School dinners and markers of cardiovascular health and type 2 diabetes in 13-16 year olds: cross sectional study

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Recent concern about the diets of British children and adolescents has focused on the nutritional content of school dinners.[1] However, whether markers of nutrition, cardiovascular health, and type 2 diabetes differ between school pupils who eat school dinners and those whose school day meal is provided from home has been little studied. We have examined this question in a survey of state secondary school pupils.

Participants, methods, and results

The ten towns heart health study (third phase) took place in 72 secondary schools across England and Wales in 1998-2000.[2,3] Parents gave written consent (response rate 66%). We assessed height, weight, waist and hip circumference, skinfold thicknesses, bioimpedance measurement (percentage body fat), and pubertal status.[2–4] We measured blood pressure, and participants provided blood samples for measurements of plasma glucose, serum insulin, and blood lipids after an overnight fast.[2,3] We measured serum leptin by radioimmunoassay, plasma vitamin C by high performance liquid chromatography, and serum folate by microbiological assay. Participants indicated whether they usually ate a school dinner, had a meal from home, or made other eating arrangements. Parental occupation was provided by the parent (75%) or the participant (25%) to determine household social class. We used standard linear modelling procedures to determine adjusted means, log transforming variables when necessary. We fitted town as a fixed effect and school as a random effect to allow for clustering at school level.

The table compares the characteristics of 1112 pupils (53% boys) who usually ate a school dinner or a meal from home; results are standardised for town, school, age, and sex. Among pupils who ate school dinners, anthropometric markers of adiposity were slightly but not significantly lower; mean levels of leptin, systolic blood pressure, ratio of total cholesterol to high density lipoprotein cholesterol, glucose, insulin, and folate were significantly lower in this group. Although pupils whose parents were in unskilled occupations or unemployed were more likely to eat school dinners than those from other social groups (66% *v* 38%, $P<0.0001$), the differences (apart from those in systolic blood pressure) remained statistically significant after adjustment for social class. Additional adjustment for pubertal status and physical activity level had no appreciable effect. Restricting the analysis of the school dinner group to pupils who were eligible for free school meals did not materially affect the results.

Comment

The differences in risk factor profile and nutritional status between pupils eating school dinners and those eating home meals were modest. Their long term importance remains uncertain, although if the

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Comparison of nutritional markers and risk factors among pupils eating school dinners and meals from home

	Mean* (SD)		Mean (95% CI) difference (school dinner – home meal)	
Cardiovascular risk factor	School dinner (n=465)	Home meal (n=647)	Model 1*	Model 2†
Age (years)	15.1 (0.8)	15.0 (0.9)	0.1 (–0.0 to 0.1)	0.1 (–0.0 to 0.1)
Height (cm)	167.1 (0.3)	166.7 (0.3)	0.4 (–0.5 to 1.2)	0.4 (–0.5 to 1.3)
Body mass index (kg/m^2)	20.8 (4.2)	21.1 (4.3)	–0.3 (–0.7 to 0.2)	–0.2 (–0.7 to 0.3)
Sum of skinfolds (mm)	24.8 (6.4)	25.4 (6.8)	–0.5 (–1.2 to 0.1)	–0.5 (–1.1 to 0.2)
Body fat (%)	25.5 (7.0)	26.2 (7.3)	–0.7 (–1.5 to 0.0)	–0.6 (–1.4 to 0.1)
Waist circumference (cm)‡	69.3	69.9	–0.8% (–2.3% to 0.7%)	–0.5% (–2.0% to 1.0%)
Systolic blood pressure (mm Hg)	119.7 (14.5)	121.6 (15.0)	–1.9 (–3.6 to –0.3)§	–1.6 (–3.3 to 0.1)
Diastolic blood pressure (mm Hg)	66.8 (9.2)	67.6 (9.8)	–0.7 (–1.6 to 0.2)	–0.6 (–1.6 to 0.3)
Total cholesterol (mmol/l)	4.18 (0.84)	4.23 (0.89)	–0.05 (–0.13 to 0.04)	–0.04 (–0.13 to 0.05)
LDL cholesterol (mmol/l)	2.27 (0.71)	2.34 (0.74)	–0.07 (–0.15 to 0.00)	–0.06 (–0.14 to 0.01)
HDL cholesterol (mmol/l)	1.48 (0.33)	1.45 (0.33)	0.04 (0.00 to 0.07)	0.04 (0.01 to 0.08)§
Total:HDL cholesterol ratio	2.91 (0.81)	3.03 (0.83)	–0.12 (–0.21 to –0.02)§	–0.13 (–0.22 to –0.04)¶
Triglycerides (mmol/l)‡	0.92	0.94	–2.4% (–6.8% to 2.1%)	–3.5% (–7.8% to 1.0%)
Glucose (mmol/l)	5.04 (0.60)	5.10 (0.66)	–0.07 (–0.12 to –0.02)§	–0.07 (–0.13 to –0.02)¶
Insulin (mU/l)‡	8.65	9.28	–6.8% (–12.0% to –1.3%)§	–6.7% (–11.9% to –1.2%)§
Leptin (ng/ml)‡	5.79	6.71	–13.6% (–22.1% to –4.3%)¶	–13.0% (–21.7% to –3.5%)¶
Vitamin C (μmol/l)	50.6 (33.0)	52.4 (36.9)	–1.8 (–4.4 to 0.8)	–1.3 (–3.9 to 1.4)
Folate (μmol/l)‡	13.3	14.9	–10.8% (–16.6% to –4.7%)¶	–9.7% (–15.7% to –3.4%)¶

