Policy and Practice

Evidence to support a food-based dietary guideline on sugar consumption in South Africa

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Abstract Since 1997, South Africa has been developing and implementing food-based dietary guidelines for people aged ≥6 years. The complexity of the population, which contains different ethnic groups, as well as the rapid urbanization that is taking place, means that food-based dietary guidelines need to consider both overnutrition and undernutrition. The initial guidelines did not include guidance on sugar, and the Department of Health was not prepared to approve them until appropriate guidance on sugar was included. This paper summarizes the evidence available for such a guideline and the nature of that evidence. Other low- and middle-income countries, particularly those in Africa, may face a similar dilemma and might learn from our experience.

Keywords Dietary sucrose/administration and dosage/adverse effects; Dietary carbohydrates/administration and dosage; Energy intake; Diet/standards; Dental caries/prevention and control; Protein-energy malnutrition/prevention and control; Obesity/prevention and control; Nutritive value; Micronutrients; Chronic disease; Food habits/ethnology; Guidelines; Nutrition policy; Rural health; Urban health; South Africa/epidemiology/ethnology (*source: MeSH, NLM*).

Mots clés Sucrose alimentaire/administration et posologie/effets indésirables; Glucide alimentaire/administration et posologie; Ration calorique; Régime alimentaire/normes; Carie dentaire/prévention et contrôle; Malnutrition protéino-calorique/prévention et contrôle; Obésité/prévention et contrôle; Valeur nutritive; Micronutrients; Maladie chronique; Habitude alimentaire/éthnologie; Ligne directrice; Politique nutritionnelle; Hygiène rurale; Santé urbaine; Afrique du Sud/épidémiologie/éthnologie (*source: MeSH, INSERM*).

Palabras clave Sacarosa en la dieta/administración y dosificación/efectos adversos; Carbohidratos en la dieta/administración y dosificación; Ingestión de energía; Dieta/norma; Caries dental/prevención y control; Desnutrición proteico-energética/prevención y control; Obesidad/prevención y control; Valor nutritivo; Micronutrientes; Enfermedad crónica; Hábitos alimenticios/etnología; Pautas; Política nutricional; Salud rural; Salud urbana; Sudáfrica/epidemiología/etnología (*fuente: DeCS, BIREME*).

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Voir page 606 le résumé en français. En la página 606 figura un resumen en español.

انظر صفحة 606 للاطلاع على الكلمات المفتاحية والملخص باللغة العربية

Introduction

The argument that people should limit intake of sugar added to food is based on evidence that a high intake of sugar increases the risk of certain chronic diseases, particularly dental caries and obesity. As oral diseases and obesity are widespread in South Africa and affect large numbers of people in terms of physical, economic, and social outcomes, the impact that reductions in sugar intake would have as an important preventative measure needs to be emphasized (*1*). This paper aims to determine whether a food-based dietary guideline on sugar consumption is a justifiable component of public health policy in the South African context. It reviews the scientific evidence that suggests that sugar is a risk factor for various illnesses. It examines the current patterns of sugar consumption in South African adults and children aged >6 years, and the sugar-related conditions they experience.

The term "added sugar" is used throughout and, unless otherwise stated, this refers to all monosaccharides and disaccharides that are added to foods and drinks during preparation and cooking (*2*).

The call for a sugar guideline

The development of a dietary guideline for "sugar" has been fraught with conflict and political pressure, both locally and internationally. These conflicts seem to arise primarily from the twin imperatives: the formulation of appropriate public health policy and the protection of commercial sugar interests. Both have fundamentally influenced the content and process of this debate.

In 1997, the Nutrition Society of South Africa established a task group to develop food-based dietary guidelines for South Africa. The objective of this group, the members of which were mostly volunteers, was to develop a core set of food-based dietary guidelines to promote health in South Africans aged >6 years according to WHO's guidelines for the development of food-based dietary guidelines (*3*). Members of the Food-based Dietary Guidelines Task Group came from a wide range of organizations; many active participants came from the food industry, even though some had a dual role, in that they also represented their professional association. From the start, the South African Sugar Association played a role and also sponsored workshops (*4*).

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Box 1. **Food-based dietary guidelines developed for South Africans** (*5*)

- Enjoy a variety of foods.
- Be active.
- Make starchy foods the basis of most meals.
- Eat plenty of vegetables and fruit every day.
- Eat dry beans, peas, lentils, and soy regularly.
- Chicken, fish, milk, meat, or eggs can be eaten daily.
- Eat fats sparingly.
- Drink lots of clean, safe water.
- If you drink alcohol, drink sensibly.
- Use salt sparingly.
- Eat and drink food and drinks that contain sugar sparingly and not between meals.

