Nutrition Bulletin

ORIGINAL ARTICLE

What's for breakfast? Nutritional implications of breakfast habits: insights from the NDNS dietary records

S.A. Gibson and P. Gunn
Sig-Nurture Ltd., Guildford, Surrey, UK

Summary

Studies suggest that eating breakfast (as opposed to skipping breakfast) has nutrition and health benefits. However, it is not altogether clear whether these benefits are attributes of breakfast as a meal or meals that include breakfast cereals.

To explore associations with nutrient intakes according to the type of breakfast chosen, we extracted data on all foods consumed at breakfast time (0600–1000 h) from the individual weighed food records of respondents in the National Diet and Nutrition Survey of adults aged 19-to-64-years. Seven days of data were available for each person, giving a total of 12 068 potential breakfast-eating occasions. Our hypotheses were: (1) that adults who skip breakfast have lower-quality diets on that day than those who eat breakfast and (2) that a meal containing breakfast cereal has enhanced nutritional benefits over other types of breakfast.

Approximately 1 in 5 adults consumed no solid food between the hours of 0600 and 1000 h, one-third ate a breakfast that included ready-to-eat cereal or porridge, and 45% consumed a non-cereal breakfast.

Overall, eating breakfast was associated with a lower fat and higher carbohyrate intake over 24 h compared with breakfast skipping. However, 'cereal' breakfasts (containing a ready-to-eat cereal or porridge, usually consumed with milk) were associated with signficantly better macronutrient composition [lower in fat, saturated fatty acids (SFAs), and non-milk extrinsic sugars (NMES) and higher in protein and carbohydrate] compared with other breakfasts. Compared with skipping breakfast, micronutrient intakes were marginally higher on days when non-cereal breakfast was consumed but 30–90% higher on days where cereal was consumed.

In terms of public health recommendations, the results suggest that a cereal breakfast should be encouraged as part of a healthy lifestyle not only in helping to meet nutritional guidelines for fat, SFA, NMES and dietary fibre, but just as importantly in enhancing micronutrient intakes. Given the substantial reductions in sodium content achieved by reformulation since 2000, cereal breakfasts are not high in salt. Other studies have generally demonstrated a favourable impact of a breakfast habit on metabolism, body weight and some aspects of cognitive function, and this study further highlights the special significance of breakfast cereal,

Correspondence: Sigrid A. Gibson, MA MSc RPHNutr, Director, Sig-Nurture Ltd., Guildford, Surrey GU1 2TF, UK.
E-mail: sigrid@sig-nurture.com

rather than breakfast as a meal occasion, to help consumers meet nutritional guidelines.

Keywords: adults, breakfast, cereal, diet, guidelines, nutrients, nutrition

Introduction

Many studies suggest that 'breakfast' benefits total nutrient intake and dietary composition (Ruxton & Kirk 1997; Barton *et al*. 2005; Rampersaud 2009). However, it is not altogether clear whether these benefits are attributes of breakfast as a meal or depend on the type of breakfast consumed. Consumption of breakfast cereals has been associated with better dietary quality among both adults (Galvin *et al*. 2003) and children (Gibson & O'Sullivan 1995; Gibson 2003; Williams *et al*. 2009), and prospective studies have also shown relationships with body weight and cardiovascular risk factors (Bazzano *et al*. 2005; De La Hunty & Ashwell 2007; Albertson *et al*. 2008; Albertson *et al*. 2009). Meal patterns have received less attention because studies rarely collect data on time of consumption. However, the work of De Castro *et al*. (2004) has suggested that food consumed in the morning may be more satiating, and this may provide a plausible mechanism for effects of breakfast on body weight. There is also some evidence that consumption of breakfast may elevate mood and performance, although the data are somewhat inconsistent, with benefits depending on individual nutritional state (Bellisle 2004). In general, eating breakfast regularly may be considered a health-promoting behaviour (Bamber *et al*. 2007).

High-quality studies such as the British National Diet and Nutrition Surveys (NDNSs) provide a rich resource for exploring the context of eating, and in particular, meal occasions. In the last full survey for which data are available, respondents recorded to the nearest 5 minutes the time at which each item was consumed (Henderson *et al*. 2002). We used the weighed food records of men and women participating in the NDNS 2000/2001 (>300 000 items recorded over 12 068 person–days) to extract information on the foods consumed at breakfast time and explore correlations between the type of breakfast and nutrient intakes over the whole day. By using individual diaries at the day-to-day level we were able to assess more precisely the impact of breakfast type, allowing for the fact that people may consume different types of breakfast on different days. The use of daily rather than weekly data also provided a larger sample size and hence increased the power to detect significant differences between types of breakfast.

Our hypotheses were that adults who skip breakfast have lower-quality diets on that day than those who eat breakfast and that a cereal-based breakfast in particular has enhanced nutritional benefits over other types of breakfast.

