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Invited commentary

Dietary guidelines for sugar: the need for evidence

Within the area of public health nutrition, the dietary component arguably most in need of an evidence-based approach is sugar. Since the 1970s, when it was labelled 'pure, white and deadly' (Yudkin, 1972), and through the intervening years, when the ills of obesity, heart disease, hyperactivity, diabetes and Crohn's disease were laid at its door, sugar has been the subject of much discussion and even controversy in the scientific community.

As in the case of dietary fat, there are various types of sugar, e.g. sucrose, glucose, lactose and fructose. Unlike dietary fat, there is no accepted definition to categorise sugars, which makes comparisons between surveys and studies rather difficult (Kelly *et al.* 2003). While many countries express their intake data and dietary guidelines as 'added sugars', 'total sugars' or sucrose (for review, see Ruxton *et al.* 1999), the UK was unique in adopting the more complex definition of non-milk extrinsic sugars (NMES) (Committee on Medical Aspects of Food Policy, Department of Health, 1989). The aim of the definition was to differentiate between the array of simple sugars inherent in whole fruits and vegetables, and those of an identical chemical nature that are added to food or are naturally present in juices. The reasoning behind such a differentiation was that NMES were cariogenic, while milk sugars and those of an intrinsic nature had a negligible effect on teeth. However, the evidence supporting the classification of NMES and the selection of a quantitative guideline of 10 % food energy (Committee on Medical Aspects of Food Policy, Department of Health, 1991) have been questioned by some authors (Hussein *et al.* 1996; Ruxton *et al.* 1999; Kelly *et al.* 2003).

In a controlled experiment to examine the justification for the NMES classification, Hussein *et al.* (1996) prepared samples of whole (representing intrinsic sugars) and homogenised and juiced (representing extrinsic sugars) fruits. Ten adult subjects were exposed to a 1 min rinse–chew of each preparation, after which samples of dental plaque were removed and tested for pH. The results were compared with a standard sucrose solution (100 g/l). Statistical analyses of both the minimum pH and the area under the curve demonstrated no significant difference between intrinsic and extrinsic sugars, except for minimum pH after rinsing with orange juice. The authors concluded that the acidogenic potential of intrinsic and extrinsic sugars derived from fruits was similar. The importance of this study was not the finding that intrinsic sugars are potentially cariogenic (in practice fruit consumption does not correlate with dental caries), but the serious questions it raises about the theory underpinning the NMES classification.

Even if the NMES classification were scientifically supported, it is not easy to use in practice. There is currently no analytical method available to differentiate intrinsic from extrinsic sugars; thus, assumptions have to be made about the types of sugar present in food products, e.g. tinned fruits are assumed to contain 50 % extrinsic and 50 % intrinsic sugars (Ruxton *et al.* 1999). A less arbitrary way of defining dietary sugars would undoubtedly assist in designing studies to investigate their effects on health. Perversely, this creates a circular argument; in order to pin down scientifically the definition of sugars, a clear idea of the supposed problem is needed. For example, it is widely acknowledged that fruit is health-giving (Department of Health, 1997), yet fruit contains glucose, sucrose and fructose that are chemically indistinguishable from those used to sweeten foods and beverages. This suggests that any adverse health effects of sugar cannot be due to their chemical composition but must relate to some other attribute of high-sugar foods. If this is the case, why the need for a quantitative guideline for sucrose?

Quantitative guidelines infer that there is a cut-off point beyond which consumers increase or decrease their risk of disease. The widely accepted limits on dietary fat owe their existence to evidence, such as that reviewed by Committee on Medical Aspects of Food Policy, Department of Health (1994), that demonstrates a convincing relationship between cardiovascular disease risk and consumption of saturated fat. The quantitative guidelines for sugars adopted by a number of European countries, which range from 10–25 % food energy, have a rather less convincing foundation.

