake of total sugars as a percentage of food energy also appeared high. Yet there is concern that the presence of an inverse relationship between percentage energies from total fat and total sugars could result in population fat intakes increasing if reductions in total sugar intakes are made. Such a relationship was investigated in the present paper using Pearson's correlation coefficient and Fig. 2 clearly illustrates that an inverse correlation is present ( $r = -0.65$ ,  $P < 0.001$ ). There was also an inverse relationship between percentage energy from total sugars and percentage energy from saturated fat ( $r = -0.24$ ;  $P < 0.01$ ).

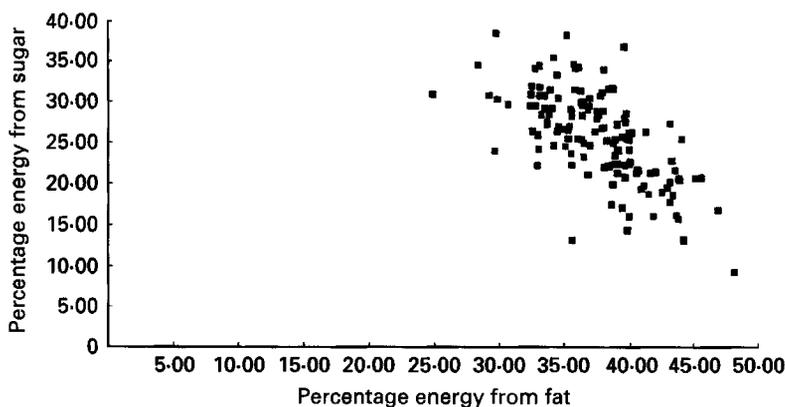


Fig. 2. Relationship between values for percentage food energy derived from total fat and that derived from sugar for 7–8-year-old schoolchildren living in Edinburgh. For details of subjects and procedures, see pp. 152–153 of proof.

Table 4. Five main sources of selected nutrients (not in order) and primary sources of selected nutrients (percentage of total sample) in a sample of 136 7–8-year-old schoolchildren living in Edinburgh\*

Total fat	Total saturates	Total sugars	Starch	NSP	
<b>Main source</b>					
Milk†	Milk†	Milk†	Bread	Potato crisps	
Potato crisps	Potato crisps	Diluting juices	Potato crisps	Bread	
Margarine	Cheese	'Fresh' juices§	RTEBC	RTEBC	
Processed meat	Processed meat	Chocolate‡	Chips	Chips	
Cheese	Chocolate‡	'Fizzy' drinks	Potato¶	Fruit	
<b>Primary source (% of total sample)</b>					
Milk†	37 Milk†	57 Milk†	26 Bread	55 Potato crisps	43
Potato crisps	33 Cheese	11 'Fresh' juices§	23 RTEBC	25 RTEBC	27
Margarine	11 Potato crisps	8 Diluting juices	18 Potato crisps	14 Bread	20
Processed meat	6 Butter	6 'Fizzy' drinks	10 Plain biscuits	2 Baked beans	6
Cheese	5 Processed meat	5 Chocolate‡	6 Processed meat	2 Potato¶	2
Butter	3 Margarine	5 Table sugar	5 Rice	2 Pizza	2
Chocolate‡	3 Chocolate biscuits	3 Confectionery	5		
	Plain biscuits	2 Sweet preserves	3		
	Chocolate‡	2 Fruit yoghurt	2		
		Chocolate biscuits	2		

RTEBC, ready-to-eat breakfast cereal.

\* For details of subjects and procedures, see pp. 152–153.

† Includes whole fat and semi-skimmed.

‡ Includes chocolate bars and chocolate-based confectionery.

§ Includes those made from concentrates.

|| Includes both wholemeal and white.

¶ Refers to other potatoes apart from chips and crisps.

#### *Sources of fat, carbohydrate and non-starch polysaccharide*

Attempts to alter nutritional intake in a population group must address specific food sources of target nutrients in order to be effective. Thus it was deemed important to investigate the major contributing foods to intakes of total fat, saturated fat, total sugars, starch and NSP in this sample of children. This was done in two ways: first by listing the

main five sources of each nutrient for every child and combining the data to produce a table for the whole sample; and second by collating the primary source of each nutrient for every child and expressing this as a percentage of the total sample. The results are shown in Table 4 and reveal a number of interesting findings. Milk appeared to be the main source of total fat, saturated fat and total sugar, while potato crisps were an important source of total fat, saturated fat, starch and NSP. Fruit beverages and carbonated beverages contributed strongly to total sugar intakes. Bread and ready-to-eat breakfast cereals were important contributors to starch and NSP intakes.

#### DISCUSSION AND CONCLUSIONS

In interpreting the results of the present study, one should take into account that mean daily energy and nutrient intakes of children in the study were, in most cases, close to DRV (Department of Health, 1991), although it is accepted that the data reflect term-time dietary intakes. It would have been interesting and useful to collect data on intakes during the school holidays but this was not possible due to methodological constraints. Energy intakes in the present study were close to those of UK 7–10 year olds (Nelson *et al.* 1990) but lower than those of Swedish 7–8 year olds (Hagman *et al.* 1986) and higher than those of Australian 7–8 year olds (Magarey & Boulton, 1987). Protein intakes were more than acceptable at 180% RNI, while mean percentage energy from protein (12) was close to that reported by other UK studies (Department of Health, 1989; Nelson *et al.* 1990; McNeill *et al.* 1991).

