



NUTRIENT DILUTION

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1. INTRODUCTION

«Empty calories» and «junk food» are derogatory terms often levelled at confectionery items (i.e. biscuits, cakes, chocolate and sugar confectionery). This view arises from the perception that these foods provide little in the way of nutrients, displace more nutritious food in diet and could potentially result in micronutrient deficiencies (Glinsman, 1986).

This fact sheet will weigh up the evidence by examining the following questions :

1. Do these sugary foods contribute anything to the diet?
2. Do they displace other more nutritious foods, such as fruit?
3. Are they consumed disproportionately by people in lower socio-economic groups?
4. Do high-consumers of sugars, or of sugary foods, have inadequate dietary intakes of vitamins and minerals?

2. DO THESE SUGARY FOODS CONTRIBUTE ANYTHING TO THE DIET?

2.1. Biscuits, cakes and confectionery are rich in carbohydrate

This group of foods is highly diverse, so sweeping generalisations about nutritional contribution are out of place. However, they are principally high in carbohydrate, with varying proportions of sugar and starch. According to current nutritional guidelines (e.g. Department of Health, 1991) we should eat more of the energy (calories) we need in the form of carbohydrate (i.e. >50%, compared with a current intake of around 40%).

Some items of this food group are criticised for their fat content, but these are not a major source of fat in the average diet. In Britain, for example, they provide around 10% of the total intake of fat (Gregory *et al.*, 1990). Some products (notably chocolate and rich pastries) have a relatively high fat content (30-50% energy as fat) whereas biscuits and cakes have around 5 to 50 % calories under the form of fat with an average of 35 % on a European basis and most types of sugar confectionery are very low in fat.

On balance, therefore, this group of foods is no higher in fat than the rest of the diet (35-40% energy from fat). Indeed, high-consumers of biscuits, cakes and confectionery have diets closer to the nutritional guidelines (cfr national nutritional guidelines) (30-35% energy from fat) than those of low-consumers of these items (Gibson, 1996a). This is because most of these foods are higher in carbohydrate than they are in fat.

2.2. Confectionery goods, in particular, tend to be high in sugars

For many (but not all) foods in this class, sugars contribute most of the carbohydrate. Dietary recommendations suggest that added sugars, or "non-milk extrinsic" sugars (NMES) should provide around 10% of total dietary energy, although very few people manage such a low sugar intake. Concern has been expressed that "high intakes of NMES may compromise micronutrient intake in individuals with low energy requirements and intakes" (DH, 1989). The impact of sugars on micronutrient intakes is evaluated in section 4.

2.3. Biscuits, cakes and confectionery contribute other nutrients besides fat and sugar

Bakery and some confectionery goods are not just mixtures of sugar and fat. Typically, they provide useful quantities of B vitamins, E vitamins, magnesium, calcium and iron, and where flour is used in significant amount, some dietary fibre and vegetable proteins. The fats used in manufacture provide small quantities of fat-soluble vitamins. Chocolate is a source of copper (Joo & Betts, 1996) as well as iron, while milk chocolate provides small quantities of calcium and zinc. Chocolate is also a source of various non-nutrient compounds that have antioxidant properties. Although it must be conceded that the quantities of some of these micronutrients are small relative to the foods' energy content, this does not justify the criticism that they are empty calories. The extent to which they can be said to dilute the nutritional quality of the diet is discussed in the following sections.

3. DO THEY DISPLACE OTHER MORE NUTRITIOUS FOODS SUCH AS FRUIT?

Few studies have examined this question directly, but the evidence from large cross-sectional studies suggests that sugary snacks tend to supplement the diet, rather than displace foods from it. Looking specifically at fruit consumption, an analysis from the WHO MONICA study in Glasgow found that normal-weight, frequent consumers of sweetened foods (biscuits, cakes, chocolates, sweets and desserts) actually consumed more fruit as well. For the overweight, fruit consumption was similar among frequent and less frequent consumers of sweetened foods (Wrieden *et al.*, 1996).

4. ARE THESE FOODS CONSUMED DISPROPORTIONATELY BY PEOPLE IN LOWER SOCIO-ECONOMIC GROUPS?

It is sometimes suggested that bakery goods and confectionery are disproportionately consumed by people on lower incomes. In fact, consumption of sweet bakery goods (biscuits, cakes and pastries) tends to be higher among the non-manual groups. Similarly, results from over 2000 adults in the WHO MONICA project in Glasgow show that adults in the upper, not the lower socio-economic groups tend to consume biscuits/cakes and chocolate/sweets most frequently (Wrieden *et al.*, 1995). Among pre-schoolchildren (Gregory *et al.*, 1995), combined consumption of bakery goods and confectionery was identical between upper and lower socio-economic groups, although upper groups consumed a higher proportion of biscuits and cakes.