In September 2001, preliminary guidelines (that excluded guidance on sugar) and results of a pilot study on consumers were published along with a series of technical papers that supported the guidelines (*5*). The preliminary guidelines were tested on consumers in order to test their understanding of the messages conveyed. The Department of Health raised concerns about the guidelines and urged the inclusion of a guideline on sugar as a preventative measure against the high prevalence of dental caries in certain population groups in South Africa. Such a guideline would conform to the national oral health goal: "to promote the reduction of risk factors, like sugar intake, tobacco and alcohol abuse" (*1*) and to the Department of Health's "obesity guidelines", which advocate a sugar intake of less than 45 g per day (Department of Health, personal communication, 2002). The Department of Health provisionally accepted the food-based dietary guidelines (Box 1) with minor revisions, but it insisted that a sugar guideline be developed and included. We were charged with the task of writing a technical support paper for an appropriate sugar guideline aimed at children (aged >6 years) and adults.

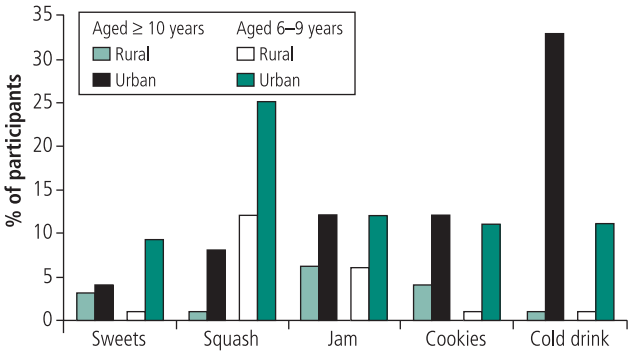
Sugar consumption in South Africa

Average intakes and sources of added sugar

The National Food Consumption Survey (NFCS) undertaken in 1999 is a useful source of data on consumption of added sugar in children aged 7–9 years (*6*). Large differences in sugar intake are seen according to geographical area and dietary assessment method used. For example, the lowest mean sugar consumption in the NFCS determined with the 24-hour recall dietary method was 22 g in the Eastern Cape Province and the highest was 57 g in the Western Cape Province. When the food frequency method was used, the lowest mean intake was 22 g in the Free State Province and the highest was 91 g in Western Cape Province.

Urban and rural differences are also seen, with mean intakes with the food frequency method of 42–59 g sugar in urban areas compared with means of 26–41 g in rural areas (*6*). White children had mean intakes of added sugar of 67–81 g and black children 44–53 g. In black adults (aged 15–44 years) from urban areas, average consumption of added sugar was 47–52 g/day (*7*). For adult South Africans, mean sugar intake with the 24-hour recall method was 27.8–41.1 g/day (*8*).

Fig. 1. **Percentage of individuals aged ≥ 10 years (for South Africa (*8*)) and 6–9 years (NFCS) (*6*) who consumed sugar-containing items**



The average amounts of consumed sugar reported for South Africans are generally lower than those reported in the United States, where consumers consume the equivalent of 82 g added sugar per day (*9*). As indicated earlier, however, this is not true for all of South Africa.

Generally, it is inappropriate to compare sugar intake in South Africa with that reported in studies from most European countries, because such studies have not all used the same classification system for sugar. For example, Denmark, France, and Germany reported average sugar intakes in terms of "sucrose", but the Netherlands included milk sugar (lactose) (*10*).

Fig. 1 and Table 1 show the actual percentage of sugar-containing food items consumed in urban and rural areas of South Africa (*8*). White table sugar and squash (non-carbonated soft drinks) are the most commonly consumed food items in rural areas of South Africa. In urban areas, the variety of sugar-containing items consumed is greater. The most striking finding was that <3 % of adolescents and adults consumed carbonated beverages in rural areas compared with 33% in urban areas (*8*). In the United Kingdom and the United States, the largest source of added sugar is regular soft drinks, which account for about one-third of intake (*11*).

Sugar as a percentage of energy intake

Intake of added sugar of adolescents and adults (aged ≥10 years) amounts to 5.9% of total energy intake in rural areas and 12.3% in urban areas (twofold difference) (Table 2). A similar trend was found in children aged 6–9 years (*6*). In black adolescents (aged 15–18 years) in urban areas, sugar was 10.7% as a percentage of energy intake in male participants and 14.6% in female participants (*7, 12*). The latter (14.6%) is similar to that of children in the United States, which is namely 16% of energy intake (*11*).

WHO recommended a sugar intake of <10% of total energy intake (*13*) for the prevention of caries; 23 countries currently comply and have this as a set objective (*14*). As consumption in people in urban areas of South Africa exceeded the 10% recommended by WHO (*13*), we caution against the argument that South Africans do not eat a lot of sugar. In urban areas, consumption of sugar is much higher than in rural areas, and national averages can hide dramatic local variations in consumption.