Methods

Data set

The NDNS: adults aged 19-to-64 years is a nationally representative survey of the diet and health of adults living in private households in Great Britain in 2000/2001 (Hoare *et al*. 2004). Respondents were interviewed in person by trained fieldworkers to gather information on a wide range of demographic, lifestyle and health factors, including whether the respondent was on a diet to lose weight. Of the 2251 interviewed, 1724 went on to complete a weighed diet record of food and drink consumed, both in and out of the home, over 7 days, giving a total of 12 068 person–days records. Body weight, height and waist circumference were measured (after the dietary record period) by trained fieldworkers. Physical activity was assessed over the same 7 days as the dietary record and within the same diary. Further details are given in appendix D of the published report. A summary is downloadable from the Food Standards Agency website: (http://www.food.gov.uk/multimedia/pdfs/ndns5full.pdf).

Data files and documentation for the survey were obtained from the UK Data Archive (http://www.esds.ac.uk) and analysed using IBM® SPSS statistics18 (SPSS IBM Inc Chicago, IL, USA).

Data preparation and analysis

Breakfast was defined by the time of day (any item consumed between 06.00 and 10.00 h).

Main classes of food and drink consumed at breakfast were tabulated according to popularity (total number of occasions recorded). Data were then aggregated such

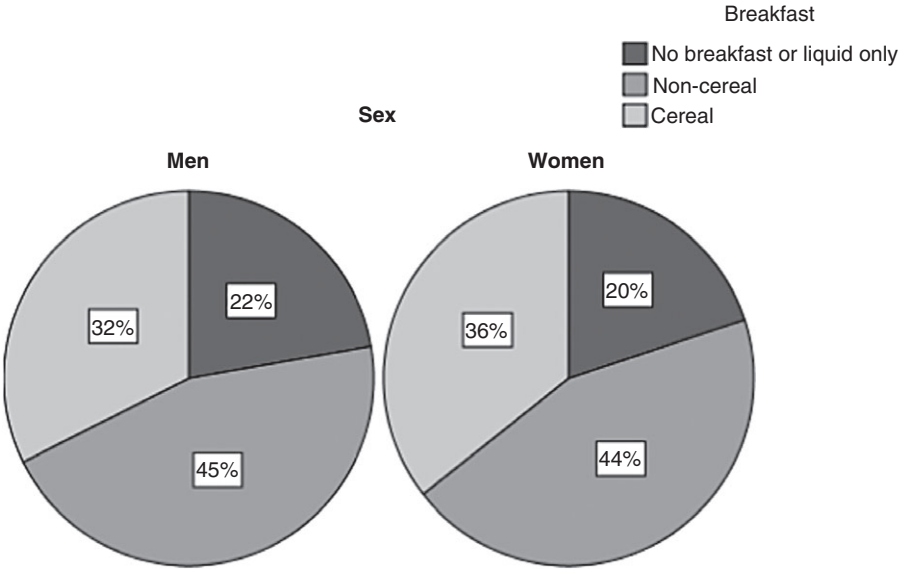

Figure 1 Breakfast type consumed in men and women over 12 068 person–days.

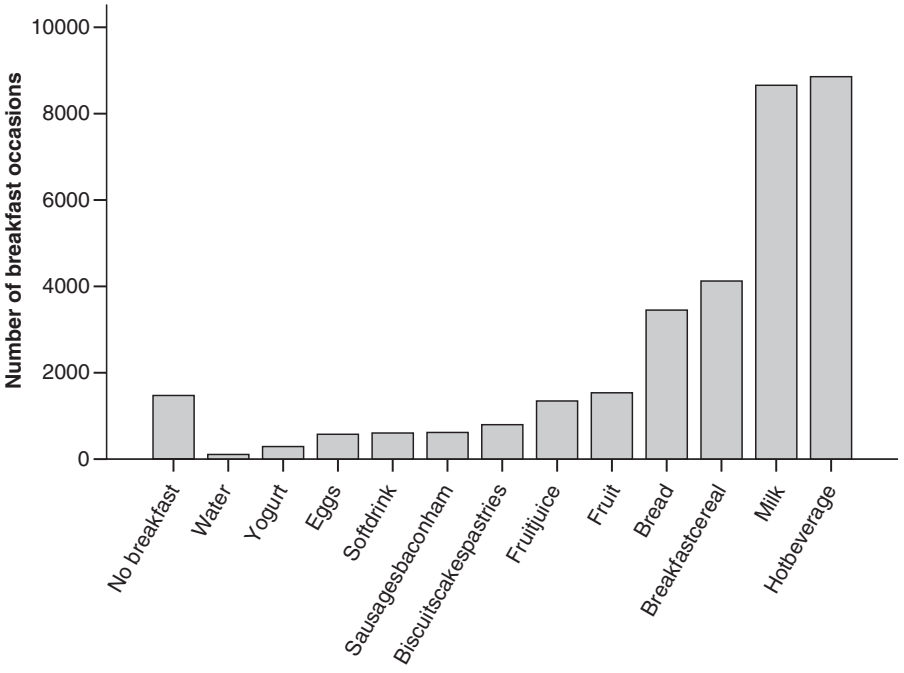

Figure 2 Composition of breakfast time meal over 12 068 d (frequency of citation).

that each record represented one day. The breakfast meal was classified according to whether it included breakfast cereal (cereal), items other than cereal (non-cereal) or whether it consisted of nothing or merely a drink (tea/coffee/water/juice).

