Sugar sweetened beverage consumption in the early years and implications for type 2 diabetes: A sub-Saharan Africa context

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Abstract

This review aims to explore trends of early consumption of sugar-sweetened beverages (SSBs) in Sub-Saharan Africa (SSA), within the context of growing child and adolescent obesity and escalating type-2 diabetes prevalence. We explore efforts to mitigate these, drawing on examples from Africa and elsewhere. SSBs including carbonated drinks and fruit juices, play a contributory role in the development of obesity and associated non-communicable diseases. SSA is an attractive market for beverage companies owing to its rapid economic growth, growing middle class and youthful populations. SSBs already contribute significantly to total sugar and energy consumption in SSA where a plethora of marketing techniques targeted at younger people are utilised to ensure brand recognition and influence purchasing and brand loyalty. Coupled with a general lack of nutrition knowledge or engagement with preventative health, this can lead to frequent consumption of sugary drinks at a young age. Many high and some middle income countries public health efforts address increasing prevalence of obesity and type-2 diabetes by focussing on strategies to encourage reduction in sugar consumption via health policy and public education campaigns. However, similar efforts are not as developed or forthcoming in low-income countries. Health care systems across SSA are ill-prepared to cope with epidemic proportions of non-communicable diseases, particularly when contextualized with the ongoing battle with infectious diseases. We conclude that greater efforts by governments and the nutrition community to educate the public on the health effects of increased and excessive consumption of SSBs are necessary to help address this issue.

Introduction

Sub-Saharan Africa has long been battling with communicable diseases; namely HIV, malaria and tuberculosis. However, the region's disease burden continues to grow given the onset of the nutrition transition, which has led to an increase in prevalence of non-communicable diseases (NCDs) such as type-2 diabetes [(1)]. Out of the 371 million people with diabetes worldwide, Africa is home to 27.5 million (7.4%) of them. Table 1 presents a summary of data on prevalence of type 2 diabetes in sub-Saharan Africa aged 20-79 years and table 2 presents this data in relation to highest prevalence. However, the full extent of the diabetes epidemic in Africa may be underestimated given poor disease surveillance and a lack of local diagnostic data [(2-4)]. Table 3 presents the regional perspective on proportion of undiagnosed type 2 diabetes in 20-79 year olds. By 2030 the total burden of NCDs in Africa is expected to surpass that of communicable diseases.

Table 1: Sub-Saharan countries with the highest number of people aged 20-79 years with type-2 diabetes [(5)].

Country	Prevalence (n)
1. Nigeria	3,921,500
2. South Africa	2,646,050
3. Ethiopia	1,852,230
4. United Republic of Tanzania	1,706,930
5. Democratic Republic of the Congo	1,594,110
6. Kenya	749,248
7. Uganda	625,045
8. Zimbabwe	600,668
9. Coˆte d'Ivoire	500,529
10. Cameroon	497,976

Table 2: Sub-Saharan countries with the highest percentage of people aged 20-79 years with type-2 diabetes [(5)].

Country	Prevalence (%)
1. Reunion	15.4
2. Seychelles	12.1
Gabon	10.7
Zimbabwe	9.7
South Africa	9.3

Western Sahara	9.2
United Republic of Tanzania	9.0
Comoros	8.4
Djibouti	6.8
Republic of Congo	6.3

Table 3: Regional estimates of the proportion and number of undiagnosed type-2 diabetes among adults ages 20-79 years [6].

Region	**Undiagnosed diabetes (%)**	**Undiagnosed diabetes (million)**
Africa	66.7	9.5
Europe	39.3	23.5
Middle East/North Africa	40.6	14.4
North America/Caribbean	29.9	13.3
South/Central America	39.0	11.5
South-East Asia	52.1	40.8
Western Pacific	52.1	79.8
World	46.5	192.8

High rates of type 2 diabetes and other NCDs are mainly due the nutrition transition in African countries that are advancing economically. Nine out of the ten fastest growing economies are in Africa; bringing with it changes in the environmental and nutritional landscape of a country that has embraced globalisation [7]. Some of these changes include rapid urbanization and shifting of traditional diets towards more globalised foods; including SSBs [8]. This is reflected in predictions that Africa will experience the largest increase in type-2 diabetes cases (estimated 41.4 million by 2035); and that nine out of ten countries with the highest rates of type-2 diabetes will be in Africa [8, 9]. This is supported by data from the International Diabetes Federation (IDF), which estimates that between 2010 and 2030, Africa will see a 98.1% increase in diabetic patients; the highest in the world [10].

