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Body Mass, Frequency of Eating and Breakfast Consumption in 9-13 Year Olds

Tara Coppinger
Department of Sport, Leisure & Childhood Studies, Cork Institute of Technology, Cork, Ireland,
tara.coppinger@cit.ie

Y. M. Jeanes
University of Roehampton

J. Hardwick
University of Roehampton

S. Reeves
University of Roehampton

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Abstract

Background

It is widely believed that unhealthy eating patterns in childhood can lead to adverse health conditions, particularly obesity. Yet, debate remains around the precise eating behaviours that lead to these conditions. This study aimed to address this lack of evidence by reporting on the eating frequency, breakfast consumption and body mass of youth.

Methods

A total of 315 (162 boys, 153 girls) participants from nine primary and secondary schools in south-west London provided self-report measures of dietary intake, via 3-day food diaries. Anthropometric measures of height and weight were also obtained.

Results

Frequent breakfast consumers had significantly lower BMI Z-scores than those who did not eat breakfast regularly and overall, those aged 10 and under consumed breakfast more frequently than those aged 11 or over. Mean BMI *Z*-scores for both genders were within the healthy range 'normal' and there was no relationship between BMI Z-score and eating frequency. Older boys (11-13 y) were less likely to eat regularly and had the lowest breakfast consumption intakes.

Conclusions

Although this study shows participants eating regularly, older boys were the least likely to eat regularly and to consume breakfast. Educating these boys on the importance of regular eating patterns, particularly breakfast consumption, may be essential to ensure healthier long-term eating patterns. Furthermore, the lower breakfast intakes in older youth and higher BMI Z-scores of those who do not eat breakfast regularly, needs to be monitored.

Introduction

Although it is widely recognised that unhealthy eating patterns in childhood can lead to adverse health conditions, particularly obesity (McNaughton et al. 2008), debate still remains around the precise eating behaviours that lead to these conditions (Patro & Szajewska, 2010). Breakfast consumption, in particular, has received much attention in recent years, with evidence showing greater fibre, calcium and lower saturated fat intakes (Timlin et al. 2008; Song et al. 2006) , in children who consume breakfast regularly. Improvements in cognitive function and academic performance are also reported (Hoyland et al. 2009). Some studies also suggest children who eat breakfast regularly maintain healthier weights and undertake more healthful food choices (Rampersaud, 2008). Yet, research within this field remains inconclusive (Abalkhail & Shawky, 2002; Resnicow, 1991; Walker et al. 1982), particularly with regards the relationship between meal frequency, breakfast consumption and body mass in youth (Patro & Szajewska, 2010; Timlin et al. 2008). A few cross-sectional studies (Hackett et al. 2002; Keski-Rahkonen et al. 2003; Sjoberg et al. 2003; Gibson & O'Sullivan, 1995) have shown an inverse relationship between body weight and breakfast consumption; while others (Toschke et al. 2009; Koletzko & Toschke, 2010) report, instead, that a higher meal frequency, not regular breakfast eating, as the most important factor in the inverse obesity relationship. Much of the current research also originates from the United States, and hence, the findings should not be applied to a British setting, where children exhibit different behavioural eating patterns. Of some of the available research from the UK (Albertson et al. 2009; Sandercock et al. 2010; Macdiarmid et al. 2009), only one of the studies (Macdiarmid et al. 2009) reported on weekend eating patterns and the frequency of eating, breakfast consumption and body mass. The most recent paper (Sandercock et al. 2010) only included data on school day breakfast patterns. Much is still to be learned, therefore, on any such relationship between meal patterns and obesity, which this study aims to address. The frequency of eating and breakfast consumption will therefore be investigated alongside body mass in boys and girls attending both primary and secondary schools in London, UK to identify any relationships that may exist.

Materials and Methods

Study Population and Design

A detailed outline of the study design has been reported elsewhere (Finnerty et al. 2010; Coppinger et al. 2010). In brief, a one-stage cluster sampling method was used to select schools and overcome the constraints of time and costs associated with a dispersed population. These clusters included: (1) type of school; (2) school geographic location; (3) gender make-up of school; (4) secondary school feeding system (due to an associated longitudinal study that was also taking place) and (5) school classification. The study was approved by the Roehampton University Ethics Committee. Furthermore, Head teacher permission was received from each of the participating schools, each child gave informed consent and parental consent was obtained prior to the child's participation in the study.

