

The Role of Breakfast Cereal in Contributing to Nutrient Shortfalls Associated with Low Calorie Diets



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Overweight and obesity remain a major public health challenge in the UK. A report by the Health and Social Care Information Centre entitled '*Statistics on Obesity, Physical Activity and Diet: England 2015*' states that 26% of men and 23.8% of women are obese, and if you combine the proportion of people that are overweight and obese these figures increase to 67% of men and 57% of women.¹ It remains a national ambition to achieve a downward trend in the level of excess weight averaged across all adults in the UK by 2020.² The promotion of healthy eating is one way of addressing the problem,³ along with physical activity and personalised support for overweight and obese individuals, through weight management services.⁴ The benefits of modest weight loss can include reduced incidence of hypertension, cardiovascular disease and type 2 diabetes.⁵ Consciously controlling energy intakes can help individuals remain in energy balance and/or achieve weight loss. However, restricting food intakes can concomitantly reduce the consumption of micronutrients. This article will investigate the nutrient shortfalls that can occur with low calorie diets.

Micronutrients intakes

Parts of the UK population are already at risk of micronutrient deficiency even before any energy restriction or dieting behaviour takes place. Results from the National Diet and Nutrition Survey (NDNS)⁶ rolling programme have shown that 12% of women are below the lower reference nutrient intake (LRNI) for riboflavin, 39% below the LRNI for selenium and 23% below the LRNI for iron. Likewise across Europe, intakes in many countries are below the LRNI for minerals, such as selenium, copper and iron, as well as vitamin D.⁷ Other European wide studies confirm a high prevalence of inadequate intakes of vitamin D, folic acid, calcium and selenium.⁸

In the United States (US) a third of people are on a diet at any one time,^{9,10} with similar figures estimated in the UK.¹¹ Consequently, restricting energy intakes will make achieving micronutrient recommendations even more challenging. To compound this further, it has been observed that micronutrient deficiencies appear to be higher in obese populations compared to normal weight individuals. In fact some researchers would go as far as to say that obese populations are characterised by micronutrient deficiencies.¹² Accordingly, research has suggested that poor diet quality and micronutrient deficiencies may be linked to a higher risk of being overweight or obese.¹⁰

Micronutrient inadequacy can effect overall health and wellbeing, and its possible micronutrient deficiencies could lead to further weight gain.^{12, 14}

A study¹³ comparing the healthy eating index (HEI) score, a composite measure of diet quality established by the US Department of Agriculture, with obesity levels, reported a significant graded increase in the likelihood of obesity with descending HEI in both men and women. Micronutrient inadequacy can effect overall health and wellbeing, and its possible micronutrient deficiencies could lead to further weight gain.^{12, 14} From data collected as part of the SU.VI.MAX Study,¹⁵ the association between diet quality and weight changes over a six year period was investigated in 1029 men and 450 women participants. The results indicated that men with a low dietary quality gained more weight over time than those with a high quality diet, suggesting that diet quality has a role in the progression of overweight and obesity. However this finding was not replicated in women, where confounders such as hormonal changes linked to menopause, actively dieting and levels of physical activity may have influenced the results.¹⁵

Even some well-known and popular weight loss diets fail to provide adequate levels of micronutrients. In a study investigating diet books, it was noticed that some of the most well-known diets failed to provide minimum reference daily intakes of a range of micronutrients.¹⁰ This was particularly true amongst diets with an emphasis on macronutrient composition that failed to check for adequacy of micronutrients.⁹ Thus weight loss programmes should consider focusing on diet quality as well as quantity.⁵

Correcting nutrient shortfalls

There are several strategies to ensure a diet is nutrient dense and to correct any micronutrient shortfalls, as described below:

- 1. **Choosing nutrient rich food**
This can prove challenging on a low energy intake, as some studies have shown that obese populations can have energy dense but nutrient poor diets¹² and, as such, this approach may need to incorporate nutrition education.¹⁶
- 2. **Augmenting the diet with a vitamin and mineral supplement**
Supplements have been recommended as a way of filling the nutritional gap for people on low kcal diets^{5, 10} and studies have shown that this can be effective at an individual level.^{17, 18} Though there are cases

where a particular weight loss diet has recommended a supplement as part of the plan, few participants actually complied.⁹ There are also limitations to this approach as a strategy for public health.¹⁷ From data collected across Europe, it was noted that supplement use made very little difference to the proportion of individuals who were below the LRNI, and this lack of effect was put down to the fact that in many cases those who take supplements are not those with low micronutrient intakes from food.⁷ Of course with supplements there is also an increased risk of excessive intakes, since some may contain 100% or more of the reference nutrient intake, plus the amount of nutrients from food needs to be considered in addition to the levels contained in the supplement.

3. Consuming fortified food

Fortification is the addition of nutrients to food.^{19, 20} Adding vitamins and minerals to staple foods has been shown to be an effective way of increasing nutrient intakes at the individual and population level. For some foods, such as wheat flour, fortification is mandatory whereas for other foods, like breakfast cereals, fortification is voluntary.²¹ Table One presents a list of commonly consumed fortified foods. It is possible that high consumption of fortified foods may put some people above the upper limits for some micronutrients, but reports have stated that the risk of this is low¹⁷ but balance needs to be considered.²² In a study of Irish adults it was reported that increased consumption of fortified foods did not contribute to increased risk of intakes exceeding the upper tolerable level for any of the micronutrients studied.¹⁶ Consuming a range of fortified food can help maintain micronutrient levels without necessarily increasing energy intakes. For example, amongst Irish adults, fortified food contributes less than 10% of total energy intakes, yet makes a much larger contribution to the mean daily intakes of micronutrients, including 26.5% of the folate intake, 20.6% of iron, 21% B6 and between 16% and 18% of the intake of riboflavin, thiamine and niacin.¹⁷