Nutrient intakes based on daily (24 h) weighed dietary records were compared between groups using analysis of variance with adjustment for unequal variances. Bonferroni correction was employed for multiple comparisons. All analyses were conducted for men and women separately. Tables show means and signficance levels for comparison of (1) any breakast vs. none and (2) cereal vs. non-cereal breakfast.

Results

Items consumed at breakfast

Approximately 1 in 5 adults consumed nothing at all at breakfast time or only had a drink between the hours of

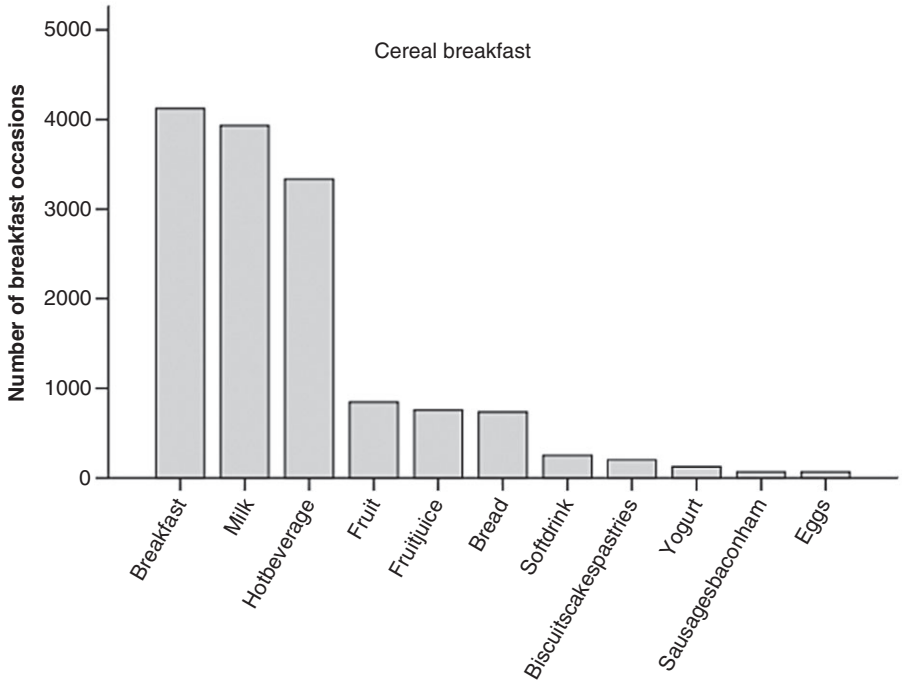

Figure 3 Items consumed at breakfast time in cereal breakfast sample.

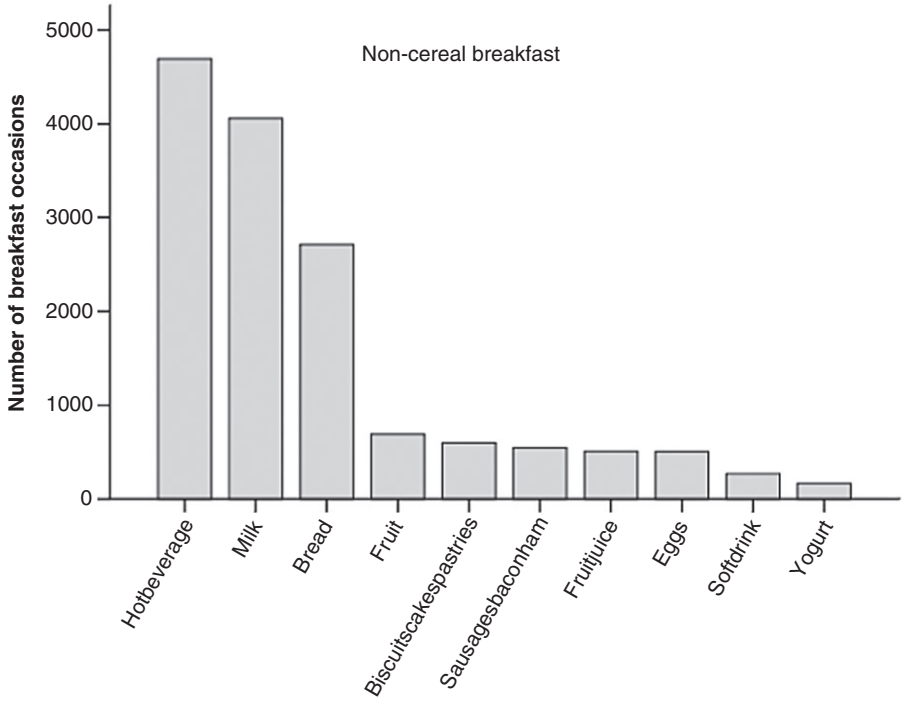

Figure 4 Items consumed at breakfast time in non-cereal breakfast sample.