In total, 315 (162 boys and 153 girls) children were recruited in 2007, who were between the ages of 10 and 13 years (11·4 ± 1·1 years) and in full-time education in 3 primary and 6 secondary schools that ranged from mid-high socio-economic backgrounds, in south-west London. Due to absenteeism, drop-out and apparatus-related issues including loss or incomplete diary completion, 264 (133 boys, 131 girls) completed all aspects of the study.

Breakfast consumption and frequency of eating

Dietary intake (including meal frequency and breakfast consumption) was assessed via 3 day food/drink diaries (Friday-Sunday). De Castro (1991) states that greater variation in food intake occurs over the weekend compared with weekdays, and this method of choice also helped minimise interference with the school day. Children were asked to record everything they ate and drank over the three days, including portion sizes. As Gatenby (1997) reports that 'meals' are generally described in a colloquial sense, that is, one of the main eating occasions of the day and 'snacks,' refer to other eating episodes that are generally smaller and less structured, the diary contained prompts e.g. 'What did you have for breakfast?' and 'Did you have any snacks today?' In order to validate intake, it was also cross-validated with a Fruit and Vegetables Screening Measure (Prochaska & Sallis, 2004) (r=.43, p<.05) and five subjects (2 boys, 3 girls) were randomly selected to take photographs of all their food

and drink (Ovaskainen et al. 2008) with a disposable camera. No significant differences (p>.05) in energy intake were found.

Once all diaries were completed and to ascertain the frequency of eating, an Eating Frequency Chart was created for each participant (using the Microsoft Excel software package) and the diaries analysed using the DietPlan 6 (Forestfield Software, UK) nutritional software. Children aged 9-13 can reliably report food intake and the 3 day food/drink diary is a valid tool to measure this behaviour (Rockitt & Colditz, 1997).

Height and weight

The Omron M5-1 Intellisense (Kyoto, Japan) weighing scales and Leicester (Crawlea Medical, Birmingham, UK) free-standing stadiometer were used to measure participants' height and weight by trained researchers in a private area in participating schools. Measurements were recorded to the nearest 0·1 kg and 0·1 cm, respectively, and all children were asked to remove their shoes and any other heavy outer garments before measurement. BMI (kg/m^2) and BMI *Z*-score were then calculated using equations based on UK reference data (Cole et al. 1995). To allow for international comparisons, Pan and Cole's (2007) Microsoft® Excel add-in 'ImsGrowth' package was also used to calculate graded levels of thinness, normal weight, overweight and obesity of participants.

Data analyses

Preliminary analysis of the variables using a Kolmogorov–Smirnov test of normality revealed that the meal and snacking pattern data was normally distributed. Parametric data analyses were undertaken accordingly using the SPSS statistical software package (17·0, SPSS Inc., Chicago, IL, USA). Multivariable linear regression was used to examine any association between breakfast consumption, frequency of eating and BMI. Pearson's correlations were also used to investigate bivariate relationships between BMI Z-scores, age and eating frequency and independent samples t- tests used to investigate differences between genders against a range of variables including BMI Z-score, frequency of breakfast consumption, caloric intake and the different micronutrients. In order for analysis by age-group, the data was also divided into four groups (group 1: boys aged 9-10 years old; group 2: boys aged 11-13 years old; group

3: girls aged 9-10 years old and group 4: girls aged 11-13 years old) and analysis of variance (ANOVA) tests used to investigate differences.

Results

Table 1 shows the descriptive characteristics of the participants by age group, and also gives the findings from the most recent National Diet and Nutrition Survey (Bates et al. 2010).

Body Mass Index

Using UK reference data (Cole et al. 1995), mean BMI *Z*-scores for both genders were within the 'normal' weight category (Table 1) and an independent-samples t-test found no significant difference between boys (M=.36, ±.97) and girls (M=.12, ±1.20; $t(262)$=1.77, p=.08). A one-way ANOVA investigated the impact of age and gender on BMI Z-scores and found a statistically significant difference in BMI Z-scores for the four groups [F (3, 260) =3.30, p=.021]. Post-hoc comparisons indicated that the mean BMI Z-score for Group 2 (11-13 year old boys) (M=.44, ±.78) was significantly greater than Group 3 (9-10 year old girls) (M=-.14, ±.91). No significant differences were found between the other groups.

