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Association between diet and physical activity and sedentary behaviours in 9–10-year-old British White children

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SUMMARY

Objectives: To examine the association between diet and physical activity and sedentary behaviours in 9–10-year-old children.

Study design: A cross-sectional study using data from the SPEEDY (Sport, Physical activity and Eating behaviour: Environmental Determinants in Young People) study undertaken in Norfolk, UK.

Methods: Data from 4-day food diaries and 7 days of accelerometry were matched on concurrent days. Time spent in moderate-to-vigorous physical activity (MVPA), time spent in sedentary behaviour and various measures of dietary intake were collected. Covariates included age, sex, weight status, family socio-economic status, and energy intake reporting quality. Multivariable regression models, adjusted for clustering of children by school and stratified by sex, were fitted to examine the associations between dietary measures and physical activity and sedentary outcomes.

Results: In total, 1317 children (584 boys and 733 girls) provided concurrent data. Boys in the highest quartile of energy percentage from protein spent approximately 6 min [95% confidence interval (CI) 0–12] less in MVPA compared with boys in the lowest quartile. Those in the highest quartiles of fruit and vegetable intake and fruit juice intake had respective average activity counts per minute that were 56 above (95% CI 8–105) and 48 below (95% CI 2–95) those in the lowest quartiles, whilst those in the highest quartile of fizzy drink consumption spent approximately 7 min (95% CI 2–13) more in MVPA and approximately 14 min (95% CI 5–24 min) less in sedentary behaviour. Boys in the highest quartile of savoury snack consumption spent approximately 8 min (95% CI 2–13 min) more in MVPA per day, and approximately 12 min (95% CI 2–23) less in sedentary behaviour. No significant associations were apparent among girls.

Conclusions: Few associations were detected, and the directions of those that were apparent were mainly counterintuitive. The extent to which this reflects a true lack of association or

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is associated with the measurement methods used for diet and physical activity needs further investigation.

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Introduction

The prevalence of overweight and obesity in children is rising sharply.^{1–3} For example, the prevalence in England increased from 11% in 1995 to 17% in 2008 among 2–15-year-old boys, and from 12% to 15% in 2–15-year-old girls.⁴ This is of concern as obese children are more likely to develop psychological and physiological problems. They are known to be more likely to have lower self-esteem and more behavioural problems than non-obese children.⁵ Furthermore, several cardiovascular risk factors, such as hypertension, dyslipidaemia, hyperinsulinaemia and insulin resistance, are associated with childhood obesity.⁶ A further concern is that childhood obesity tracks into adulthood,⁷ which presents a risk for a range of chronic conditions including cardiovascular disease, musculoskeletal disorders and type 2 diabetes.⁸ Although the precise mechanisms of childhood obesity remain unclear, the presence of energy imbalance (higher energy intake than expenditure) is pivotal.⁹

Several dietary behaviours have been associated with overweight in children, with total energy intake,¹⁰ percentage energy from fat, and energy density¹¹ all identified as risks. Conversely, higher fruit and vegetable intake has been found to be protective against weight gain.¹² Worryingly, the British National Diet and Nutrition Survey found that average intakes of saturated fat, salt and non-milk intrinsic sugars are above recommended levels amongst young people, whilst fruit, vegetable and fibre intakes are below recommended levels.¹³ In addition, energy expenditure appears low, with physical activity levels below recommended levels in British children and adolescents.¹⁴ One-third of boys and one-third to one-half of girls report activity levels that may compromise their health.¹⁵

There are indications that diet may be correlated with physical activity and sedentary behaviours, but associations are not well understood in children. In adults, higher physical activity has been associated with higher consumption of fruit, fruit juices and vegetables,^{16–19} whilst high consumption of energy from fat has been associated with lower activity levels.^{16,17,19,20} Evidence in young people often comes from studies focusing on sedentary behaviour, including television and computer use. In 16–20-year-old English adolescents, it was found that more time spent watching films at home at the weekend was related to higher total energy intake, higher fat intake, higher percentage energy intake from fat and lower carbohydrate intake.²¹ A multicountry study found that children who watched more television were more likely to consume more sweets and soft drinks, and less fruit and vegetables.²² Television and computer use has also been inversely associated with fruit and vegetable intake in 5–17-year-old children in Scotland,²³ and a recent systematic review suggested that television viewing is consistently associated with lower fruit and vegetable consumption, and higher energy-dense snack consumption in children.²⁴

Two studies investigated associations with physical activity. The first showed a negative association with fat intake and a positive association with carbohydrate intake in 8–10-year-old African-American girls.²⁵ A second study in 10–11-year-old children in England reported a negative association between physical activity and fat intake, and a positive association with total energy and carbohydrate intake amongst boys. In girls, fruit and vegetable intake was consistently positively associated with physical activity.²⁶ Taken together, these studies suggest some association between dietary intakes and physical activity, but this association may be moderated by gender.

The evidence to date on the relationship between diet and physical activity in children has a number of limitations. Many previous studies^{21–23} have assessed dietary intakes using food frequency questionnaires, and assessed physical activity with self-reported questionnaires, rather than use food diaries to assess dietary intakes and measure physical activity objectively by accelerometry.^{27,28} Just one study, that of Jago *et al.*,²⁶ used both those methods, although the diet and physical activity data were recorded 12 months apart which may attenuate the strength of associations present.

The objective of this study was to extend the evidence base on the association between diet and physical activity, including sedentary behaviour, by analysing data collected amongst a well-characterised sample of 9–10-year-old British children using validated dietary and physical activity instruments. A 4-day food diary was used to assess dietary intake, and physical activity measurements were based on accelerometry.

Methods

Study sample and analytical design

This cross-sectional analysis used data from the SPEDY (Sport, Physical activity and Eating behaviour: Environmental Determinants in Young People) study, undertaken to examine physical activity and dietary behaviours in a population-based sample of Year 5 (aged 9–10 years) children in Norfolk, England. A detailed overview of the sampling and data collection has been published elsewhere.²⁹ In brief, the study sample consisted of 2064 children attending 92 schools between April and July 2007. Each school was visited by a team of research assistants who distributed a range of items including a 4-day food diary, an accelerometer for the measurement of physical activity, and a questionnaire for the parent or carer of each child. A range of anthropometric measurements was also taken during the school visit.

Data from 4-day food diaries were matched with data on physical activity recorded during the same period in order to assess the relationship between eating and physical

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