0600 and 1000 (Fig. 1). Around one-third (32% of men, 36% of women) ate a breakfast that included cereal, while around 45% consumed a non-cereal breakfast.

The composition of these breakfasts, in terms of items recorded, is shown in Figure 2. Overall, the most popular breakfast item was a hot beverage (tea or coffee), consumed on 84% of breakfast occasions. Milk was consumed on 82% of occasions, followed by breakfast cereal (39%), bread (33%) and fruit (14%). There were slight differences between men and women, in that women were less likely to have consumed bread/

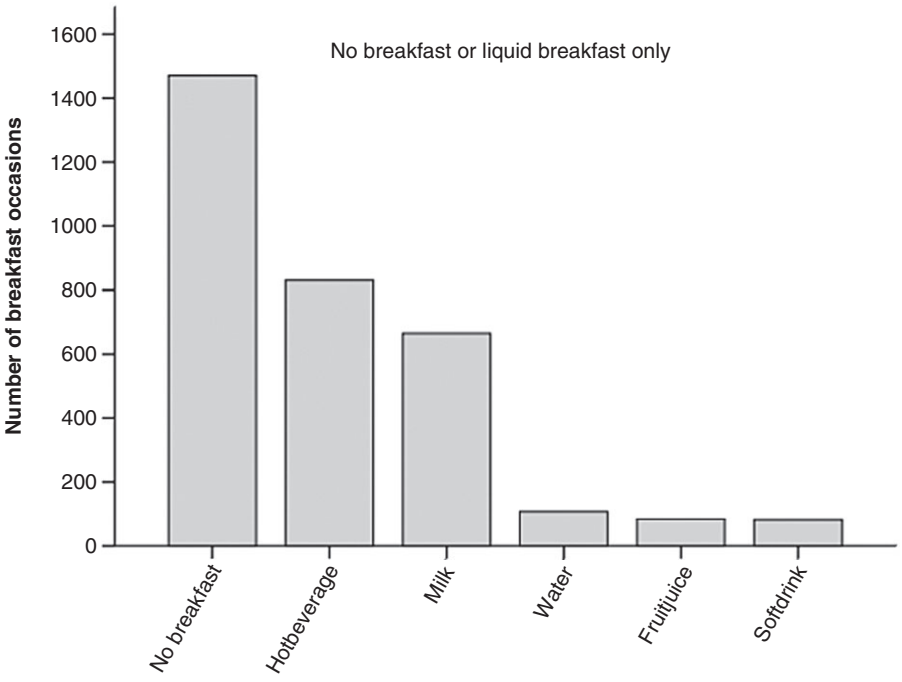

Figure 5 Items consumed at breakfast time in no-breakfast or liquid breakfast-only sample.

Table 1 Energy and macronutrient intake according to breakfast type (total sample)

	Breakfast type				Statistical comparison	
					Any breakfast vs. none	**Cereal vs. non-cereal**
	No breakfast or liquid only	**Non-cereal**	**Cereal**	**Total**	***P* value**	***P* value**
Valid N	*2516*	*5410*	*4122*	*12048*		
Energy in day (kcal)	1772	1937	2016	1929	<0.0001	<0.0001
Energy in day (kJ)	7448	8141	8490	8115	<0.0001	<0.0001
% from protein	15.9	15.5	16.4	15.9	ns	<0.0001
% from fat	34.0	34.3	30.7	33	<0.0001	<0.0001
% from SFA	12.6	13.0	11.7	12.5	ns	<0.0001
% from carbohydrate	44.5	45.1	49.2	46.4	<0.0001	<0.0001
% from NMES	12.1	12.5	11.3	12	ns	<0.0001

SFA, saturated fatty acid; NMES, non-milk extrinsic sugars.

sausage/bacon/eggs and more likely to have consumed fruit (data not shown). Within each type of breakfast (cereal breakfast, non-cereal breakfast and liquid/no breakfast), items consumed and frequencies are displayed in Figures 3–5, respectively.

Association of breakfast type with energy and macronutrient intake

Breakfast skippers (non-breakfast or liquids only) consumed about 200 kJ less over the day (mean 1772 kJ/d) than those who ate breakfast (Table 1).

Cereal breakfasts were associated with a slightly higher energy intake during the day than non-cereal breakfasts (2016 vs. 1937 kJ/d; $P < 0.0001$). Both men and women showed nearly identical trends and therefore only results for the total sample are given.