Also, countries experiencing high levels of globalisation are more likely to import and consume sugar-based processed products including SSBs. Country-specific fixed effects models exploring the relationship between sugar and processed foods imports, globalization,

and average body mass index (BMI) revealed an association between sugar and processed food imports and increasing BMI [11].

SSBs, Obesity and Type 2 Diabetes

Obesity is a risk-factor for diabetes and other NCDs, and excess bodyweight is the sixth most important risk factor contributing to the overall global burden of disease [12]. The link between SSBs and obesity is well established [12, 16]. Its growing intake plays an important role in the onset of type 2 diabetes [3, 13].

Studies conducted in both high-income and low-to-middle-income countries have provided clear evidence of this [12, 17-19]. Data from the Euromonitor Global Market Information Database, the World Health Organization, and the International Diabetes Federation were analysed to estimate the association between SSB consumption and overweight, obesity, and diabetes prevalence in 75 countries. It was shown that there was a global increase in SSB consumption from 9.5 gallons per person per year in 1997 to 11.4 gallons in 2010. There was also a 1% rise in SSB consumption was linked to an additional 4.8 overweight, 2.3 obese and 0.3 diabetic adults per 100 people. Such results were found to be particularly robust in low-middle income countries (LMICs) [15].

The average 330ml serving of sugar-sweetened soda or fruit juice contains anywhere between 40-45g of sugar [13]. Owing to their popularity and often lack of nutritional knowledge, SSBs contribute to a considerable proportion of total per capita sugar and energy consumption [13]. Using data from 165 countries, it was shown that diabetes prevalence was strongly correlated to per capita sugar consumption [20]. Therefore, regular SSB consumption can raise both glucose and insulin levels in an individual; leading to a high dietary glycemic load, and eventual weight gain [12]. Estimates indicate that one 330ml SSB serving containing between 140 and 150 calories can result in a weight increase of up to 6.8kg in one year in a person consuming a standard American diet over a year [12]. This is plausible given the considerably large quantities of rapidly-absorbed carbohydrates such as sucrose and high-fructose corn syrup in most SSBs. The flavour-enhancing effect of these added carbohydrates comes with adverse effects for the consumer. When consumed in large quantities, the likelihood of developing glucose intolerance and insulin resistance increases, as well as inflammation and cell dysfunction [13]. This indicates that SSBs can lead to diabetes independently of obesity [19].

A meta-analysis conducted by Malik *et al*. provided a clear association between SSB consumption and type 2 diabetes. It was shown that participants with the highest SSB intake had a 26% higher risk of developing type 2 diabetes compared to those with the lowest intake [19].

Furthermore, it has even been identified that a high sugar intake can inevitably reduce micronutrient intake by lowering the density of key micronutrients in the diet such as zinc, magnesium, calcium, iron and vitamins A, C and B12 [18, 21].

Implications for Africa

The type-2 diabetes epidemic is having a devastating impact on Sub-Saharan Africa, resulting in higher mortality and morbidity than any other region. This is largely due to factors such as inadequate public healthcare system and medication supply, along with inadequate funding for diabetes research, and disparities between urban and rural diabetic patients [22].

Despite recent advances, African healthcare systems still have challenges for mapping the epidemiological transition from communicable to non-communicable diseases, and/or effectively dealing with the shift in disease patterns [23]. These inadequacies range from a lack of key diagnostic tools, essential medications, as well as standardized protocols for treatment monitoring and specialist referral [24]. In addition, the poor integration of diabetic care into African healthcare systems is widespread [25].