Table 1. **Percentage of children[a] and adults[b] in urban and rural areas of South Africa consuming sugar-containing items and the amounts of the food items in grams**

Food items consumed by at least 3% of participants	Children aged 6–9 years			Participants aged ≥ 10 years		
	Proportion that consumed item (%)	Average amount consumed/ person/day (g)	Per capita amount consumed/ person/day (g)	Proportion that consumed item (%)	Average amount consumed/ person/day (g)	Per capita amount consumed/ person/day (g)
Rural areas						
n		412			1167	
Sugar (white)	71.7	23.6	16.9	76.7	26.1	18.5
Cold drink (squash)	12.0	279.2	33.5	NA[c]	NA	NA
Jam	5.5	25.3	1.4	6.0	31.6	1.9
Cookies/cake	NA	NA	NA	3.5	104.3	3.6
Cold drink (carbonated)	NA	NA	NA	NA	NA	NA
Sweets (candy)	NA	NA	NA	3.1	30.0	0.9
Wheat-based breakfast cereals	NA	NA	NA	NA	NA	NA
Maize-based breakfast cereals	NA	NA	NA	NA	NA	NA
Ice cream	NA	NA	NA	NA	NA	NA
Rusks	NA	NA	NA	NA	NA	NA
Chocolates	NA	NA	NA	NA	NA	NA
Urban areas						
n		399			2368	
Sugar (white)	81.3	22.8	18.5	77.1	37.8	29.1
Cold drink (squash)	24.5	349.3	85.6	7.8	368.6	28.6
Jam	11.5	20.6	2.4	12.1	39.6	4.8
Cookies/cake	11.3	58.0	6.5	11.7	126.6	14.8
Cold drink (carbonated)	10.5	348.1	36.6	32.6	448.7	146.2
Sweets (candy)	8.8	34.5	3.0	4.1	35.3	1.5
Wheat-based breakfast cereals	8.0	42.5	3.4	5.5	46.8	2.6
Maize-based breakfast cereals	7.0	39.0	2.7	NA	NA	NA
Ice cream	3.0	92.5	2.8	NA	NA	NA
Rusks	NA	NA	NA	8.8	61.6	5.4
Chocolates	NA	NA	NA	4.4	44.1	1.9

[a] Data from Labadarios et al., 2000 (*6*).
[b] Data from Nel et al., 2002 (*8*).
[c] Amounts consumed by less than 3% of the group.

Nutritional conditions associated with sugar intake

Dental caries

Does sugar cause dental caries? The answer to this question is a resounding yes. Although sugar does not work alone (it also needs oral commensal bacteria, teeth, and time), it is an essential component in the pathogenesis of dental caries (*15*). Evidence shows that free sugars are undoubtedly the most important dietary factor in the development of dental caries. Free sugars (sugars) are monosaccharides and disaccharides that are added during the preparation or production of foods and drinks, as well as sugars that naturally occur in foods such as honey and fruit juices. When we refer to sugar in isolation, we mean sucrose (*13*).

Dental caries is the disease probably most strongly associated with sugar consumption. The ability of oral bacteria, most notably *Streptococcus mutans*, to ferment sucrose and other sugars into acid and thus produce a sustained pH <5.5 is the basis of the demineralization process that is capable of destroying tooth enamel and that eventually leads to tooth loss.

Some of the strongest evidence to show a link between the risk of dental caries and dietary intake of sugar comes from studies carried out during the last 50 years, which all showed that the caries process depended on a sustained supply of fermentable sugars (*16–20*). The simultaneous presence of fermentable sugar and specific bacteria (mainly *S. mutans*) led to significant caries. Absence of either component meant caries did not develop (*21*).

Various researchers have shown changes in intraoral pH brought about by sustained intake of fermentable sugars (*22*). Animal studies (*23*) and human studies (*17, 18, 24*) have highlighted the impact of frequent intake of dietary sugar on caries development. The frequency and total consumption of sugar-rich foods both correlate strongly with the occurrence of dental caries, and also with each other, which suggests that strategies to control one variable will help control the other (*14*). Other researchers have shown the danger of consuming sugar in forms that are very sticky (that have strong adhesive properties), as they are cleared from the mouth by saliva very slowly and with great difficulty (*25–27*).

