

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

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13 **Abstract**

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

34

## 35 Introduction

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

47 Table 1: Sub-Saharan countries with the highest number of people aged 20-79 years with  
48 type-2 diabetes <sup>(5)</sup>.

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. Co <sup>^</sup> te d'Ivoire	500,529
10. Cameroon	497,976

49 Table 2: Sub-Saharan countries with the highest percentage of people aged 20-79 years with  
50 type-2 diabetes <sup>(5)</sup>.

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

51 Table 3: Regional estimates of the proportion and number of undiagnosed type-2 diabetes  
52 among adults ages 20-79 years <sup>(6)</sup>.

<b>Region</b>	<b>Undiagnosed diabetes (%)</b>	<b>Undiagnosed diabetes (million)</b>
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

53  
54 High rates of type 2 diabetes and other NCDs are mainly due the nutrition transition in  
55 African countries that are advancing economically. Nine out of the ten fastest growing  
56 economies are in Africa; bringing with it changes in the environmental and nutritional  
57 landscape of a country that has embraced globalisation <sup>(7)</sup>. Some of these changes include  
58 rapid urbanization and shifting of traditional diets towards more globalised foods; including  
59 SSBs <sup>(8)</sup>. This is reflected in predictions that Africa will experience the largest increase in  
60 type-2 diabetes cases (estimated 41.4 million by 2035); and that nine out of ten countries with  
61 the highest rates of type-2 diabetes will be in Africa <sup>(8,9)</sup>. This is supported by data from the  
62 International Diabetes Federation (IDF), which estimates that between 2010 and 2030, Africa  
63 will see a 98.1% increase in diabetic patients; the highest in the world <sup>(10)</sup>.  
64 Also, countries experiencing high levels of globalisation are more likely to import and  
65 consume sugar-based processed products including SSBs. Country-specific fixed effects  
66 models exploring the relationship between sugar and processed foods imports, globalization,

67 and average body mass index (BMI) revealed an association between sugar and processed  
68 food imports and increasing BMI <sup>(11)</sup>.

69

## 70 **SSBs, Obesity and Type 2 Diabetes**

71 Obesity is a risk-factor for diabetes and other NCDs, and excess bodyweight is the sixth most  
72 important risk factor contributing to the overall global burden of disease <sup>(12)</sup>. The link  
73 between SSBs and obesity is well established <sup>(12, 16)</sup>. Its growing intake plays an important  
74 role in the onset of type 2 diabetes <sup>(3, 13)</sup>.

75

76 Studies conducted in both high-income and low-to-middle-income countries have provided  
77 clear evidence of this <sup>(12, 17-19)</sup>. Data from the Euromonitor Global Market Information  
78 Database, the World Health Organization, and the International Diabetes Federation were  
79 analysed to estimate the association between SSB consumption and overweight, obesity, and  
80 diabetes prevalence in 75 countries. It was shown that there was a global increase in SSB  
81 consumption from 9.5 gallons per person per year in 1997 to 11.4 gallons in 2010. There was  
82 also a 1% rise in SSB consumption was linked to an additional 4.8 overweight, 2.3 obese and  
83 0.3 diabetic adults per 100 people. Such results were found to be particularly robust in low-  
84 middle income countries (LMICs) <sup>(15)</sup>.

85

86 The average 330ml serving of sugar-sweetened soda or fruit juice contains anywhere between  
87 40-45g of sugar <sup>(13)</sup>. Owing to their popularity and often lack of nutritional knowledge, SSBs  
88 contribute to a considerable proportion of total per capita sugar and energy consumption <sup>(13)</sup>.  
89 Using data from 165 countries, it was shown that diabetes prevalence was strongly correlated  
90 to per capita sugar consumption <sup>(20)</sup>. Therefore, regular SSB consumption can raise both  
91 glucose and insulin levels in an individual; leading to a high dietary glycemic load, and  
92 eventual weight gain <sup>(12)</sup>. Estimates indicate that one 330ml SSB serving containing between  
93 140 and 150 calories can result in a weight increase of up to 6.8kg in one year in a person  
94 consuming a standard American diet over a year <sup>(12)</sup>. This is plausible given the considerably  
95 large quantities of rapidly-absorbed carbohydrates such as sucrose and high-fructose corn  
96 syrup in most SSBs. The flavour-enhancing effect of these added carbohydrates comes with  
97 adverse effects for the consumer. When consumed in large quantities, the likelihood of  
98 developing glucose intolerance and insulin resistance increases, as well as inflammation and  
99 cell dysfunction <sup>(13)</sup>. This indicates that SSBs can lead to diabetes independently of obesity  
100 <sup>(19)</sup>.

