

A spoonful of sugar helps the medicine go down!

There has been considerable debate on the impact of sugar in our daily diet. While the relationship between sugar and dental caries has long been known, the relationship of sugar to other disease conditions has only recently come to light. There is strong evidence to show that sugar-sweetened beverages increase the risk of the development of obesity^{1,2} and type 2 diabetes.^{3,4}

Furthermore, there is emerging evidence that increased sugar consumption also relates to micronutrient dilution,⁵ hypertension and coronary heart disease.⁶⁻⁸

International guidelines⁹ and national guidelines from many countries¹⁰ suggest that sugar should not exceed 10% of the energy (E) in the diet. The American Heart Association recently recommended that added sugar in the diet should not exceed 100 calories (25 g) per day for women or 150 calories (37.5 g) for men.¹¹ This is equivalent to about 5-6% of dietary E. It has been suggested that a sugar intake of 10% E should be seen as an acceptable upper limit, while an intake of < 6% E is closer to the ideal intake. The latter would apply especially to people at increased risk of the negative health consequences of sugar, such as those who are overweight, have pre-diabetes, or who live in areas where the drinking water is not fluoridated.¹²

The current average levels of sugar consumption in South Africa have generally not been shown to be excessive, but there is a wide variation in sugar intakes, from 2.5-18.2% E from added sugar intakes in six- to nine-year-old children [tertile means from 1999 National Food Consumption Survey (NFCS) data],¹³ and 3.0-20.7% E from added sugar intakes (quartile means from Transition and Health during Urbanisation in South Africa study) (Venter et al, this issue of the *South African Journal of Clinical Nutrition*).

However, there is recent evidence at the regional level to show that sugar intake in South Africa may be higher than expected. A study of children attending a school in Wynberg, Cape Town, found that the average consumption of soft drinks was 730 g [standard deviation (SD) 530g] per child per day, i.e. about two servings at 350 g each. This implies that these children have a sugar intake of 40-80 g per day from soft drinks alone.¹⁴ Adolescents who were studied in Gauteng¹⁵ were also found to have very high intakes of sugar, approximating 16-20% of E intake. At age 10 years (year 2000) their mean intake of sugar was 68 g [confidence interval (CI) 62.5-73.1 g] per day, while at age 13 years (year 2003) intake for the same adolescents increased to 102 g (CI 95-109.7 g) per day, which is a very high intake.¹⁵ Given the wide regional variation in added sugar intakes,¹³ poor micronutrient intakes and high quadruple burden of disease affecting South Africa,^{16,17} sugar intakes could be problematic.

The paper in this edition of the *SAJCN* by Venter et al investigates the relationship of added sugar consumption and micronutrient intakes in an adult South African population in transition. Internationally,

several studies have investigated the impact of differences in sugar consumption on micronutrient intakes and micronutrient dilution which have been summarised in systematic reviews.^{18,19} These reviews concluded that the data were not consistent. However Gibson¹⁸ determined that there is some evidence that diets that contain a high proportion of added sugars are slightly lower in micronutrients than diets with a moderate proportion of added sugars.

Analysis of the data is complicated by the many different methodological approaches which have been used. These relate to differences regarding the study design (cross-sectional observational studies and randomised controlled trials), dietary intake methodology (24-hour recall, food frequency questionnaires, weighed dietary records and food diaries) and dietary under-reporting. They also relate to differences in adjustments for variations in E intake, definition of sugar (total sugar, added sugar and non-milk-extrinsic sugar), reporting of sugar intakes (g/day and % E intake), and reporting of micronutrient intakes (absolute, % recommended daily allowance, % recommended nutrient intake, prevalence of low intakes and micronutrient density intakes per 1000 kJ). In addition, it is to be expected that the impact of sugar on the micronutrient content of the diet varies according to the age of the population being studied. As micronutrient intakes are consistently positively related to E intakes,²⁰ the risk of low micronutrient intakes and micronutrient dilution appears to be highest in diets with a high % of E intake from added sugar and a low total E intake.²⁰ Thus populations most at risk of micronutrient dilution in relation to increased sugar intakes, will be those with highest micronutrient requirements in relation to E intakes, such as the elderly and children. The study by Venter et al, which investigates adults, does not fall in this category, and shows that absolute intakes of most micronutrients were significantly higher in the high-sugar consumers, who were also high E consumers. However, micronutrient dilution, i.e. micronutrient intake per 4.18 kJ, was found for most micronutrients in those who consumed the most added sugar compared to those who consumed the least added sugar.