Overall, eating breakfast was associated with a lower fat and higher carbohydrate intake over 24 h compared with breakfast skipping ($P < 0.0001$). However, this was mainly attributable to cereal-based breakfasts as the non-cereal breakfasts were associated with slightly higher saturated fatty acid (SFA) and lower protein intakes ($P < 0.001$). Macronutrient composition was

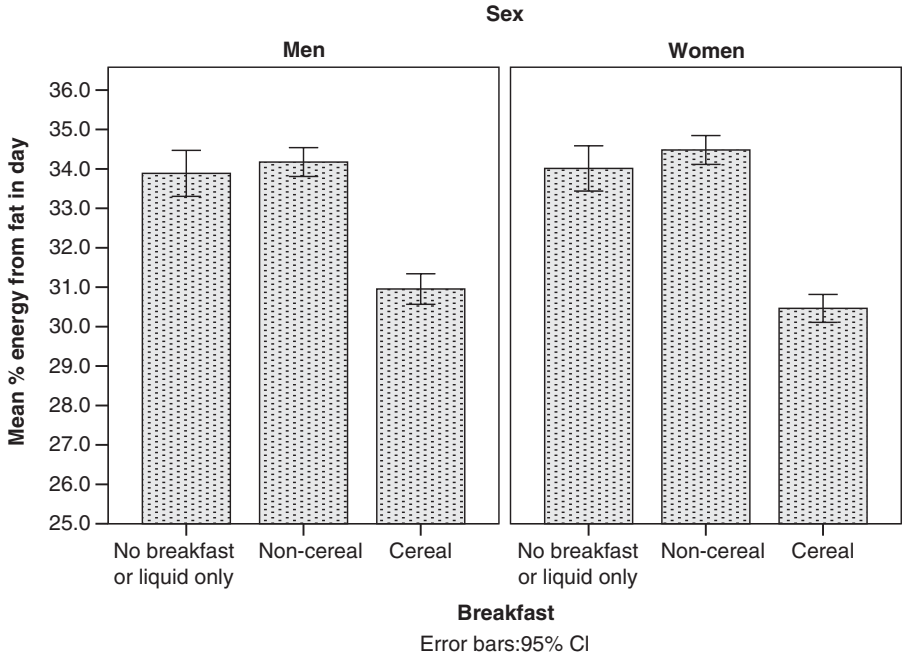

Figure 6 Average percentage energy intake from fat over 24 h according to breakfast type and sex.

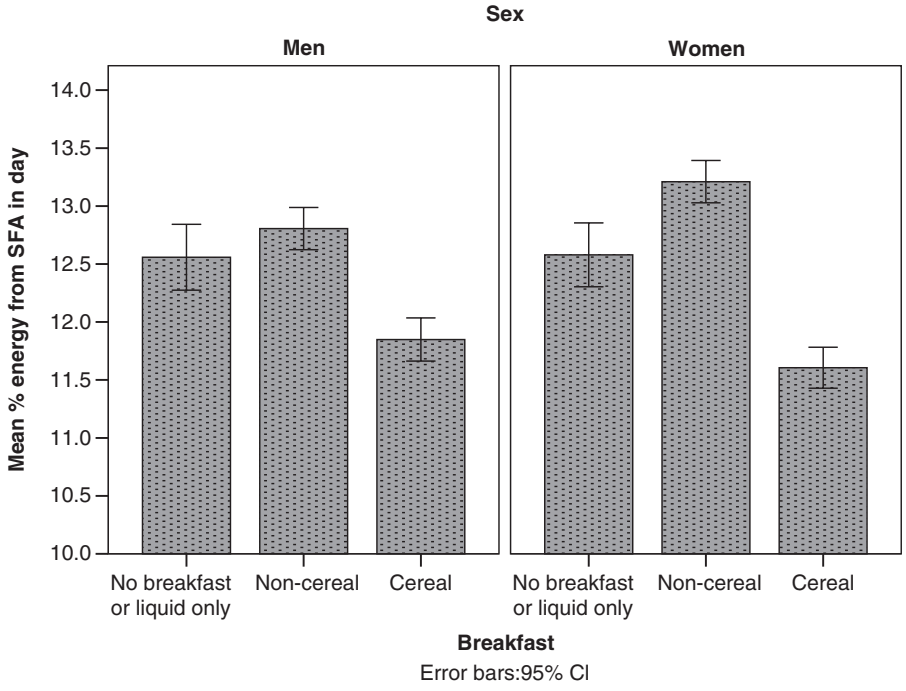

Figure 7 Average percentage energy intake from saturated fatty acid (SFA) over 24 h according to breakfast type and sex.

closest to dietary recommendations for fat, SFA, carbohydrate and non-milk extrinsic sugars (NMES) on days in which cereal was consumed at breakfast (Figs 6–8). Cereal breakfasts, many of which included milk, also resulted in a higher percentage of energy intake from protein over the day compared with other types of breakfast or liquid-only/no breakfast ($P < 0.0001$).