Micronutrient intakes tend to be poorer among the lower socio-economic groups in Britain, and this is particularly evident for vitamin C (Gregory *et al.*, 1990). However, these nutritional inequalities are explained by a lower intake of fruit and vegetables and not by excessive intakes of biscuits, cakes and confectionery. Poor micronutrient intakes among lower socio-economic groups are more likely to be improved by interventions to augment fruit and vegetable consumption than by "negative" messages to avoid pleasurable foods. Some studies have attempted to substitute behaviours; "fruit instead of cakes", and although this has been demonstrated in a (3-week) study in non-manual women (Barker *et al.*, 1996), it is perhaps naïve to assume that such changes will be maintained long-term or will be as easy to achieve in the low-income target group.

5. IS CONSUMPTION OF SUGARS AND SUGARY FOODS LINKED TO POORER MICRONUTRIENT INTAKES ?

Several studies have examined the concept of micronutrient dilution by sugars and sugary foods among children and adults consuming their normal diets. Most of these studies have examined the impact of high intakes of sugars (Rugg-Gunn *et al.*, 1991; Nelson *et al.*, 1990; Gibson, 1993, 1997; Naismith *et al.*, 1995). Some have looked more specifically at high consumers of confectionery products (Gibson, 1992; Reddy, 1994; New & Grubb, 1995; Gibson, 1996b).

5.1. Micronutrient density and micronutrient intakes among high-consumers of sugars

A high (absolute) intake of sugars tends to be associated with a diet less concentrated in nutrient per MJ energy, but total micronutrient intakes are often no different. This is because people who eat most sugar tend to be more physically active and to eat more food overall, boosting their nutrient intake in the process. Most surveys show broadly similar results, with discrepancies mostly being explained by the differing definitions used for the term "sugars".

For example, a survey of 419 pregnant women in a poor area of London showed that the 25% with the highest "added" sugar intakes (g/d) had diets with lower concentrations of nutrients (per MJ energy), compared with the 25% with the lowest intakes. Yet there were no significant differences in total micronutrient intake between the low and high consumers. In a study of Cambridge adults, considered by the UK COMA Panel on Dietary Sugars, there was a trend for lower intake of micronutrients in those with a higher (non-milk extrinsic) sugars consumption, *within each third of energy intake*. However the effect was not always consistent between the sexes, nor statistically significant (DH, 1989). Rugg-Gunn's study of schoolchildren aged 11-14, though interpreted as "supporting, to some extent, the concept of empty calories" also found a weak effect of (added) sugars concentration on diet quality, but this was not statistically significant for many micronutrients, nor consistent between the sexes (Rugg-Gunn *et al*, 1991). Conversely, Naismith *et al*'s study of a similar age group found no decline in most vitamin or mineral intakes as (total) sugars accounted for an increasing proportion of energy. Niacin was an exception to this, but intakes were adequate, while calcium and vitamin C intakes actually rose with increasing consumption of total sugars (Naismith *et al*, 1995). This was attributable to the definition of sugars used by these investigators, which included milk and fruit sugars.

More recent surveys have investigated relationships with micronutrient levels across the range of sugars intake, adjusted for energy. These confirm that the impact is small and suggest that it may be non-linear. Large-scale epidemiological surveys show that diets both high and low in sugars (whether total or extrinsic) are associated with poor micronutrient quality, and that micronutrient intakes tend to be highest at "moderate" or average, levels of sugars concentration (Bolton-Smith & Woodward, 1995; Gibney *et al.*, 1995; Gibson, 1997). Diets very low in sugars (e.g. at the 10% level currently recommended for non-milk extrinsic sugars) could even be counterproductive to micronutrient adequacy, because they tend to be high in fat, and high-fat diets tend to have a lower nutrient density by virtue of their high energy density.

Importantly, dietary surveys have shown that total daily micronutrient intakes are generally more than adequate in comparison to recommendations, even in people with high-sugar diets. The notable exception is iron, but intake of this nutrient is borderline in many groups, (particularly in children, adolescents and dieters) irrespective of the level of dietary sugars (Gibson, 1997). Reducing sugar consumption is unlikely to have any impact on iron intakes or status, whose optimisation involves giving attention to factors affecting bioavailability, such as vitamin C, as well as to increasing iron intakes.