A further important consideration is the dietary context. Most studies have been carried out in developed countries where the E and micronutrient intake is adequate overall, food patterns are diverse and there are many processed foods, with added sugars which are fortified or enriched with micronutrients.²¹ Few studies have been reported from less developed countries. Two studies in South Africa have published evidence of micronutrient dilution.^{13,22} In a study of black elderly women, E, protein, fibre and a number of micronutrients were significantly lowest in women in the highest percentage E tertile.²² When data from the NFCS for children aged six to nine years were divided into tertiles of amounts of consumed sugar, it was shown that protein intake was significantly lower in the highest tertile of sugar intake than in the lowest (40 vs. 45 g per day, p-value

= 0.04), as was protein as % E (12 vs. 14% E, p-value = 0.02).¹³ The intake of thiamine in the highest tertile of sugar intake was also significantly lower than in the lowest sugar tertile group (0.51 vs. 0.65 mg per day, p-value = 0.0001). Therefore, the current study by Venter et al that investigated micronutrient intakes and micronutrient dilution in a sample of South African adults is a useful addition to the national and global literature. In less developed countries such as our own, micronutrient intakes have been shown to be inadequate, food patterns to have low dietary diversity, there has been a lack of nutrient-rich foods and a low intake of processed foods with added sugars that are fortified or enriched with micronutrients.^{13,16} Given these differences in dietary context between developed and less developed countries, the relationship between sugar intakes and micronutrient intakes could be different.

Alexy et al²¹ showed in their study in Germany that the negative effect of added sugars on micronutrient density in the diet was masked by the positive impact of sweetened processed foods that were fortified with micronutrients. In the South African context, most sugar that is added to the diet, has been shown in the study by Venter et al and previous studies^{13,22,23} to derive from the intake of sweets, sugar and soft drinks (squash and cool drinks), none of which are fortified with micronutrients.

The study by Venter et al also investigated one aspect of the sugar diet and health debate, i.e. the impact of added sugar intake on micronutrient intakes and micronutrient dilution in the diet. In terms of this question, all three sets of data that were published in South Africa [which investigated populations considered to be at greater risk (children and the elderly) and those who were relatively protected (adults)], have shown that in the dietary context of South Africa, increasing added sugar is associated with micronutrient dilution.^{13,22}