Reducing percentage energy from total fat and from saturated fat in adults and children over the age of 5 years is viewed by both Government and health workers as a key aim. Mean percentage energy from fat in this sample (37) exceeded the reference value (35) as did percentage energy from saturated fat (14 v. 11). The relatively high intakes of fat found in the present study are in accordance with results from other studies. Work conducted on UK children shows fat intakes of about 37% of energy for 5–8 year olds (Widdowson, 1947; Cook *et al.* 1973; Black *et al.* 1976) and about 38% of energy for 11–12 year olds (Benton & Roberts, 1988; Department of Health, 1989; McNeill *et al.* 1991). Non-UK studies on 7–8-year-old Caucasians report fat intakes of about 36% of energy (Australia: Magarey & Boulton, 1987; Sweden: Hagman *et al.* 1986). The main source of fat and saturated fat in the present study was milk and it has been reported elsewhere that children drank significantly more full-fat milk than low-fat milk (Ruxton *et al.* 1996). Reductions in percentage energy from total fat and saturated fat could be made if 7–8-year-old children were encouraged to drink semi-skimmed milk and to consume less potato crisps, also an important contributor to fat intakes.

Mean carbohydrate intake as a percentage of food energy met the DRV of 50, but it was not possible to break down this value into non-milk extrinsic sugars and intrinsic plus milk sugars due to the limitations of the COMP-EAT 4.0 program. However, it was still apparent from the values for percentage energy from starch and from total sugar that the former was too low and the latter too high at 23 and 26 respectively. The estimation of mean sucrose intake was hindered by a lack of manufacturers' data on the sucrose content of confectionery, resulting in severe underestimation. Thus, the value of 28 g cannot be used as an approximation of non-milk extrinsic sugars. The main non-milk sources of sugars in the present study were juices and carbonated beverages and this has been found also by Payne (1991) in Edinburgh preschool children. A reduction in intake of sugars is desirable according to the DRV report (Department of Health, 1991) yet the 'fat-sugar seesaw' demonstrated in the present paper suggests that efforts to decrease percentage energy from total sugar may result in further increases in percentage energy from fat as it is unlikely that sugar will be replaced by starch. Based on strong evidence linking high

intakes of total fat and saturated fat to coronary heart disease, the priority in the case of children should be a reduction in fat. Concerns that reductions in fat may adversely affect growth have not been justified in this sample of children (Ruxton *et al.* 1995).

Intakes of NSP were approximately 57% of the CRV advocated by The Caroline Walker Trust (1992). This guideline was used because there are no DRV for NSP intakes in children. It is difficult to make firm conclusions regarding the adequacy of the NSP intakes reported in the present study since there are few published data on actual NSP intakes in children and even less published evidence to suggest what constitutes a 'high' or 'low' NSP intake. Adamson *et al.* (1992) reported mean intakes of about 9 g NSP for adolescents, which is only slightly more than the 8 g reported in the present study of 7–8 year olds. An additional point is that the CRV proposed by The Caroline Walker Trust (1992) is based simply on an attempt to 'scale-down' adult reference values on the basis of energy requirements. This may not be an appropriate method since children have higher energy requirements per kg body weight than adults. However, despite difficulty in establishing an 'ideal' NSP intake for children, it remains noteworthy that the primary source of NSP for 43% of children in the present study was potato crisps. Advocating replacing crisps with fruit as a snack may result in benefits to intakes of NSP as well as those of percentage energy from fat.

Research on adolescent children (Benton & Roberts, 1988; Department of Health, 1989) has suggested that some UK children are at risk of low intakes of certain micronutrients, e.g. Fe, Ca, vitamin A, folate. This was not the case for the 7–8-year-old children in the present study. Mean intakes of most micronutrients were in excess of UK DRV and few children had intakes below LRNI. The distribution of data demonstrated that the majority of children had micronutrient intakes in excess of the RNI, suggesting that most micronutrient deficiencies were unlikely. Exceptions to this appeared to be vitamin A, Zn and Se, since more than the expected 2.5% of children had intakes below LRNI. Certainly the low intakes of vitamin A found here agree with published work on Scottish children (Department of Health, 1989; McNeill *et al.* 1991; Payne & Belton, 1992). However, the results for Zn and Se should be treated with caution since it is likely that they represent an underestimation of intake due to the incompleteness of the Royal Society of Chemistry database on which the COMP-EAT 4.0 program was based. Alternatively, the new DRV for these two nutrients may have been set too high. Further research on biochemical indices would be useful to establish whether or not clinical deficiencies in Zn and Se exist, particularly since DRV have been set for the first time. It is thought that high intakes of antioxidant nutrients (vitamins C and E,  $\beta$ -carotene, Zn and Se) may have a role to play in the prevention of chronic adult diseases. However, since there is inadequate information on what constitutes optimal levels of intake, the adequacy of intakes in the present study cannot be assessed. It is hoped, nevertheless, that the data presented on vitamin E and  $\beta$ -carotene intakes in the present paper will benefit future researchers in this area.

The evidence from the present study only partially confirms the opening observation that 'The usual Scottish diet consumed by children is also that which we would now expect to be conducive to the development of adult chronic diseases' (Scottish Office, 1993). Clearly, there is a need to reduce percentage energy from total fat and from saturated fat in children as these are likely to contribute to later obesity, coronary heart disease and cancers. Intakes of NSP appear to be low, which could potentially contribute to later colonic disease, if sustained. However, conclusions cannot be drawn until satisfactory reference values for NSP in children have been established. Intakes of most micronutrients were satisfactory and the risk of deficiencies in this particular age-group would not appear to be an area of public health concern. Instead, the focus should be on reducing intakes of total fat and of saturated fat, possibly by targeting the main food sources of these in children's diets.

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