Table One: Foods Commonly Fortified

Fortified Foods most Frequently Consumed in the UK and Ireland ¹⁷	Fortification Status	Micronutrients Typically Added
Breads and flour	Mandatory	In the UK, iron, thiamine, nicotinic acid or nicotinamide and calcium carbonate are added to wheat flour.
Breakfast cereals (ready to eat) and cereal bars	Voluntary	Thiamine, riboflavin, niacin, folic acid, B6, B12, vitamin D, iron and zinc (check labels).
Beverages, e.g. fruit juice, flavoured drinks	Voluntary	A wide variety added – always check individual labels for content and amounts, e.g. calcium, thiamine, folic acid, biotin, vitamins B6, B12, C, D, and docosahexaenoic acid (DHA).
Margarines and spreads	Voluntary	Prior to 2014, it was mandatory for margarine to be fortified with vitamin A and D, but as margarine has been taken over in terms of sales by spreads which have lower fat contents, this legislation has now been revoked.
Milks and yoghurt	Voluntary	Most commonly vitamins A & D.

Fortified ready to eat breakfast cereals

Many ready to eat breakfast cereals (RTEBC) can be described as fortified food since vitamins and minerals have been added during the manufacturing process. A wide range of nutrients are frequently added to breakfast cereals, including riboflavin, thiamine, folic acid, B12, iron and, more recently, some now also contain vitamin D and zinc. In the UK, Ireland and across Europe breakfast cereals are the most popular and main food group voluntarily fortified.¹⁹ Many studies, from both Europe and America have reported that consumption of RTEBC can be linked to higher intakes of a range of micronutrients and make a significant contribution to the micronutrient status of individuals.^{23, 24} Furthermore, most RTEBC are a source of fibre and wholegrain and given that most breakfast cereals are consumed with milk this also increases the micronutrient intakes of calcium²⁵ as well as riboflavin, B12 and zinc.²³ RTEBC breakfasts are generally associated with improved nutrient adequacy without increasing intakes above upper limits.²⁶

In experimental studies,^{27, 28} where participants were asked to eat breakfast for a week and then not eat breakfast for a week, significantly less folate and calcium were consumed when breakfast was omitted. Data from surveys show similar findings, the NDNS data show that in the UK, increasing cereal consumption is positively associated with greater intakes of iron, vitamin D and B vitamins, including folate,²⁴ and it has been suggested that a cereal breakfast should be encouraged as part of a healthy lifestyle to help enhance micronutrient intakes.²⁹ Likewise, the Low Income Diet and Nutrition Survey³⁰ reported that mean intakes of fibre, B vitamins, calcium,

iron and zinc were consistently higher in consumers of RTEBC. In a survey of Irish adults RTEBC contributed significantly to mean daily intakes of iron (18%), thiamine (14%), riboflavin (17%), niacin (15%), vitamin B6 (13%) and folate (18%).³¹ Studies around Europe have reported similar findings, for example, in Greece a study of 392 adolescents found that RTEBC consumption was associated with significantly ($P < 0.05$) higher intakes of fibre, magnesium, calcium, iron, folate, vitamin A, riboflavin and vitamin B6, as well as being associated with some health and diet indicators.³² A Spanish study of 3534 participants ranging in age from two to 24 years, showed that thiamine, riboflavin and vitamin B6 intakes increased significantly with increasing consumption of RTEBC in all age and gender groups.³³ Many studies have shown that RTEBC can make substantial contributions to the micronutrient intakes of children^{24, 34, 35} and the same is true of older adults too; a cross-sectional survey of US households including 1759 older adults found that the majority of micronutrients were found to be positively associated with the frequent consumption of RTEBC.³⁶ Furthermore, nutrients lost by skipping breakfast are unlikely to be replaced at subsequent meals.³⁷

Lower BMI of breakfast consumers

Breakfast consumption and, in particular, the consumption of RTEBC has been shown to be associated with lower body mass index (BMI).^{34, 38} People who consume breakfast frequently have a lower BMI than people who skip breakfast.³⁹ Results from the 3rd National Health and Nutrition Examination Survey³⁴ indicated that participants who consumed breakfast cereal

had significantly lower BMIs than people who skipped breakfast or had a meat and egg type breakfast. The fibre content and relatively low glycaemic index of some breakfast cereals may have beneficial roles, since the fibre content may increase a feeling of fullness and satiety and that can help reduce snacking later in the day.⁴⁰

However, whether the differences in BMI between people who eat breakfast and people who skip breakfast are due to differences in post-breakfast energy expenditure or differences in energy intake is still not clear, since some studies have shown that when experimentally asked to skip breakfast some participants consume a lower number of calories than when asked to eat breakfast.⁴¹ The timing of food intake and habitual breakfast eating behaviour are also important factors to consider when investigating why breakfast consumption may be associated with BMI.²⁷

However, it is also possible that any association between breakfast and BMI is that breakfast eating is a marker for a healthier lifestyle, and people who eat breakfast are therefore more likely to generally have a healthy daily regime, exercise regularly and have a nutrient dense diet.^{42, 43, 44}

Conclusion

With increasing numbers of people now overweight and obese it may be necessary for individuals to control their energy intakes. Low calorie diets can sometimes result in low intakes of micronutrients. However with appropriate selection of nutrient dense food, including fortified foods such as breakfast cereals, micronutrient shortfalls can be ameliorated or corrected.

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