Sub-Saharan Africa spends the least on healthcare despite having some of the highest disease burdens. Healthcare costs related to type-2 diabetes alone is expected to rise by 50% between 2010 and 2030; to reach an estimated two billion USD by 2030 [9]. Yet countries such as Ivory Coast, Ethiopia, Madagascar and Niger spend less than US$20 per diabetic person; which is not even sufficient to cover the cost of the most basic pharmaceutical treatment [9].

In total, the 18 African countries belonging to International Diabetes Federation cumulatively spend only 0.3% of the global diabetic bill, compared to 52.7% paid by the United States [9].

Less than 10% of the world's expenditure on diabetes will come from the least developed countries, despite having close to 70% of the world's diabetic patients [9].

In a conceptual review, Renzaho *et al*. (2015) highlighted several challenges facing diabetes prevention, treatment and management programmes in Africa. These include: 1) inadequate risk factor documentation, 2) demographic shifts (urbanisation and ageing populations), 3) co-morbidities, namely tuberculosis and HIV 4) nutrition emergencies, 5) lack of political

prioritisation, and 6) an insufficiently regulated food and beverage industry [26].

Meanwhile, population-based surveys conducted across Africa between 1980 and 2014 for BMI and diabetes revealed an increase in (age-standardized) mean BMI from 21.0 kg/m^2 to 23.0 kg/m^2 in men and 21.9 kg/m^2 to 24.9 kg/m^2 in women; while (age-standardized) prevalence of diabetes grew from 3.4% to 8.5% in men and from 4.1% to 8.9% in women. These estimates were significantly higher in Northern and Southern Africa, more so than the global average [27].

Prevalence data from 12 Sub-Saharan African countries showed a median diabetes prevalence of 5% (2-14% range) and a median overweight/obesity prevalence of 27% (16-68% range) [28]. Such trends are also observed in the lower-income countries. Data collected between 2013 and 2016 from adults in Malawi showed overweight and obesity prevalence of 18% and 44% in urban men and women respectively; and 9% and 27% in rural men and women respectively. Meanwhile, diabetes prevalence was 3% in urban residents and 2% in rural residents, irrespective of gender [29]. This presents an urgent need for action particualrly on prevention of disease.

Consumption in early years (childhood)

Childhood years, particularly infancy and adolescence, are critical to the physical growth and cognitive development of an individual [30]. Optimum nutrition during this time is essential to achieving positive health outcomes in adulthood. Hence many chronic diseases experienced during adulthood can be traced to dietary factors during these early development years. The current trend observed in LMICs is a shift from childhood diseases associated with undernutrition to a double-burden of under and over-nutrition-related conditions [30].

Although increase in age remains a risk factor for type 2 diabetes, it is predicted that a shift towards earlier onset will be witnessed as the epidemic matures [4]. In 2013, most diabetic cases in Africa were amongst individuals under the age of 60 years, with peak onset found between 40-59 years [4, 31]. This is likely to fall to an even lower age, given the trend for early age consumption of SSB in Sub-Saharan Africa. In some instances, infants are given SSBs as a means of weaning them off breast milk. A Nigerian cross-sectional survey revealed that close to 90% of 6 to 18 month-old babies were given sugar sweetened chocolate drinks, while 79.9% were given fruit juices. Just over 70% of infants were given carbonated drinks, of

which roughly 16% received it daily [32]. In a similar study in rural South Africa, 54% of infants between 4 and 24 months in one area and 37% in another area were given carbonated drinks up to three times per week [33]. It is thus unsurprising that carbonated drinks are the third most commonly consumed beverage among infants aged 12-24 months in urban South Africa [34].

A cross-sectional survey conducted in 11 South African primary school shops revealed that children had a daily sugar of intake of 34g from carbonated drinks; in addition to 13g from flavoured milk and 24g from mixed fruit blends, all consumed at school [35]. Two of the shops also sold 500ml and one litre servings of carbonated drinks; raising flags of concern over the lack of nutritional knowledge regarding the dangers of regularly consuming SSBs in such large quantities [36].

In a descriptive survey conducted in Cape Town, school children aged nine to 13 years were consuming up to 730g of carbonated drinks per day, equalling a sugar intake of 40-80g each day from carbonated drinks alone [37]. Such high intake levels persist into adolescence. In urban Uganda, a 2004 cross-sectional survey involving 614 adolescents aged 10 to 14 years found that an average of 30% were consuming carbonated drinks on a daily basis [38].