The ability of fluoride to protect teeth against caries is well established. The association between frequency of sugar intake and dental caries is negated only partly by the presence of fluoride (*28*). The beneficial effects of fluoride vary according to the amount of sugars consumed (*29*). In one of the

Table 2. **Energy distribution of macronutrients for children[a] and adults[b] in South Africa**

Energy source	Mean proportion of total energy source					
	Children aged 6–9 years			Participants aged ≥ 10 years		
	South Africa (*n* = 811)	Rural (*n* = 412)	Urban (*n* = 399)	South Africa (*n* = 3535)	Rural (*n* = 1167)	Urban (*n* = 2368)
Protein	13 (4.5)[c]	13 (5)	13.5 (4)	14.1 (4.6)	13.2 (2.3)	14.8 (4.0)
Fat	22.5 (11)	19.5 (10.5)	25 (10.5)	23.3 (12.5)	16.1 (5.6)	29.5 (9.1)
Carbohydrate	71 (14)	74 (14)	66.5 (13.5)	62.2 (14.4)	70.0 (6.7)	55.5 (10.7)
Added sugar	9.5 (8.5)	8.5 (8)	11 (8.5)	9.4 (8.6)	5.9 (3.9)	12.3 (7.3)

[a] Data from Labadarios et al., 2000 (*6*).
[b] Data from Nel et al., 2002 (*8*).
[c] Values in parentheses are standard deviations.

Table 3. **National Oral Health Survey data summarized for various groups (1994)**

Variable	Age (years)	Ethnic group			
		Black	White	Coloured	Indian
Caries free (%)	6	32	41	21	24
Mean (decayed, missing, and filled teeth)	12	1.7	1.8	2.1	1.3
Retained all teeth (%)	20	56	57	26	56
Edentulous (no teeth) (%)	35–44	2	17	51	2
	60–64	10	40	67	20

Source: National Oral Health Survey, 1994 (*38*).

most recent systematic reviews of the subject, Burt & Pai concluded that where there is good exposure to fluoride, consumption of sugars is a moderate risk factor for caries in most people. Preventing consumption of excess sugars is therefore a justifiable part of caries prevention if not the most crucial aspect for most people; consumption of sugars is likely to be a more powerful indicator of the risk of caries in people who do not have a regular exposure to fluoride; and with widespread use of fluoride, consumption of sugars still has a role to play in the prevention of caries, but this role is not as strong as without exposure to fluoride (*1, 30–32*).

Other researchers have illustrated a dose-response relation between the level of dental caries and the intake of sugars; a dramatic rise in the prevalence and severity of caries is seen as the intake of sugars increases from around 15 kg to 35 kg per person per year (*33–36*). On the basis of this evidence, Sheiham recommended that in the presence of fluoride, a safe intake of sugars would be up to 15 kg/person/year, and in the absence of fluoride, up to 10 kg (*37*).

Is tooth decay a problem for South Africans?

Unfortunately, tooth decay is widespread in most South African populations, but it also displays wide variations in prevalence and severity across communities (*38*). Values for decayed, missing, and filled teeth range from 5 to 32. The prevalence of dental caries approaches 90% in most South African adult communities (*38*).

Table 3 gives a small selection of results from the South African National Oral Health Survey carried out in 1988–89 and reported in 1994. A more recent effort to collect data on the national oral health status in 2000 has yet to report its findings. Preliminary data from KwaZulu-Natal seem to suggest that urban populations have more dental caries than rural populations in this province (*1*) and that people of white and coloured (mixed ethnic ancestry) groups still have substantially more caries than black people, with Indians somewhere between (*31*).

According to the recently published demographic and health survey undertaken by the Department of Health in 1998, dental problems are of great concern among South Africans (*1*). In 1998, 4.3 million (34.6%) African men and 6.3 million (46.9%) African women aged ≥15 years indicated that they experienced oral health problems. In total, 23.7% coloured men, 20.8% white men, 34.5% coloured women, and 23.7% of white women had lost all their natural teeth (*1*). For this reason, the promotion of meaningful guidelines on sugar consumption is a critical public health promotion measure in our communities.

In short, to limit the caries risk posed by dietary sugar intake:

- Intake of free sugars should be limited to 15–20 kg/person/year (40–55 g/day) in the presence of fluoride and <15 kg/year (<40 g/day) in the absence of fluoride.
- Frequency of intake of foods that contain sugar should be limited to a maximum of four times a day.
- Fluoride exposure should be promoted and managed at optimum levels.
- Frequency of intake of soft drinks and fruit juice should be limited to prevent dental erosion.

Protein–energy malnutrition

One of the most common arguments for the lack (or absence) of a dietary guideline on added sugar in South Africa has been the importance of sugar as a source of energy in children (*39*). As a deficiency of energy is associated with a deficit in growth and related consequences, children (aged ≥6 years) and adults need to be evaluated in this context.