HDL=high density lipoprotein; LDL=low density lipoprotein.
*Means and mean differences (model 1) adjusted for age, sex, town, ethnicity, and school (fitted as a random effect).
†Mean differences (model 2) adjusted for factors in model 1 and for parental occupation.
‡Geometric means and percentage differences.
§P<0.05.
¶P<0.01.

differences in blood lipids, insulin, and leptin persist with increasing age these could be of public health importance. As the provision of school dinners has changed little in the past five years,[1] the differences could be of continuing relevance. However, the extent to which the differences reflect dissimilarities in the composition of school dinners and home provided school meals or other aspects of the dietary patterns and health behaviours of the two groups remains uncertain.

Despite these uncertainties, we can draw two general conclusions. Firstly, the lower mean folate concentration seen among pupils eating school dinners suggests that new initiatives likely to increase the folate content of school dinners would be appropriate.[5] Secondly, the other differences seen suggest that the average health status of pupils eating school dinners is no worse—and may actually be better—than that of pupils eating meals provided from home. This suggests that efforts to improve the diet and nutrition of British children and adolescents will need to extend beyond school dinners to tackle overall dietary patterns and their societal determinants if they are to be successful.

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Contributors: PHW developed the idea for this report, conducted the study with assistance from DGC, and drafted the paper. CGO did the statistical analysis. NS provided analyses of leptin. All authors contributed to the final version of the paper. PHW is the guarantor.

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What is already known on this topic

The content of school dinners has been a cause for concern

Little information is available on the health of school pupils who do and do not eat school dinners

What this study adds

Several markers associated with chronic disease risk were potentially more favourable in pupils who ate school dinners, although serum folate concentrations were also lower

Competing interests: None declared.

Ethical approval: Ethical approval was obtained from all relevant local research ethics committees.

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The broader impact of walking to school among adolescents: seven day accelerometry based study

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How children travel to and from school may significantly influence their overall physical activity levels.[1 2] We measured moderate to vigorous physical activity (MVPA) among adolescents and explored their means of travel to and from school.

Participants, methods, and results

We recruited four classes, each of about 30 pupils aged 13-14 years, from four schools in the Edinburgh area. We visited the classes three times: to introduce the study and distribute consent forms and information for pupils and parents or guardians; to allocate accelerometers (instruments used to measure vertical movement); and to collect accelerometers and issue questionnaires. Inclusion in the study required consent from pupils and primary guardians.

In spring 2004 we obtained objective measures of the children's activity with precalibrated accelerometers (MTI, Fort Walton, Florida; model 7164), which record activity accumulated each minute.[3] We asked the pupils to wear the accelerometers on their hip from waking until bedtime, except while showering, bathing, swimming, and participating in other water based activities. We used age specific cut-off points (on the accelerometer count) to calculate minutes of MVPA per pupil for weekdays (≥10 hours' data daily from 0500 to 2400); during school, including morning and lunch breaks; time outside school (defined as daily MVPA minus MVPA accrued at school, including travel time). Cut-off points were ≥1399 and ≥1547 per minute for ages 13 and 14 respectively.[4]

We collected data from the questionnaire responses about the children's main part of their journey to school (options were walking, car, bicycle, bus, train, or other). Responses to both questions reflected very good agreement after a 14 day retest ($K_w = 0.874$ and 0.836 respectively).

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