Available national data on sugar consumption in children from the 1999 South African National Food Consumption Survey showed an average daily consumption in one to nine year olds of 10.4g of sugar from squash, and 6g of sugar from carbonated drinks [18].

Sugar consumption in urban South Africa for adolescents and adults (over 10 years), was reported to be 12.3% of total energy intake, which exceeds WHO recommendations of less than 10% of total energy intake; and less than 5% for additional health benefits [39, 40]. From 1999 to 2012, there was a 68.9% increase in carbonated drink consumption in South Africa; with consumption by rural women increasing from 25% in 2005 to 56% in 2010; and from 33% to 63% in men during the same period [40]. Carbonated drinks were second only to fruit as the most commonly consumed street food in South Africa [40].

Much of this frequent and early consumption stems from the affordability of SSBs Goryakin *et al.* (2017) assessed the relationship between sales and prices of carbonated soft drinks and BMI, overweight, obesity and diabetes in 78 countries. Interestingly, the study discovered a

significantly positive relationship only in low and lower-middle income countries. It was then suggested that restricting sales of SSBs could prove beneficial towards minimising the health impact in least developed countries [41].

Nutritional Knowledge/Education

A lack of nutritional knowledge/education of the risks involved with frequent SSB intake may also play a role in early consumption. Data from high and low-income high school students in peri-urban South Africa showed an inverse relationship between level of mothers' education and students' frequency of carbonated drink consumption [42].

Despite the association between SSBs and diabetes, there is little to no data on the level of consumer knowledge of the adverse effects of frequent SSB consumption within the African context. In a US study, it was observed that less than a third of survey respondents correctly identified the daily calorie recommendations for a typical adult; and these were also found to consume on average nine fewer SSBs per month compared to respondents who were incorrect [43].

A South African study evaluated the effect of a nutrition education (NE) programme on diabetes knowledge and attitudes of adults with type 2 diabetes; and it was discovered that the intervention group that received weekly group education, follow-up meetings and education materials had higher mean diabetes knowledge scores than the control group that received education materials only. However, it was also observed that the scores were below 50%. The study concluded that education programmes should focus on addressing misconceptions about healthy eating and unhealthy eating practices, increasing self-efficacy regarding purchasing and preparation of healthy food, and representing diverse cultures while paying attention to issues related to availability and affordability [44].

Policy Regulations

Globally, concerted efforts are being made to reduce SSB consumption and curb the obesity epidemic; one of which is implementing a taxation on sugar and sugar-based products. The UK Chancellor of the Exchequer announced a levy on SSB in 2016, following a report by the Scientific Advisory Committee on Nutrition (SACN); which inexplicably linked SSBs with obesity in children and teenagers, as well as type-2 diabetes independently of obesity. The

levy, which commenced in 2018, involves companies paying a higher level tax for drinks with more than 8g of sugar per 100ml [45]. The SACN also recommended that less than 5% of total dietary energy intake for adults and children from the age of 2 years should be from free sugars [46].

In response the UK government published two childhood obesity plans, which included announcements on a soft drink industry levy (SDIL) and a wider sugar reformulation programme [47, 48]. The SDIL applied to drinks with sugar content of 8% and 5%, with a view to incentivise manufacturers to reduce sugar content in their products in advance of the levy being applied. In 2018, the Public Health England published a progress report on these programmes, demonstrating an 11% reduction in sugar sales in the UK as a result of the SDIL; and a 2% reduction in sugar in the nine food categories covered by the reformulation programme [49].

In the US, SSBs are the main source of added sugars in the average diet, which includes sweeteners such as sucrose, high-fructose corn syrup, or fruit juice concentrates [19]. From 2006, the city of New York began disseminating educational messages via mass media campaigns on the adverse health effects of SSB consumption. In addition, city agencies reduced the availability of SSB; and policies on excise tax and capping drink portion sizes in the food service industry were proposed. From 2007 to 2013, a 35% decrease in consumption of one or more SSB per day by the average adult was observed; as well as a 27% decrease among adolescents [50].