When international grades were used for comparison (Cole et al. 2000), 7% of participants (3 boys, 14 girls) were identified as underweight (BMI International Grades -1, -2. -3), 76% (109 boys, 94 girls) as normal weight (BMI International Grade 0), 13% (15 boys, 17 girls) as overweight (BMI International Grade 1) and 4% as obese (5 boys, 6 girls) (BMI International Grade 2).

Frequency of Eating

The mean number of eating occasions per day was 4.7 (±1.5) amongst all participants and the relationship between age and frequency of eating showed a weak negative correlation [r=-.134, n=264, p=.03]. Nine to ten year old boys ate the most often (5.2 times (±1.8) and 11-13 year old boys, the least often (4.6 times (± 1.4). There was no relationship between BMI Z-score and eating frequency (p>.05).

Breakfast Consumption

Eighty four percent (*N*=223) of the participants ate breakfast every day over the measurement period. No significant differences were found between the genders but when analysis was undertaken via age group, those aged 10 and under consumed breakfast more frequently (*M*=.98 ±.09) than those aged 11 or over (*M*=.92, ±.20; *t*(262)=3.47, *p*=.001).

Although the caloric intake of those who ate breakfast every day was higher (*M*=1632 ±462) than those who did not eat breakfast everyday (*M*=1346 ±458; *t*(262)=-3.65, *p*<.001), these children also had higher intakes of iron (*M*=8.22 ±2.50 versus *M*=6.47 ±2.20; *t*(262)=-4.21, *p*<.001), calcium (*M*=688±=259 versus *M*=508 ±207; *t*(262)=-4.21, *p*<.001), and Vitamin E (*M*=6.16 ±2.69 versus *M*=4.91 ±2.28; *t*(262)=-2.78, *p*<.001) (Table 2). The mean BMI Z-scores for these participants were also significantly lower (*M*=.18 ±1.06) than irregular breakfast consumers (*M*=.57 ±1.23; *t*(262)=2.10, *p*=.036) (Table 2). This difference remained even when physical activity (steps taken per day) and energy intake (kcal per day) were added as possible covariates.

Further analysis of breakfast consumption revealed that those who ate breakfast every day were more likely to not have a mid morning snack but less likely to miss other meals or snacks throughout the day (Figure 1). Analysis of the percentage of energy gained from the macronutrients, sugar and saturated fat in the snacks and meals of all participants showed no differences between those that ate breakfast regularly and those who did not.

Associations between BMI Z-score, eating frequency and breakfast consumption were investigated using multiple linear regression and no significant association was found. This non-significant relationship remained when physical activity (steps taken per day) was added to the model.

Dietary Intake

All four groups failed to reach the estimated average requirement (EAR) of energy for their age in the UK. The older groups of boys and girls consumed only 73% and 80% of the EAR respectively, but the younger boys and girls had total intakes of 89% and 93% of that recommended. An independent-samples t-test found a greater total caloric intake for boys (M=1652, ±476) versus girls (M=1522, ±460; $t(262) = 2.27$, p =.02).

The impact of BMI on total caloric intake for the four groups was investigated according to BMI International Grade and a statistically significant difference was found [$F(3, 260)=2.99$, p=.03]. Post-hoc comparisons indicated that the mean score for the normal weight group (M=1624, ± 474) was higher than that of the obese group (M=1224, ± = 434).

Discussion

This paper examined the frequency of eating, breakfast consumption and body mass of 9-13 year olds in London, UK to investigate any relationship that may exist between these variables. The relationship between BMI/BMI Z-score and eating frequency showed no association. Yet, when specifically looking at frequency of breakfast consumption and BMI Z-score, those that consumed breakfast regularly had significantly lower BMI Z-scores than those who did not. This supports findings elsewhere from review (Patro & Szajewska, 2010), cross-sectional (Timlin et al. 2008) and longitudinal research (Berkey et al. 2003; Barton et al. 2005). Thus, stressing the importance of regular breakfast consumption in youth to prevent a heightened risk of obesity (Miech et al. 2006), continues to warrant support.