Data from the NFCS (*6*) showed that 13% of children aged 7–9 years were stunted (height-for-age *Z*–score <–2 standard deviations), 7.7% were underweight (weight-for-age *Z*–score <–2 standard deviations), and 3.4% had wasting (weight-for-height *Z*–score <–2 standard deviations). The prevalence of overweight children (weight-for-height *Z*–score >2 standard deviations) was 6.1%; this increased to 9% in the

Table 4. **Macronutrient and anthropometric data (mean and 95% confidence intervals) of children aged 6–9 years in the National Food Consumption Survey (NFCS) according to tertiles of sugar intake as a proportion of total energy intake**

Variable	Energy from sugar (%)			General linear model *P*–value[a]	Spearman's correlation
	Lowest tertile	Middle tertile	Highest tertile		
Mean added sugar					
Amount (g)	8.7 C (4.4–13.0)[b,c]	28.4 B (24.4–32.3)	57.9 A[d] (54.3–61.4)	<0.0001[e]	0.79133 (*P* < 0.0001)
Proportion of total energy (%)	2.5 C (1.6–3.3)	8.0 B (7.2–8.8)	18.2 A[d] (17.5–18.9)	<0.0001[e]	1.0000 (*P* < 0.0001)
Mean energy intake (kJ)	5767.0 A (5189–6345)	6278.3 A (5748–6808)	5614.9 A (5141–6089)	0.1720	–0.02384 (*P* = 0.4978)
Carbohydrates					
Mean amount (g)	206.4 A (185.3–227.5)	214.2 A (194.8–233.6)	198.0 A (180.7–215.3)	0.4706	–0.03302 (*P* = 0.3477)
Mean proportion of total energy (%)	64.2 A (61.4–67.0)	68.2 A (61.1–66.2)	65.7 A (63.4–68)	0.4878	0.01633 (*P* = 0.6424)
Fat					
Amount (g)	33.3 B (27.5–39.1)	42.5 A (37.2–47.8)	37.1 AB (32.4–41.9)	0.0680	0.05453 (*P* = 0.1208)
Mean proportion of total energy (%)	22.5 A (20.1–24.9)	24.0 A (21.9–26.2)	23.7 A (21.7–25.6)	0.6260	0.05698 (P = 0.1049)
Protein					
Amount (g)	45.2 AB (40.2–50.3)	47.9 A (43.3–52.5)	40.0 B (35.9–44.1)	0.0382[e]	–0.08572 (*P* = 0.0146)[e]
Mean proportion of total energy (%)	14.0 A (13.0–15.0)	13.5 AB (12.6–14.4)	12.3 B[d] (11.4–13.1)	0.0205	–0.18107 (*P* = 0.0001)[e]
***Z*–scores**					
Mean height-for-age	–0.55 A (–0.93 to –0.18)	–0.40 A (–0.72–0.08)	–0.58 A (–0.85 to –0.31)	0.6978	0.04201 (*P* = 0.2609)
<–2 standard deviations (%)	12.5	18.1	16.6	0.1489[f]	
>2 standard deviations (%)	1.7	1.7	1.6	0.8982[f]	
Mean weight-for-age	–0.29 A (–0.61–0.02)	–0.25 A (–0.52–0.02)	–0.16 A (–0.39–0.06)	0.7768	0.10459 (*P* = 0.0050)[e]
<–2 standard deviations (%)	9.0	6.7	8.1	0.5690[f]	
>2 standard deviations (%)	1.7	1.3	3.6	0.6106[f]	
Mean weight-for-height	0.12 A (–0.25–0.48)	0.06 A (–0.25–0.37)	0.37A (0.11–0.63)	0.2705	0.09503 (*P* = 0.0108)[e]
<–2 standard deviations (%)	4.3	2.9	4.5	0.6668[f]	
>2 standard deviations (%)	5.2	8.4	6.9	0.3360[f]	

[a] Adjusted for socioeconomic status.
[b] Values in parentheses are 95% confidence intervals.
[c] Alphabetic symbols (A, B, and C) indicate whether means are different, i.e. means with the same alphabetic symbol are not significantly different to each other: A and A are similar but A and D differ significantly (Bonferroni test).
[d] $P < 0.05$ high versus low tertiles (Bonferroni test).
[e] $P < 0.05$ (significant linear relation).
[f] Cochrane–Mantel–Haenszel statistic.
Source: Labadarios et al., 2000 (*6*).

same age group in urban areas only. These results can be interpreted as a chronic deficit of energy intake in up to 13% of children aged 7–9 years. In this same age group, however, 6–9% of children were classified as overweight. Of greater concern, however, is the increasing prevalence of overweight people aged >15 years. The recent demographic and health survey in adults found a prevalence of obesity (body mass index ≥30) of 19.2 % in South Africans and 29% in black women (*1*).