101 A meta-analysis conducted by Malik *et al.* provided a clear association between SSB  
102 consumption and type 2 diabetes. It was shown that participants with the highest SSB intake  
103 had a 26% higher risk of developing type 2 diabetes compared to those with the lowest intake  
104 <sup>(19)</sup>.

105 Furthermore, it has even been identified that a high sugar intake can inevitably reduce  
106 micronutrient intake by lowering the density of key micronutrients in the diet such as zinc,  
107 magnesium, calcium, iron and vitamins A, C and B12 <sup>(18, 21)</sup>.

108

### 109 **Implications for Africa**

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

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

120

121 Sub-Saharan Africa spends the least on healthcare despite having some of the highest disease  
122 burdens. Healthcare costs related to type-2 diabetes alone is expected to rise by 50% between  
123 2010 and 2030; to reach an estimated two billion USD by 2030 <sup>(9)</sup>. Yet countries such as  
124 Ivory Coast, Ethiopia, Madagascar and Niger spend less than US\$20 per diabetic person;  
125 which is not even sufficient to cover the cost of the most basic pharmaceutical treatment <sup>(9)</sup>.

126 In total, the 18 African countries belonging to International Diabetes Federation cumulatively  
127 spend only 0.3% of the global diabetic bill, compared to 52.7% paid by the United States <sup>(9)</sup>.

128 Less than 10% of the world's expenditure on diabetes will come from the least developed  
129 countries, despite having close to 70% of the world's diabetic patients <sup>(9)</sup>.

130

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

135 prioritisation, and 6) an insufficiently regulated food and beverage industry <sup>(26)</sup>.

136

137 Meanwhile, population-based surveys conducted across Africa between 1980 and 2014 for  
138 BMI and diabetes revealed an increase in (age-standardized) mean BMI from 21.0 kg/m<sup>2</sup> to  
139 23.0 kg/m<sup>2</sup> in men and 21.9 kg/m<sup>2</sup> to 24.9 kg/m<sup>2</sup> in women; while (age-standardized)  
140 prevalence of diabetes grew from 3.4% to 8.5% in men and from 4.1% to 8.9% in women.  
141 These estimates were significantly higher in Northern and Southern Africa, more so than the  
142 global average <sup>(27)</sup>.

143

144 Prevalence data from 12 Sub-Saharan African countries showed a median diabetes  
145 prevalence of 5% (2-14% range) and a median overweight/obesity prevalence of 27% (16-  
146 68% range) <sup>(28)</sup>. Such trends are also observed in the lower-income countries. Data collected  
147 between 2013 and 2016 from adults in Malawi showed overweight and obesity prevalence of  
148 18% and 44% in urban men and women respectively; and 9% and 27% in rural men and  
149 women respectively. Meanwhile, diabetes prevalence was 3% in urban residents and 2% in  
150 rural residents, irrespective of gender <sup>(29)</sup>. This presents an urgent need for action particularly  
151 on prevention of disease.

152

### 153 **Consumption in early years (childhood)**

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

160

161 Although increase in age remains a risk factor for type 2 diabetes, it is predicted that a shift  
162 towards earlier onset will be witnessed as the epidemic matures <sup>(4)</sup>. In 2013, most diabetic  
163 cases in Africa were amongst individuals under the age of 60 years, with peak onset found  
164 between 40-59 years <sup>(4, 31)</sup>. This is likely to fall to an even lower age, given the trend for early  
165 age consumption of SSB in Sub-Saharan Africa. In some instances, infants are given SSBs  
166 as a means of weaning them off breast milk. A Nigerian cross-sectional survey revealed that  
167 close to 90% of 6 to 18 month-old babies were given sugar sweetened chocolate drinks, while  
168 79.9% were given fruit juices. Just over 70% of infants were given carbonated drinks, of

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

174

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

181

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

187

188 Available national data on sugar consumption in children from the 1999 South African  
189 National Food Consumption Survey showed an average daily consumption in one to nine  
190 year olds of 10.4g of sugar from squash, and 6g of sugar from carbonated drinks <sup>(18)</sup>.

