

How does breakfast help manage bodyweight?

M. Ashwell and A. de la Hunty

Ashwell Associates, Herts, UK

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A satellite symposium 'How does breakfast help manage bodyweight?' was held at the Nutrition Society's Summer meeting in Belfast on 16 July 2012. The objective of this meeting was to highlight the scientific research surrounding this interesting question. The breakfast meal as a whole and the role of breakfast cereal, in particular, were discussed. Attendees included nutrition scientists and students from around the UK and the audience included about 100 delegates.

The first speaker of the symposium was Dr Margaret Ashwell, (Ashwell Associates, UK) who discussed the observational evidence investigating the link between breakfast intake and bodyweight. Dr Ashwell summarised the evidence from two reviews on this topic that she and her colleagues have conducted.

The first was a systematic review of nine studies (published up to 2006), which showed consistent evidence for an association between breakfast cereal consumption and a healthy bodyweight in both adults and children (de la Hunty & Ashwell 2007). Five of the studies were in adults. They comprised three cross-sectional observational studies, one prospective study and one randomised trial. The relationship with body mass index (BMI) was analysed in two different ways: some studies compared the average BMI between low and high consumers of breakfast cereals, while others calculated the odds ratio of having a BMI greater than 25 for different consumers of breakfast cereals or they gave the percentages with a BMI greater than 25 for the different groups. Overall, these studies consistently showed that people who regularly consume breakfast cereals tend to have a lower BMI and are less likely to be overweight than those who do not consume breakfast cereals on a regular basis. Although not all of the results were statistically significant, the associations were in the same

direction. There was no evidence that regular breakfast cereal consumers had lower daily energy intakes than infrequent consumers.

Four of the studies were in children, all of which investigated the relationship between breakfast cereal consumption and BMI; three studies were cross-sectional studies and one was a prospective study. As with adults, the evidence from these studies was consistent that children who regularly consume breakfast cereals tend to have a lower BMI and are less likely to be overweight than those who consume breakfast cereals infrequently. There was also no evidence that children who consume breakfast cereals regularly have lower energy intakes than infrequent cereal consumers.

The second systematic review (not yet published, de la Hunty *et al.* 2013) investigated the most recent evidence examining the association between breakfast cereal consumption and bodyweight in children and adolescents, but this time, it was possible to perform a meta-analysis of the pertinent papers identified from the systematic review. Thus, the evidence from 14 pertinent papers containing 25 subgroups was examined. The meta-analysis allowed calculation of the computed effect for the difference in mean BMI between high breakfast cereal consumption and low/non-breakfast cereal consumption across the 25 subgroups, being -1.13 kg/m^2 (95% CI $-0.81, -1.46$) in the random effects model. This is equivalent to a standardised mean difference (effect size) of 0.24 units, which is a reasonable effect size for this type of comparison of data and is statistically significant. Although adjustment for age and publication bias attenuated the difference in BMI somewhat, the difference remained statistically significant. The results therefore showed that the prevalence and risk of being overweight was lower in children and adolescents who regularly consume breakfast cereals compared to those who consume them infrequently or not at all. As in the first systematic review, daily energy intakes tended to be higher in regular breakfast cereal consumers. This implies that a mechanism related to energy expenditure rather than energy intake must account for the BMI difference (see later). The systematic review was unable to explore this possibility, however, because energy expenditure was not measured in any of the studies.

Correspondence: Dr. Margaret Ashwell OBE, Director, Ashwell Associates, Ashwell, Herts SG7 5PZ, UK.
E-mail: margaret@ashwell.uk.com

In her conclusions, Dr Ashwell suggested that the evidence reviewed was indicative that regular consumption of breakfast cereals may be associated with a lower BMI and a reduced likelihood of being overweight in children and adolescents. She also stated that to demonstrate a causal relationship would require three things. First, sufficient evidence from cereal eaters to minimise the impact of confounding factors. For example, they might be more likely to have other potentially healthier lifestyle factors such as physical activity habits causing them to be slim. Secondly, evidence is needed from overweight people to discount the fact that they might skip breakfast to reduce their calorie intake. Thirdly, she pointed out that there would need to be plausible biological mechanisms to support a causal relationship.