More frequent breakfast consumers were also found to have higher intakes of calcium, iron and Vitamin E; highlighting the need to regularly consume breakfast to promote healthy growth and development. Other work has shown infrequent breakfast eating to be related to negative health and lifestyle factors such as smoking, irregular intake of lunch and dinner (Sjoberg et al. 2003), higher serum cholesterol levels, insulin resistance, lower dietary induced thermogenesis and poorer performance levels at

school (Berkey et al. 2003; Ruxton et al. 1996; Siega-Riz et al. 1998; Grantham-McGregor, 2005).

Although only a small significant difference, those aged 10 and under consumed breakfast more often than those aged 11 and over. There was also a significant negative correlation between age and frequency of eating, with the youngest male participants (9-10 year old boys) eating the most often. Older boys (11-13 years old) ate the least frequently. The findings from large epidemiologic (Barton et al. 2005; Affenito et al. 2005) and cross-sectional (Siega-Riz et al. 1998; Berg-Kelly, 1995) work elsewhere suggesting food habits, particularly breakfast consumption, to change during maturation, implies that such changes may also be a factor among participants of different ages involved in this study.

As the oldest boys (11-13 year olds) were less likely to eat regularly and have the lowest breakfast consumption intakes, future research should consider investigating why these boys' behaviors were different. Furthermore, as those who ate breakfast in this present study were also less likely to miss other meals or snacks throughout the day (aside from mid-morning snacks), educating these boys on the importance of regular eating patterns, particularly breakfast consumption, may be essential to ensure healthier eating patterns. While issues related to under-reporting cannot be ignored, these boys may be placing themselves at risk of eating only at times of considerable hunger; increasing their chances of consuming higher fat foods at these times (Lozano et al. 1999).

It is important to note that analysis of the percentage of energy gained from the macronutrients, sugar and saturated fat in the snacks and meals of all participants showed no differences between those that ate breakfast regularly and those who did not. Although this goes against the findings in other observational studies (Skinner et al. 1995; Nicklas et al. 2000) that report healthier diet profiles in those who eat breakfast regularly, there are few prospective studies confirming such relationships (Szajewska & Ruszczynski, 2010). Thus, until such data becomes available, attention must be paid to encouraging healthier food choices across the entire day and at all meal sittings in youth, as previously published data from this group of participants

(Finnerty et al. 2010) also found them to have insufficient fruit and vegetable intakes and higher than recommended intakes of saturated fat.

There are some limitations to this study. The cross-sectional, observational findings do not allow us to evaluate whether low frequency breakfast consumers have a direct causal relationship to becoming overweight/obese over time. It could be just as likely that children who were overweight/obese were missing breakfast in an attempt to lose or manage their weight. It is also possible that measurement error in the potential confounding variables may have biased associations towards the null i.e. any true relationship between breakfast, eating frequency and body mass may have been under estimated. The self-reporting nature of dietary intake may too have played a role. Unfortunately, studies on dietary habits in free-living populations most often rely on self-report (Livingstone et al. 2004) but we took a number of steps to try and reduce its effects. Prompts were used in the diary to act as reminders for participants and food photographs and foods were cross-validated with a validated fruit and vegetable screening questionnaire. No statistical differences were found between the energy intakes of the different methods used for validation.

Conclusion

In conclusion, while the majority of youth currently eat frequently (approximately five times a day), older boys are the least likely to eat regularly and consume breakfast. Targeting older children, particularly boys, during the transition into adolescence on the importance of regular eating patterns, particularly breakfast consumption, may be essential to ensure healthier long-term eating patterns (Timlin et al. 2008). Furthermore, the finding that higher BMI Z-scores are evident in participants who do not eat breakfast regularly needs to be monitored as knowledge of long-term (longitudinal) breakfast habits may provide potential behaviour targets for intervention programmes (Alexy et al. 2010) and should identify whether there are causal links between breakfast consumption and future chronic disease.

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Conflict of Interest

The authors report no conflict of interest

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