4.2. Are micronutrient intakes compromised in high-consumers of biscuits, cakes and confectionery?

Studies have focused on consumption of sugar foods, rather than on dietary sugars intake, have shown results similar to those discussed above. High and/or frequent consumers of biscuits, cakes and confectionery do not, in practice, have lower absolute intakes of micronutrients. Indeed, on an absolute basis, their intake of micronutrients is often higher, because again they tend to eat more food in general and have higher energy intake. This in turn is linked to greater levels of physical activity (Bolton-Smith *et al.*, 1991).

Concern is often expressed about diet quality among schoolchildren, for whom confectionery, biscuits and cakes are popular snack foods. Associations between nutrient intake and the consumption of each of these foods were examined using data from a UK government survey of over 2700 British school children aged 10-15 years (DH, 1989). Intakes of protein, calcium and iron mostly rose in parallel with energy intakes from the lowest to the highest third of intake of these foods, indicating that above-average intakes did not appear to have an adverse effect on intakes of the nutrients examined (Gibson, 1992, 1996b).

Similarly, an analysis of data from the Dietary and Nutritional Survey of British Adults showed that increased consumption (g/day) of bakery products (biscuits and cakes) was associated with increased intakes of several vitamins and minerals.

Consumers of confectionery had significantly higher intakes (compared with non-consumers) of several micronutrients including calcium, iron and vitamin E, while the only nutrient to show an inverse relationship was vitamin A in women (Reddy, 1994).

A study of food frequency in nearly 1000 women aged between 45 and 49, found that intakes of most nutrients (protein, fat fibre, calcium and iron) increased with increasing frequency of consumption of biscuits, cakes and confectionery, while vitamin C intakes did not change significantly (New & Grubb, 1997). Energy intakes were also significantly higher among the most frequent consumers of these foods, yet their mean body mass index (relative weight) was no higher, confirming the fact that high-consumers were more active (New & Grubb, 1996)

5. RELATED ISSUES...

On the impact of sugars and sugary foods on nutrient density

- There is only weak evidence that sugars have a biologically important diluting effect on nutrient density (Astrup & Raben, 1996)

On the importance of actual micronutrient intakes

- Although nutrient density of the diet (per MJ of energy) may be reduced in diets containing a high proportion of sugars or sugary foods, actual micronutrient intakes are often higher. This, and not nutrient density, is what determines dietary adequacy for the individual.
- The adequacy of micronutrient intakes is more strongly dependent on energy intakes than on sugars concentration (DH, 1989).
- People who combine a very low energy intake with a high proportion of sugars in the diet could be potentially at risk, but such diets are highly atypical.

On socio-economic inequalities in micronutrient intake and the putative role of sugary food

- People in lower socio-economic groups tend to have poorer intakes of micronutrients, especially antioxidant vitamins. However, this is associated with low intakes of vegetables, fruit and fruit juice, rather than with excessive intakes of biscuits, cakes and confectionery.

On the possible impact of interventions to reduce consumption of sugary foods

- Severe restriction of sugars and sugary foods, or their substitution by non-sweet foods would most likely increase the percentage fat in the diet (the sugar-fat see-saw). This may paradoxically have the effect of reducing dietary nutrient density.

6. SUMMARY

1. Biscuits, cakes and confectionery are good sources of carbohydrate, and are not necessarily high in fat. Depending on the product, they can provide useful quantities of B vitamins, E vitamins, magnesium, calcium, iron, copper, zinc, fat-soluble vitamins and when flour is used in significant amount, some dietary fibre and vegetable proteins. Chocolate also contains natural antioxidant compounds.

2. Studies suggests that sugary snacks such as biscuits, cakes and confectionery tend to supplement the diet, rather than displace foods such as fruit, from it. Persuading people to eat fruit instead of cakes may be successful for some but unrealistic for others.

3. There is little evidence to support this contention, or its related argument that low micronutrient intakes in poorer people are the result of their eating sweet bakery goods. In fact, consumption of sweet bakery goods (biscuits, cakes and pastries) tends to be higher among the upper social groups, while the poorer vitamin and mineral intakes of some poorer groups is more closely related to their lower intake of fruit and vegetables.

4. High and/or frequent consumers of biscuits, cakes and confectionery do not, in practice, have lower absolute intakes of micronutrients. Indeed, on an absolute basis, their intake of micronutrients is often higher, because again they tend to eat more food in general and have higher energy intake (see also related issues).

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