Table 4 gives data on the macronutrient and anthropometric status of children aged 6–9 years in the NFCS in relation to consumption of added sugar, adjusted for socioeconomic status, which was found to be a significant confounding variable (*6*). Total energy intake was not

Table 5. **Daily micronutrient intakes (density) of children aged 6–9 years in the National Food and Consumption Survey (NFCS) according to tertiles of sugar intake**

Micronutrient (mg/4.18 kJ)	Energy from sugar (%)			General linear model *P*–value[a]	Spearman's correlation
	Lowest tertile	Middle tertile	Highest tertile		
Vitamin A	362.7 A[b] (90.4– 635.1)[c]	489.8 A (244.9– 734.6)	572.2 A (357.8– 786.3)	0.4949	0.02889 ($P = 0.4117$)
Thiamin	0.65 A (0.60– 0.69)	0.57 B (0.53– 0.61)	0.51 C[d] (0.4– 0.54)	<0.0001[e]	–0.32701 ($P < 0.0001$[e])
Riboflavin	0.63 A (0.47– 0.79)	0.58 A (0.44– 0.72)	0.65 A (0.52– 0.77)	0.7777	0.04011 ($P = 0.2539$)
Niacin	6.13 A (5.29– 6.98)	6.43 A (5.68– 7.19)	6.51 A (5.84– 7.17)	0.7800	0.06342 ($P = 0.0701$)
Vitamin B6	0.51 A (0.44– 0.58)	0.51 A (0.44– 0.57)	0.57 A (0.52– 0.63)	0.1896	0.08452 ($P = 0.0161$)[e]
Vitamin C	33.29 A (8.94– 57.64)	34.93 A (13.03– 56.82)	28.53 A (9.36– 47.70)	0.9025	–0.01320 ($P = 0.7074$)
Iron	5.46 A (4.66– 6.26)	5.17 A (4.45– 5.90)	4.45 A (3.81– 5.08)	0.115	–0.133382 ($P = 0.0001$)[e]
Zinc	4.28 A (3.87– 4.70)	4.19 A (3.82– 4.56)	3.95 A (3.63– 4.28)	0.4203	–0.13023 ($P = 0.0002$)[e]
Calcium	259.1 A (215.6– 302.5)	217.4 A (178.3– 256.4)	217.0 A (182.8– 251.2)	0.2453	–0.05494 ($P = 0.1180$)
Folate (µg/4.18MJ)	106.1A (84.9– 127.3)	124.5 A (105.4– 143.6)	115.8 A (99.1– 132.5)	0.4483	0.04339 ($P = 0.2174$)

[a] Adjusted for socioeconomic status.
[b] Alphabetic symbols (A, B, and C) indicate whether means are different, i.e. means with the same alphabetic symbol are not significantly different to each other: A and A are similar but A and D differ significantly (Bonferroni test).
[c] Values in parentheses are 95% confidence intervals.
[d] $P < 0.05$, high versus low sugar tertiles (Bonferroni test).
[e] $P < 0.05$ = significant linear relationship.
Source: Labadarios et al., 2000 (*6*).

significantly greater in the highest tertile of sugar intake for which the average consumption was 57.9 g/day of sugar (18.2% of total energy intake). No significant differences were seen in carbohydrate or fat intakes between the groups with different levels of sugar intake. A significantly lower protein intake was seen, however, in the highest tertile of sugar consumers. In addition, percentage of energy contributed by protein was significantly lower in the highest tertile of added sugar.

No significant association was seen between the sugar tertiles with respect to mean height, weight, or weight-for-height and level of sugar intake. This implies that the mean weight and height status in the highest quartile of sugar intake did not differ significantly from those in the lowest quintile. With respect to protein–energy malnutrition among older children (aged ≥6 years), these data show no fundamental need for concentrated high-energy, low-nutrient dense foods such as sugar, as the highest sugar consumers did not have a significantly higher energy intake than low sugar consumers, and the percentage of protein consumed decreased significantly in the highest tertile of sugar consumers. This implies that sugar sources may replace protein-rich sources. These results should be explored further in adults.

Micronutrient dilution

A diet high in added sugars is suggested to dilute micronutrients and displace nutrient-dense foods. Evidence of micronutrient dilution in diets high in added sugar comes from numerous recent publications (*40–44*). Several studies, however, found little or no negative association between intake of total sugars and nutrient intake (*45–50*).

Of some concern are the results of two studies on soft drink consumption in the United States, which found that energy intake was associated positively with consumption of regular soft drinks in teenagers (*42, 43*). Those who fell in the highest soft drink consumption category consumed less milk and fruit juice than those in the lowest category of consumers, which implied that teenagers may have substituted soft drinks for milk.

Undoubtedly, some of the most comprehensive findings in this regard come from Bowman, who assessed the effects of added sugar in more than 14 000 people from the US Department of Agriculture's 1994–96 Continuing Survey of Food Intakes by Individuals (*41*). The participants in the highest sugar intake group (>18% of total energy intake) had the lowest mean absolute intakes of all micronutrients. This group also had the lowest proportion of people that met the recommended dietary allowances.