References

- Mozaffarian D, Hao T, Rimm EB, et al. Changes in diet and lifestyle and long-term weight gain in women and men. *New Eng J Med*. 2011;364(25):2392-2404.
- Malik VS, Schulze MB, Hu FB. Intake of sugar-sweetened beverages and weight gain: a systematic review. *Am J Clin Nutr*. 2006;84(2):274-288.
- Malik VS, Popkin BM, Bray GA, et al. Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes: a meta-analysis. *Diabetes Care*. 2010;33(11):2477-2483.
- Schulze MB, Manson JE, Ludwig DS, et al. Sugar-sweetened beverages, weight gain, and incidence of type 2 diabetes in young and middle-aged women. *JAMA*. 2004;292(8):927-934.
- Joyce T, Gibney MJ. The impact of added sugar consumption on overall dietary quality in Irish children and teenagers. *J Hum Nutr Diet*. 2008;21(5):438-4350.
- Dhingra R, Sullivan L, Jacques PF, et al. Soft drink consumption and risk of developing cardiometabolic risk factors and the metabolic syndrome in middle-aged adults in the community. *Circulation*. 2007;116(5):480-488.
- Winkelmayr WC, Stampfer MJ, Willett WC, Curhan GC. Habitual caffeine intake and the risk of hypertension in women. *JAMA*. 2005;294(18):2330-2335.
- Fung TT, Malik V, Rexrode KM, et al. Sweetened beverage consumption and risk of coronary heart disease in women. *Am J Clin Nutr*. 2009;89(4):1037-1042.
- Diet, nutrition and the prevention of chronic diseases. *World Health Organ Tech Rep Serv*. 2003;916:1-149.
- Sheiham A. Dietary effects on dental diseases. *Public Health Nutr*. 2001;4(2B):569-591.
- Johnson RK, Appel LJ, Brands M, et al. Dietary sugars intake and cardiovascular health: a scientific statement from the American Heart Association. *Circulation*. 2009;120(11):1011-1020.
- Steyn NP, Temple NJ. Evidence to support a food-based dietary guideline on sugar consumption in South Africa. *BMC Public Health* [homepage on the Internet]. 2012, c2012. Available from: <http://www.biomedcentral.com/content/pdf/1471-2458-12-502.pdf>
- Steyn NP, Myburgh NG, Nel JH. Evidence to support a food-based dietary guideline on sugar consumption in South Africa. *Bull World Health Organ*. 2003;81(8):599-608.
- Louwrens H, Venter I, Otty C. Soft drink consumption of Grade 4 and Grade 7 learners in the Wynberg area, City of Cape Town, South Africa and the factors influencing the consumption. *South African Association for Family Ecology and Consumer Sciences*; 2010.
- MacKeown JM, Pedro TM, Norris SA. Energy, macro- and micronutrient intake among a true longitudinal group of South African adolescents at two interceptions (2000 and 2003): the Birth-to-Twenty (Bt20) Study. *Public Health Nutr*. 2007;10(6):635-643.
- Labadarios D, Steyn NP, Maunder E, et al. The National Food Consumption Survey (NFCS): South Africa, 1999. *Public Health Nutr*. 2005;8(5):533-543.
- Steyn NP, Bradshaw D, Norman R, et al. Dietary changes and the health transition in South Africa: implications for health policy. The double burden of malnutrition. Case studies from six developing countries. *FAO Food and Nutrition Paper*. 2006;84:46.
- Gibson SA. Dietary sugars intake and micronutrient adequacy: a systematic review of the evidence. *Nutrition Research Reviews*. 2007;20(2):121-131.
- Rennie KL, Livingstone MBE. Associations between dietary added sugar intake and micronutrient intake: a systematic review. *Br J Nutr*. 2007;97(5):832-841.
- Livingstone MBE, Rennie KL. Added sugars and micronutrient dilution. *Obes Rev*. 2009;10 Suppl 1:34-40.
- Alexy U, Sichert-Hellert W, Kersting M. Fortification masks nutrient dilution due to added sugars in the diet of children and adolescents. *J Nutr*. 2002;132(9):2785-2791.
- Charlton KE, Kolbe-Alexander TL, Nel JH. Micronutrient dilution associated with added sugar intake in elderly black South African women. *Eur J Clin Nutr*. 2005;59(9):1030-1042.
- Charlton KE, Wolmarans P, Lombard CJ. Evidence of nutrient dilution with high sugar intakes in older South Africans. *J Hum Nutr Diet*. 1998;11(4):331-343.
- World Health Organization. Preparation and use of food-based dietary guidelines. Geneva: World Health Organization; 1998.

The issue of a food-based dietary guideline (FBDG) on sugar was discussed during the first formulation of a FBDG in South Africa¹³ and has been recently reviewed.¹² This recent review of the literature, that investigates a number of issues in relation to sugar, diet and health, has argued that the South Africa FBDG on sugar “use food and drinks that contain sugar sparingly and not between meals” should stand. An important underlying principle when considering diet and health is that individual foods and nutrients cannot be considered in isolation. Hence, the importance of FBDGs where dietary guidelines are considered as a group and consideration is given to dietary patterns.²⁴ This approach is in line with sentiments that were expressed by Livingstone and Rennie who suggested that: “Rather than vilifying foods such as added sugars, the promotion of foods with a high ratio of nutrients to E against a background of variety, balance and moderation may be a better strategy for improving overall diet quality”.²⁰ The South African FBDG aims to do just that.

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