The second speaker of this symposium was Dr Sue Reeves (University of Roehampton, UK) who shared results from a clinical trial to explore some of the mechanisms that appear to link bodyweight and breakfast habit. Her research group set out to establish the underlying differences between habitual breakfast eaters and breakfast skippers that were both normal weight and overweight using a randomised controlled trial (RCT). The trial involved 37 participants who were organised into four different groups on the basis of their BMI [low (<25 kg/m²) vs. high (>25 kg/m²)] and breakfast habits: low BMI breakfast eaters (group 1); low BMI breakfast skippers (group 2); high BMI breakfast eaters (group 3); and high BMI breakfast skippers (group 4). Food intake and physical activity were assessed using 7-day food and activity diaries. Measures of resting metabolic rate (RMR), dietary induced thermogenesis (DIT), blood glucose and hunger were measured in the laboratory to establish if there were any metabolic differences between groups and the way in which they responded to breakfast or fasting. In addition 'morningness' of the participants was assessed, that is, how active they feel in the morning. 'Morningness' is considered a measure of circadian rhythm and diurnal preference and was assessed using the Composite Morningness Questionnaire (Barton *et al.* 1995) that includes questions and scales that relate to normal and preferred sleep and waking times. All tests were repeated in the laboratory in both breakfast and non-breakfast conditions. Findings showed that the overweight groups had a lower RMR (*i.e.* energy expended at rest) compared to normal weight groups. Although there were no differences in total energy intake, there were differences in the way in which the groups compensated for missing breakfast in terms of their energy intake and carbohydrate consumption and the timing of these intakes over

the course of the day; overweight groups being more likely to eat more, later in the day. The role of DIT and the energy expended after breakfast consumption, warrants further investigation as there was a suggestion that there may be differences between the four groups; however, more data is required to confirm this. Breakfast skippers were less hungry during the morning, consumed more caffeine during the day and according to their morningness score, were less likely to be active morning-type people, perhaps influencing their chosen breakfast behaviour.

Finally, Dr Jonathan Johnston (University of Surrey) gave a talk in which he described how diet, metabolism and circadian rhythms are all closely linked and that our health may be determined by 'when we eat' as well as 'what we eat'. It is well documented that circadian clocks regulate key biochemical pathways in metabolic tissues (reviewed in Green *et al.* 2008) and that postprandial (*i.e.* after a meal) responses differ with time of day (reviewed in Morgan *et al.* 2003). Studies conducted in animal models also indicate that the timing of food intake may be a powerful means of synchronising circadian rhythms (Damiola *et al.* 2000; Stokkan *et al.* 2001). This work raises the possibility that control of meal times may represent a non-pharmaceutical method of regulating human biorhythms, applicable to everyday life and also in shift workers and other individuals with a disrupted circadian system. Together, these findings strongly suggest that breakfast plays an important role in timing daily metabolic rhythms and could thereby optimise energy balance and bodyweight regulation. Further research is needed to address these key areas.

Dr Johnston then went on to discuss how his group has recently revealed robust daily rhythms of gene expression in cultured adipocytes (Otway *et al.* 2009) and serial biopsies of human adipose tissue (Otway *et al.* 2011). Along with data from other research groups (Green *et al.* 2008), these findings suggest that multiple aspects of adipose tissue function are subject to daily fluctuation. Furthermore, he has demonstrated how daily rhythms of plasma melatonin, an endocrine output of the master circadian clock in the suprachiasmatic nuclei of the brain, vary in obese and diabetic individuals (Mäntele *et al.* 2012). Current research is investigating how appropriately timed food intake can actually reset the timing of circadian rhythms in these and other rhythms. He speculated that it may be the time of day that breakfast is eaten that causes the most beneficial effects on metabolism, rather than the effects of a specific nutrient *per se* on any metabolic pathway.

Future work

Closing this symposium, all of the presenters agreed that further research was warranted regarding the possible mechanisms that might link breakfast consumption with the maintenance of a healthy bodyweight. They agreed to work together, along with other interested research groups, to first identify the most plausible mechanisms and then to explore these mechanisms in greater detail. To move forward, they plan to agree a 'consensus map' of mechanistic pathways that link breakfast consumption to a healthy bodyweight. The researchers from the Roehampton and Surrey groups (led by Reeves and Johnston) plan to join up with researchers from the Human Physiology Research Group at the University of Bath (led by Dr James Betts). The latter group will be responsible for the first draft of the map, which will hopefully be published and stimulate further debate and research in this area in the future.

Conflict of interest

The symposium was sponsored by Kellogg's. However, the views expressed in this symposium and this article are those of the speakers and authors alone.

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