In the South African context, a recent study found that specific micronutrients decreased in men and women aged ≥65 years as the proportion of energy from sugar in the diet increased (*40*). In men, the intake of thiamine, vitamin E, zinc, iron, magnesium, and copper decreased significantly ($P<0.05$) as the proportion of sugar intake of the total energy intake increased.

Results from the NFCS (*6*) indicated that micronutrient intakes — specifically of vitamin A, vitamin C, vitamin E, the B vitamins, iron, calcium, and zinc — were inadequate in many children in all age groups. Table 5 gives data on children aged 6–9 years according to tertiles of sugar and micronutrient intake per 4.18 kJ. A significant inverse relation was found between sugar intake and thiamine, iron, and zinc. No relation or significant difference was found for the other nutrients, except for a weak linear relation between sugar intake and vitamin B6.

Obesity and the nutrition transition

The prevalence of obesity increased dramatically during the past decade, particularly in children and adolescents. This effect has been described as one of the major consequences of the nutrition transition, which includes a large increase in the consumption of fat and added sugar, a marked increase in the consumption of animal products, and a decline in intake of cereal and fibre (*51, 52*).

Some of the most dramatic increases in chronic diseases of lifestyle — such as obesity, hypertension, coronary heart disease, and type 2 diabetes — have taken place in indigenous populations exposed to large dietary shifts because of increasing urbanization (*53–56*). This is particularly relevant to the people of the black population of South Africa, who have changed their eating habits to include an increased consumption of added sugar, as urbanization has increased (*57, 58*).

The relation between sugar and fat intake has been the focus of numerous studies over the past few years. In the South African context, the people of the highest tertile of sugar consumers also have the highest mean fat intake (37.1g vs 33.3 g; $P = 0.0680$), although this difference is not significant (Table 4). Mean energy intakes did not differ significantly between the tertiles of sugar consumers, although protein intake was significantly lower in the highest sugar tertile, which suggests that sugar replaces protein foods.

The eating patterns of adolescents in high-income countries show that similar dietary patterns, which include an increased consumption of sweetened and fatty snacks, have emerged over the past decade. In a cohort of 521 Norwegian adolescents studied between the ages of 14 and 21 years, weekly frequency of fruit and vegetable consumption decreased by 1–2.5 times, while frequency of sugar-containing soft drinks increased by almost one intake per week between the ages of 15 and 16 years (*59*).

A study in Kentucky reported that 446 adolescents ate fewer servings from the bread group (5.2) and vegetable group (5.2) and considerably more from the fat and sugar group (11.2) than recommended (*60*). A cohort of Scottish adolescents studied between 1990 and 1998 had a large increase in consumption of high fat- and high sugar-containing foods, particularly among those from lower socioeconomic groups (*60*).

To date, the best evidence for a positive association between obesity and sugar intake is a 19-month prospective study on Boston schoolchildren aged 11–12 years (*31*). This found that for each sugar-sweetened drink consumed daily, both body mass index and frequency of obesity increased (odds ratio, 1.60), even after adjustment for confounding variables. Sugar consumption at baseline was associated independently with body mass index.

With respect to the issues of obesity (and micronutrient dilution), the recent American Heart Association (2002) guidelines stated that: "Intakes of vitamins and minerals are reduced by substitution of high-sugar, nutrient-poor foods for those of higher nutritional quality. Thus to improve the overall nutrient density of the diet, reduce the intake of excess calories, and prevent weight gain, individuals should choose foods and beverages low in sugars, particularly added sugars" and "match intake of energy (calories) to overall energy needs; limit consumption of foods with a high caloric density and/or low nutritional quality, including those with a high content of sugars" (*61*).

Evidence-based sugar guideline for South Africans

Several developed and developing countries have a dietary guideline for sugar (*62*). The terminology used includes "restrict", "limit", and "moderate" sugar intake. The terminology in this case is important, because it implies a value judgement, with the most negative view being "restrict" and the most liberal being "moderate".

Numerous countries have also quantified their sugar guidelines (*14*); these generally are the same as that recommended by WHO for the prevention of chronic diseases, namely <10% of total energy intake (*13*). Countries with a maximum value for added sugar <10% of total energy intake include Denmark, Finland, Germany, Greece, Poland, Spain, Sweden, and the United Kingdom (*14*).

The evidence we present here clearly shows that sugar is a prominent risk factor for a number of important conditions that are prevalent in the South African population. The severity, prevalence, and social impact of these conditions — particularly dental caries and aspects of weight status and the nutrition transition — make them a public health concern and support the assertion that sugar is a common risk factor that must be addressed by public health policy. A clear food-based dietary guideline on sugar consumption therefore is justified fully.