191

192 Sugar consumption in urban South Africa for adolescents and adults (over 10 years), was  
193 reported to be 12.3% of total energy intake, which exceeds WHO recommendations of less  
194 than 10% of total energy intake; and less than 5% for additional health benefits <sup>(39, 40)</sup>. From  
195 1999 to 2012, there was a 68.9% increase in carbonated drink consumption in South Africa;  
196 with consumption by rural women increasing from 25% in 2005 to 56% in 2010; and from  
197 33% to 63% in men during the same period <sup>(40)</sup>. Carbonated drinks were second only to fruit  
198 as the most commonly consumed street food in South Africa <sup>(40)</sup>.

199

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



203 significantly positive relationship only in low and lower-middle income countries. It was then  
204 suggested that restricting sales of SSBs could prove beneficial towards minimising the health  
205 impact in least developed countries <sup>(41)</sup>.

206

### 207 **Nutritional Knowledge/Education**

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

212

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

219

220 A South African study evaluated the effect of a nutrition education (NE) programme on  
221 diabetes knowledge and attitudes of adults with type 2 diabetes; and it was discovered that  
222 the intervention group that received weekly group education, follow-up meetings and  
223 education materials had higher mean diabetes knowledge scores than the control group that  
224 received education materials only. However, it was also observed that the scores were below  
225 50%. The study concluded that education programmes should focus on addressing  
226 misconceptions about healthy eating and unhealthy eating practices, increasing self-efficacy  
227 regarding purchasing and preparation of healthy food, and representing diverse cultures while  
228 paying attention to issues related to availability and affordability <sup>(44)</sup>.

229

### 230 **Policy Regulations**

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



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

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

248

249 In the US, SSBs are the main source of added sugars in the average diet, which includes  
250 sweeteners such as sucrose, high-fructose corn syrup, or fruit juice concentrates <sup>(19)</sup>. From  
251 2006, the city of New York began disseminating educational messages via mass media  
252 campaigns on the adverse health effects of SSB consumption. In addition, city agencies  
253 reduced the availability of SSB; and policies on excise tax and capping drink portion sizes in  
254 the food service industry were proposed. From 2007 to 2013, a 35% decrease in consumption  
255 of one or more SSB per day by the average adult was observed; as well as a 27% decrease  
256 among adolescents <sup>(50)</sup>.

257

258 Whereas, researchers highlighted in India, 11.2 million cases of overweight and obesity and  
259 400,000 cases of type-2 diabetes could be prevented, should they implement a 20% excise  
260 duty on sugar sweetened beverages from 2014 to 2023 <sup>(51)</sup>.

261

262 South Africa was the first and to date remains the only African country to attempt a taxation  
263 on sugary foods. Effective from April 2017, the tax came amidst heavy criticism from the  
264 sugar industry. Sugar directly employs up to 79,000 people in South Africa, with another one  
265 million depending on sugar for their livelihood <sup>(52)</sup>. At the same time, the country faces nearly  
266 17 million annual health centre visits as a result of diabetes and hypertension alone <sup>(53)</sup>. This  
267 has spurred the South African Department of Health to recommend considering the taxation  
268 on sugary foods as a strategy for reducing obesity and NCD prevalence <sup>(53)</sup>. A life table-based  
269 model to determine the impact of SSB taxation on nutritional status (BMI) was constructed

270 by Manyema *et al.* (2015) <sup>(13)</sup>; using consumption data from the South African National  
271 Health and Nutrition Examination Survey in 2012; along with own- and cross-price  
272 elasticities of SSBs and energy balance equations. It was noted that an increase in SSB tax of  
273 20% over a 20-year period could lower the diabetes incidence rate in women and men by  
274 106,000 and 54,000 respectively. This could lead to the avoidance of 21,000 diabetes-related  
275 deaths, 374,000 Daily-Adjusted Life Years, and over US\$650 million in healthcare  
276 expenditure <sup>(13)</sup>.

277

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

289

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

299

### 300 **Conclusion and Recommendations**

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

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

308

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

324

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332

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