The main reason cited for supporting an upper limit for sugar consumption is the desire to improve dental health, particularly amongst children. While fermentable sugars, such as sucrose, are undoubtedly cariogenic, the available evidence suggests that the deleterious effects of sugars relate to how frequently they are eaten as opposed to the actual quantity consumed per d (Stecksen-Blicks & Borssen, 1999; Tinanoff & Palmer, 2000). This is particularly true in groups of subjects where oral hygiene is poor and the ameliorating effects of fluoride are absent (Gibson & Williams, 1999). When the aetiology of caries is considered (Kandelman, 1997), it makes sense that the number of times that teeth are exposed to sugar should be the key dietary factor in the development of the disease. Such evidence has driven the consideration of dietary guidelines for sugar in some spheres (Arens, 1999; Institute of Medicine, 2002; World Health Organization/Food and Agriculture Organization, 2003) towards the adoption of a recommended frequency, rather than specific limits on the amount. However, calls for a quantitative limit remain (Watt *et al.* 2000; O'Dea & Mann, 2001).

Apart from dental health, other reasons given to justify limits on sucrose consumption include adverse effects on body weight and the possibility of micronutrient dilution. Short-term studies have certainly reported a lack of adaptation when sucrose is covertly added to drinks, resulting in higher energy intakes (DiMeglio & Mattes, 2000). In addition, epidemiological results consistently reveal a positive correlation between sucrose consumption and daily energy intakes. However, these 'excess' energy intakes do not translate into higher body weights, resulting in the common finding that high sugar consumers tend to have a lower BMI than low sugar consumers (Bolton-Smith & Woodward, 1994; Gibson, 1996; Macdiarmid *et al.* 1998). Commenting on this paradox, Stubbs *et al.* (2001) opined that epidemiology fails to take into account selective under-reporting of high-sugar foods. Yet this view is not supported by intervention studies where long-term increases in sugar intake, even up to 25 % food energy, have co-existed alongside acceptable body weights (Surwit *et al.* 1997; Lawton *et al.* 1998) and in some cases have resulted in weight loss (Saris *et al.* 2000; West & de Looy, 2001).

With respect to micronutrient dilution, studies in adults (Gibson, 1997*a*; Charlton *et al.* 1998; Gibson, 2001) and children (Forshee & Storey, 2001; Gibson, 1997*b*; Farris *et al.* 1998) have certainly demonstrated an inverse relationship between some micronutrient intakes and consumption of sugars. In the study of Alexy *et al.* (2003), published in the present issue of the *British Journal of Nutrition*, diets of 2–18-year-old subjects were considered by using the Dortmund Nutritional and Anthropometric Longitudinally Designed Study (DONALD) database and a similar relationship was found. However, in common with the studies referred to earlier, the authors found no cause for alarm when the nutritional significance of the dilution effect was considered, except for a lower consumption of fruit amongst higher sugar consumers. For a broad range of added sugars, the micronutrient intakes of the young people exceeded recommended levels, with the inadequate intakes tending to occur at both extremes of the sugar consumption spectrum.

How can it be that consumption of sucrose, a foodstuff that contains no micronutrients, seems to have a benign effect on diet quality? The answer may lie in the way that sugars are used: as sweeteners of dairy foods, breakfast cereals, beverages and preserves. These products, while representing a significant source of dietary sugars, contain a range of micronutrients both naturally present and fortified. In an earlier examination of the DONALD database, Alexy *et al.* (2002) concluded that sweetened fortified foods, such as breakfast cereals and beverages, tended to offset the negative impact of sugars on micronutrient dilution. In their sample of young people, sugar intakes correlated with the consumption of fortified foods, resulting in micronutrient densities that were generally greater than recommended levels. However, it is not clear whether fibre intakes were affected by either fortified foods or sugars.

In the absence of clear and consistent evidence linking sugar consumption with adverse health effects, it is difficult to comprehend the reasoning behind calls to restrict the daily consumption of such a widely enjoyed and ubiquitous foodstuff. It is hoped that the evidence provided by Alexy *et al.* (2003), and other similar pieces of work, will encourage a more evidence-based approach to sugars and their place in our diets.

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