In the South African context (and in similar countries), we recommend a food-based dietary guideline for children aged ≥6 years, as well as for adults. This should comply with the dose-related evidence in relation to dental caries presented earlier — namely that sugar intake should be <40 g/day in areas in which water is not fluoridated and ≤55 g/day in

fluoridated areas. This equates to about 6–10% of energy intake. The guideline should advise people to eat a smaller total amount of sugar, to consume sugar containing foods less frequently during the day, and preferably to do so only during mealtimes and not close to bedtime.

Conclusion

The evidence clearly shows that a guideline on sugar consumption must address the frequency, quantity, and timing of sugar consumption. We recommended that the guideline "Eat and drink food and drinks containing sugar sparingly and not between meals", or a suitably tested variation of this, be adopted. ■

Conflicts of interest: none declared.

Résumé

Données propres à étayer les conseils diététiques alimentaires relatifs à la consommation de sucre en Afrique du Sud

En 1997, l'Afrique du Sud a entrepris d'élaborer et d'appliquer des conseils diététiques alimentaires pour les personnes à partir de six ans. Etant donné la complexité de la population, qui est composée de groupes ethniques divers, et l'urbanisation galopante, les conseils diététiques alimentaires doivent couvrir aussi bien la suralimentation que la sous-nutrition. Les conseils initiaux faisaient l'impasse sur le sucre et le Département de la Santé a refusé de les approuver tant que la question du sucre n'y figurait pas. Le présent article récapitule les données de nature à étayer une recommandation relative au sucre ainsi que la nature de ces données. Notre expérience pourrait inspirer d'autres pays au revenu inférieur ou moyen, notamment en Afrique, qui se trouveraient devant ce même dilemme.

Resumen

Evidencia a favor de unas directrices dietéticas basadas en los alimentos para el consumo de azúcar en Sudáfrica

Desde 1997 Sudáfrica viene formulando y aplicando directrices dietéticas basadas en los alimentos para las personas mayores de 6 años. Debido a la complejidad de la población, que comprende diferentes grupos étnicos, así como a la rápida urbanización que está teniendo lugar, las normas dietéticas basadas en los alimentos han de abarcar tanto la sobrenutrición como la desnutrición. Las primeras directrices no incluían orientación sobre el azúcar, y el Departamento de Salud no estaba dispuesto a aprobarlas mientras no proporcionaran asesoramiento en ese sentido. Este artículo resume las pruebas científicas que respaldan tal asesoramiento y la naturaleza de esas pruebas. Otros países de ingresos bajos y medianos, particularmente de África, se hallan quizá ante un dilema similar y podrían sacar provecho de nuestra experiencia.

ملخص

بيِّنات لدعم الدلائل الإرشادية التغذوية حول استهلاك السكر في جنوب أفريقيا

الملخص: لقد أعدت جنوب أفريقيا منذ عام 1997 دلائل إرشادية تغذوية بالاستناد على الطعام المتناول فيها، وقامت بتنفيذها على من يزيد عمره عن ست سنوات. إن التركيبة المعقدة للسكان، والتي تضم مجموعات إثنية متعددة إلى جانب التحضُّر السريع تجعل الدلائل الإرشادية التغذوية المعدَّة بالاستناد على الطعام المتناول بحاجة إلى أن يؤخذ بالحسبان كل من فرط التغذية ونقص التغذية. ولم تشتمل الدلائل الإرشادية الأولية إرشادات حول السكر؛ ولم يكن توسع الإدارة الصحية الموافقة عليها قبل أن تشتمل على تلك الإرشادات. وتلخص هذه الورقة البيِّنات المتوافرة عند إعداد هذه الدلائل الإرشادية وطبيعة تلك البيِّنات. وقد تواجه البلدان الأخرى المنخفضة أو المتوسطة الدخل، ولاسيَّما ما كان منها في القارة الأفريقية مثل هذه المشكلات، وقد تتعلم من تجربتنا.

الكلمات المفتاحية: سكروز الطعام، إعطاء وجرعات سكروز الطعام، التأثيرات الضائرة لسكروز الطعام؛ كربوهيدرات الطعام؛ إعطاء وجرعات كربوهيدرات الطعام، المتناول من الطاقة، النظام الغذائي؛ معايير النظام الغذائي، تسوس الأسنان، الوقاية من تسوس الأسنان ومكافحته؛ سوء التغذية بالبروتين والطاقة، الوقاية من سوء التغذية بالبروتين والطاقة ومكافحته، البدانة؛ الوقاية من البدانة ومكافحتها، القيمة التغذوية؛ المعدَّيات الرعيدة المقدار، المرض المزمن، عادات الطعام، الدراسة الإثنية لعادات الطعام، دلائل إرشادية، سياسة تغذوية؛ الصحة الريفية، جنوب أفريقيا، الوبائيات في جنوب أفريقيا، الدراسة الإثنية في جنوب أفريقيا. (المصدر: رؤوس الموضوعات الطبية، المكتب الإقليمي لشرق المتوسط).

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