Association of breakfast type with micronutrient intakes

Skipping breakfast (or having only a drink) was associated with the lowest intake of all micronutrients (Table 2). In comparison, micronutrient intakes were 6–18% higher on non-cereal days and 30–90% higher

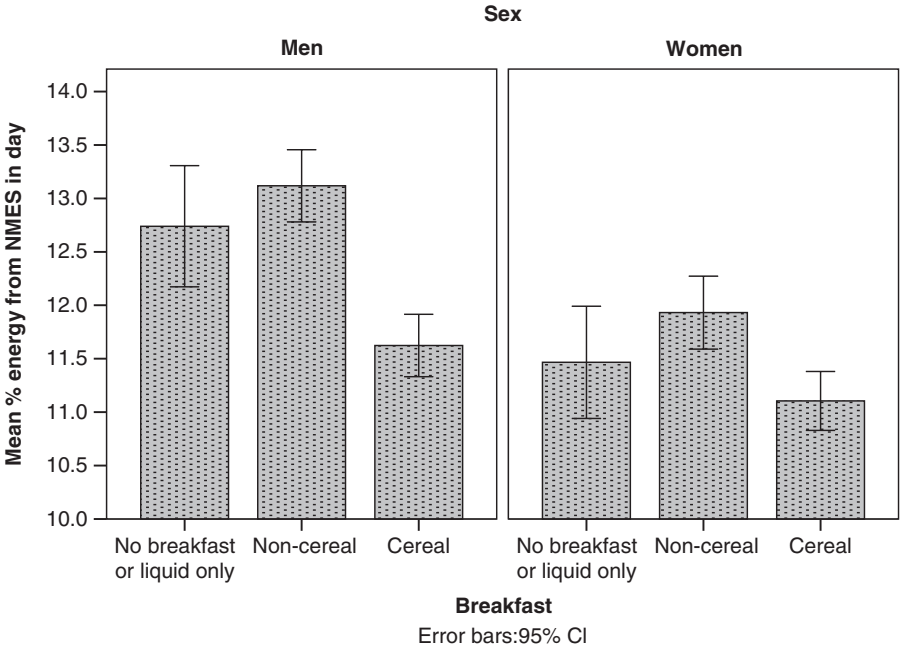

Figure 8 Average percentage energy intake from non-milk extrinsic sugars (NMES) over 24 h according to breakfast type and sex.

Table 2 Micronutrient intakes according to breakfast type

	Breakfast type			Statistical comparison	
				Any breakfast vs. none	**Cereal vs. non-cereal**
	No breakfast or liquid breakfast	**Non-cereal breakfast**	**Cereal breakfast**	***P* value**	***P* value**
Valid N	*2533*	*5413*	*4122*		
Energy (kcal) (kcal)	1772	1937	2016	<0.0001	<0.001
Energy (kJ)	7448	8141	8490	<0.0001	<0.0001
NSP fibre (g)	11	12	17	<0.0001	<0.0001
Sodium (mg)	2498	2760	2844	<0.0001	<0.0001
Calcium (mg)	758	857	1064	<0.0001	<0.0001
Iron (mg)	10.6	11.4	16.4	<0.0001	<0.0001
Vitamin D (μg)	3.1	3.7	5.0	<0.0001	<0.0001
Thiamin (mg)	1.72	1.91	2.95	<0.0001	<0.0001
Riboflavin (mg)	1.67	1.96	3.23	<0.0001	<0.0001
Niacin (mg)	35	36	45	<0.0001	<0.0001
Vitamin C (mg)	83	94	148	<0.0001	<0.0001
Vitamin B6 (mg)	2.5	2.8	4.3	<0.0001	<0.0001
Vitamin B12(μg)	4.9	5.7	7.3	<0.0001	<0.0001
Folate (μg)	262	282	418	<0.0001	<0.0001

on days cereal was consumed (Fig. 9). Because energy intakes were only 9% higher in non-cereal and 14% higher in cereal groups, this indicates significantly enhanced micronutrient density associated with cereal days in particular. Sodium intakes were 10–14% higher in breakfast-consuming groups than among breakfast skipppers, in parallel with energy intake. However, the sodium content of branded breakfast cereals has declined by around 44% since 2000 as a result of reformulation (Food Standards Agency 2009).