Whereas, researchers highlighted in India, 11.2 million cases of overweight and obesity and 400,000 cases of type-2 diabetes could be prevented, should they implement a 20% excise duty on sugar sweetened beverages from 2014 to 2023 [51].

South Africa was the first and to date remains the only African country to attempt a taxation on sugary foods. Effective from April 2017, the tax came amidst heavy criticism from the sugar industry. Sugar directly employs up to 79,000 people in South Africa, with another one million depending on sugar for their livelihood [52]. At the same time, the country faces nearly 17 million annual health centre visits as a result of diabetes and hypertension alone [53]. This has spurred the South African Department of Health to recommend considering the taxation on sugary foods as a strategy for reducing obesity and NCD prevalence [53]. A life table-based model to determine the impact of SSB taxation on nutritional status (BMI) was constructed

by Manyema *et al.* (2015) [13]; using consumption data from the South African National Health and Nutrition Examination Survey in 2012; along with own- and cross-price elasticities of SSBs and energy balance equations. It was noted that an increase in SSB tax of 20% over a 20-year period could lower the diabetes incidence rate in women and men by 106,000 and 54,000 respectively. This could lead to the avoidance of 21,000 diabetes-related deaths, 374,000 Daily-Adjusted Life Years, and over US$650 million in healthcare expenditure [13].

The South African government also made efforts to limit the exposure of its young population to aggressive marketing tactics. Sugar-sweetened beverages are aggressively marketed to younger people through multiple avenues in Sub-Saharan Africa; such as the sponsoring of high profile sporting and entertainment [45]. In data from South Africa identified television as the most influential advertising medium that encourages the consumption of SSBs and other unhealthy food choices [54]. It was revealed that most advertisements shown during children's viewing time (15.00 – 17.00) were for unhealthy foods including desserts and sweets (28%), fast foods (17%) and SSBs (11%) [54]. In 2007 the government drafted the Foodstuffs, Cosmetics & Disinfectants Act, which included restrictions of the advertising of foods considered "non-essential to a healthy lifestyle" such as SSBs to children younger than 16 years [34].

The national policies to address obesity and diabetes in LMICs and particularly SSA are currently insufficient. Some trade-related policies have been proposed, including an increase in duties and import taxes on sugar products. However, such initiatives may have marginal effectiveness, if any at all, owing to the normalisation of frequent SSB consumption amongst many populations. Hence local and community organizations can develop strategies to target individual practices surrounding SSB consumption [11]. Nutrition education campaigns may be necessary to sensitise individuals to the health impact of regular SSB consumption. Efforts cannot afford to be one-sided and should involve a multi-sectoral approach to tackling this concern.

Conclusion and Recommendations

This aim of this review is to explore trends of early consumption of sugar-sweetened beverages (SSBs) in Sub-Saharan Africa (SSA), within the context of growing child and

adolescent obesity and escalating type-2 diabetes prevalence. We explored efforts to mitigate this drawing on a review of the literature. We found that there is a paucity of published literature for many regions in Africa to inform the review and this should be an area of future research to inform country level policy. However, despite this we conclude this review with a number of points.

The contribution of SSBs to obesity and diabetes in Sub-Saharan Africa is real and escalating rapidly; therefore, immediate action to mitigate its impact must be taken. Attention should be paid to the early consumption of SSBs as well as its marketing to Africa's youthful population. The adoption of nutrition education programmes at the school level to provide information on the health risks of excess SSB consumption and their contribution to obesity, diabetes and other NCDs should be encouraged. Best practices and lessons learned from other countries should be reviewed and adopted within context. These include but are not limited to nutrition education and health behaviour change initiatives. The beverage industry in Africa should be actively monitored and regulated as they are in a number of industrialised countries; given the challenges for healthcare systems to cope with growing NCD epidemics. Governments should also be informed of the medium-to-long term health and financial benefits of investing in obesity prevention measures such as taxation on sugary foods. African nutritionists and dietitians must play a prominent role in providing this information, by collating the evidence needed to inform policy and through the use of advocacy to influence policy change.

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