Discussion

These findings of a beneficial impact of breakfast cereal on dietary quality are supported by many other studies (Gibson & O'Sullivan 1995; McNulty *et al*. 1996;

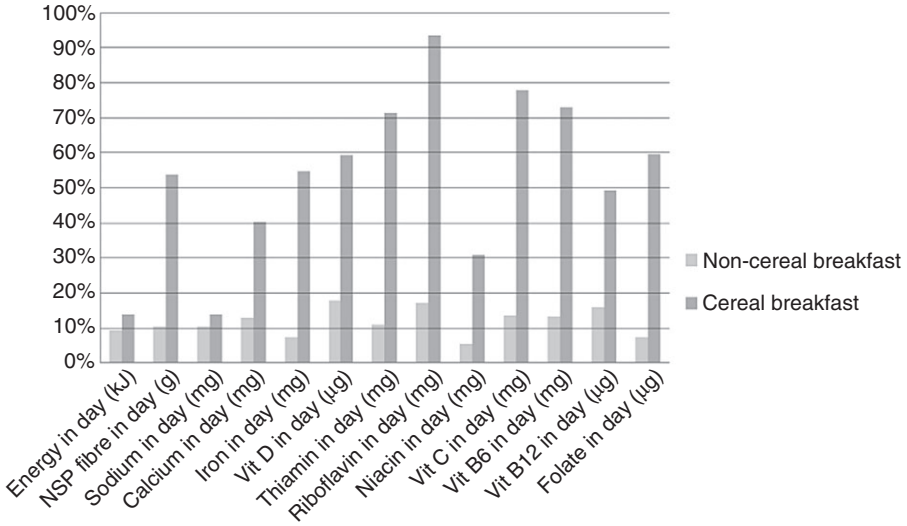

Figure 9 Nutrient intakes over the day are enhanced by breakfast and especially breakfast with cereals (values relative to breakfast skippers at 0%).

Ruxton & Kirk 1997; Bertrais *et al*. 2000; Galvin *et al*. 2003; Gibson 2003; Barton *et al*. 2005; Bazzano *et al*. 2005; Albertson *et al*. 2008). It is not surprising that the nutritional benefits do not apply equally to all types of breakfast but depend on the choice of foods consumed. However, this is not to deny that there may be other health benefits that are conveyed by the habit of breakfast but which were beyond the scope of this study.

The NDNS is a rich resource for exploring dietary patterns in a nationally representative sample of the British population, and the fact that such data are relied upon for nutritional monitoring and food and health policy is testament to their quality. Nevertheless, misreporting is a recognised phenomenon in all dietary surveys, under-reporting being more common than over-reporting. Although fieldworkers probed gaps in the dietary record such as missing meals and snacks, the 'no-breakfast' group may have included more under-reporters as well as some individuals who had lower-than-normal energy intakes that day. True energy intakes may therefore be underestimated in this group, while selective omission of mid-morning confectionery or cakes might mean that true fat and sugar intakes are higher in this group than we have estimated. On the other hand, the inclusion of some individuals who ate breakfast after 10 am, perhaps because of shift work or weekends, would tend to counteract this. Thus, on balance, our findings regarding dietary quality (percentage energy from macronutrients and contribution to micronutrient intakes relative to energy) are likely to be relatively robust.

Secondly, the definition of cereal breakfast is one of inclusion (cereal breakfast consumers ate other foods as well) whereas that of non-cereal breakfast is one of exclusion. This may explain the higher energy intakes among those consuming cereal breakfasts. Further analysis might be warranted to identify implications of different types of cereal breakfast (*e.g.* ready-to-eat or porridge; cereal and milk only, or cereal as a part of a larger breakfast) and its association with physical activity and bodyweight. More research is also required to confirm whether observed nutritional benefits are a direct result of the breakfast foods chosen or because breakfast choice is merely a marker for healthier dietary habits the rest of the day.

In terms of public health recommendations the present results suggest that a cereal-based breakfast should be encouraged as part of a healthy lifestyle. Breakfasts that include breakfast cereal (ready-to-eat or porridge) are associated with a lower percentage of energy derived from fat, SFA and NMES, and a higher intake of dietary fibre and micronutrients compared with other types of breakfast or none. The micronutrient enhancement is largely a consequence of fortification (McNulty *et al*. 1996; Galvin *et al*. 2003), while milk provided protein and a proportion of the vitamins and minerals. Although bioavailability may be an issue for some fortification nutrients such as iron, several studies have reported better micronutrient status among consumers of breakfast cereals (Ortega *et al*. 1996, 2006; Gibson 2003; Ortega *et al*. 2007). In this current NDNS data set we found cereal consumers to have lower levels of plasma homocysteine (unpublished data). Most healthy eating advice includes making breakfast a priority. While the present study qualifies this from the standpoint of nutrient supply, elucidating the effect of meal patterns on metabolism and wellbeing presents a more complex challenge.

Acknowledgements

Datafiles for the present study were obtained under license from the UK Data Archive Colchester, Essex, UK. (SN: 5140). The National Diet and Nutrition Survey: Adults Aged 19-to-64-years, 2000–2001 was conducted by the Office for National Statistics. Social and Vital Statistics Division and the Food Standards Agency and neither creators, depositors, copyright holders or distributors bear responsibility for their further analysis or interpretation.

This research was funded by The Breakfast Panel, which is supported by an unrestricted educational grant from the Association of Breakfast Cereal Manufacturers (ACFM). Neither The Breakfast Panel nor ACFM had a role in the analysis, interpretation or writing of this paper.

Conflict of interest

The authors have no conflict of interest to disclose.

References

Albertson AM, Affenito SG, Bauserman R *et al*. (2009) "The relationship of ready-to-eat cereal consumption to nutrient intake, blood lipids, and body mass index of children as they age through adolescence." *Journal of the American Dietetic Association* **109**: 1557–65.

Albertson AM, Thompson D, Franko DL *et al*. (2008) "Consumption of breakfast cereal is associated with positive health outcomes: evidence from the National Heart, Lung, and Blood Institute Growth and Health Study." *Nutr Res* **28**: 744–52.

Bamber DJ, Stokes CS & Stephen AM (2007) "The role of diet in the prevention and management of adolescent depression." *British Nutrition Foundation Nutrition Bulletin* **32** (supp): 90–9.

Barton BA, Eldridge AL, Thompson D *et al*. (2005) "The relationship of breakfast and cereal consumption to nutrient intake and body mass index: the National Heart, Lung, and Blood Institute Growth and Health Study." *Journal of the American Dietetic Association* **105**: 1383–9.

Bazzano LA, Song Y, Bubes V *et al*. (2005) "Dietary intake of whole and refined grain breakfast cereals and weight gain in men." *Obesity research* **13**: 1952–60.

Bellisle F (2004) "Effects of diet on behaviour and cognition in children." *Br J Nutr* **92** (Suppl. 2), S227–32.

Bertrais S, Polo Luque ML, Preziosi P *et al*. (2000) "Contribution of ready-to-eat cereals to nutrition intakes in French adults and relations with corpulence." *Ann Nutr Metab* **44**: 249–55.

de Castro JM (2004) "The time of day of food intake influences overall intake in humans." *J Nutr* **134**: 104–11.

De La Hunty A & Ashwell M (2007) "Are people who regularly eat breakfast cereals slimmer than those who don't? A systematic review of the evidence." *Nutrition Bulletin* **32**: 118–28.

Food Standards Agency. (2009, May 18, 2009). "Salt reduction Targets." Retrieved Nov 23, 2010, from http://www.food.gov.uk/scotland/scotnut/salt/saltreduction

Galvin MA, Kiely M & Flynn A (2003) "Impact of ready-to-eat breakfast cereal (RTEBC) consumption on adequacy of micronutrient intakes and compliance with dietary recommendations in Irish adults." *Public Health Nutr* **6**: 351–63.

Gibson S (2003) "Micronutrient intakes, micronutrient status and lipid profiles among young people consuming different amounts of breakfast cereals: further analysis of data from the National Diet and Nutrition Survey of Young People aged 4 to 18 years." *Public Health Nutr* **6**: 815–20.

Gibson SA & O'Sullivan KR (1995) "Breakfast cereal consumption patterns and nutrient intakes of British schoolchildren." *Journal of the Royal Society of Health* **115**: 366–70.

Henderson L, Gregory J & Swan G (2002) *The National Diet and Nutrition Survey: adults aged 19 to 64 years. Volume 1: Types and quantities of foods consumed*. TSO, London, Office for National Statistics.

Hoare J, Henderson L, Bates C *et al*. (2004) *The National Diet and Nutrition Survey: adults aged 19 to 64 years. Volume 5: Summary report*. TSO, London, Office for National Statistics.

McNulty H, Eaton-Evans J, Cran G *et al*. (1996) "Nutrient intakes and impact of fortified breakfast cereals in schoolchildren." *Arch Dis Child* **75**: 474–81.

Ortega RM, Andrés P, López SAM *et al*. (2007) "Changes in thiamin intake and blood levels in young, overweight/obese women following hypocaloric diets based on the increased relative consumption of cereals or vegetables." *European journal of clinical nutrition* **61**: 77–82.

Ortega RM, López SAM, Andrés P *et al*. (2006) "Changes in folate status in overweight/obese women following two different weight control programmes based on an increased consumption of vegetables or fortified breakfast cereals." *The British journal of nutrition* **96**: 712–18.

Ortega RM, Requejo AM, Redondo R *et al*. (1996) "Influence of the intake of fortified breakfast cereals on dietary habits and nutritional status of Spanish schoolchildren." *Ann Nutr Metab* **40**: 146–56.

Rampersaud GC (2009) "Benefits of Breakfast for Children and Adolescents: Update and Recommendations for Practitioners." *American Journal of Lifestyle Medicine* **3**: 86–103.

Ruxton CH & Kirk TR (1997) "Breakfast: a review of associations with measures of dietary intake, physiology and biochemistry." *Br J Nutr* **78**: 199–213.

Williams BM, O'Neil CE, Keast DR *et al*. (2009) "Are breakfast consumption patterns associated with weight status and nutrient adequacy in African-American children?" *Public health nutrition* **12**: 489–96.

