Diabetes & Metabolic Syndrome: Clinical Research & Reviews xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Diabetes & Metabolic Syndrome: Clinical Research & Reviews

journal homepage: www.elsevier.com/locate/dsx

Original Article

Sugar intake in Sudanese individuals was associated with some features of the metabolic syndrome: Population based study

Eman F El-Sayed[a], Heitham Awadalla[b], Sufian K Noor[c], Wadie M Elmadhoun[d], Amel A Sulaiman[e], Ahmed O Almobarak[f], Mohamed H Ahmed[g,*]

[a] Public and Tropical Health Program, University of Medical Sciences and Technology, Khartoum, Sudan
[b] Department of Community Medicine, Faculty of Medicine, University of Khartoum, Khartoum, Sudan
[c] Department of Medicine, Faculty of Medicine and Health Sciences, Nile Valley University, Atbara, Sudan
[d] Department of Pathology, Faculty of Medicine and Health Sciences, Nile Valley University, Atbara, Sudan
[e] Research & Information, Public Health Administration Unit – MOH, Qassim Region, Saudi Arabia
[f] Department of Pathology, Faculty of Medicine, University of Medical Sciences and Technology, Khartoum, Sudan
[g] Department of Medicine and HIV Metabolic Clinic, Milton Keynes University Hospital NHS Foundation Trust, Eaglestone, Milton Keynes, Buckinghamshire, UK

ARTICLE INFO

Article history:
Available online xxx

Keywords:
Sugar intake
Sudan
Obesity
Diabetes and overweight

ABSTRACT

Aim: The aim of this study was to assess the level of sugar intake among Sudanese individuals.
Materials and methods: A cross-sectional study with 323 participants. Respondents were grouped by the total intake of added sugars into two groups, one group with sugar intake more than 200 calories per day and other group with sugar intake less than 200 calories per day. Demographic data were collected with anthropometric measurements like body mass index (BMI) and waist circumference. Chi square, T-Tests and stepwise logistic regression were used (a p-value <0.05 was considered significant).
Results: High sugar intake was noted among 74.6% participants and among overweight, normal weight, followed by obese ($p < 0.015$) and then individuals with diabetes and hypertension ($p < 0.000$ and 0.038 respectively).High sugar intake was also associated with abdominal obesity ($p < 0.016$), mean age of 33 years old ($p < 0.00$) and being married and single($p < 0.003$). Stepwise logistic regression showed diabetes and BMI < 25 were absolute predictors for sugar consumption with p value of 0.001 and 0.039 respectively. Individuals with diabetes have more than five times probability to consume large amount of sugar (Odd ratio 5.6), while those with BMI < 25 have two times risk of consuming more sugar compared to those with BMI > 25 group (Odd ratio 2.1).
Conclusion: A large percentage of Sudanese population uses a high amount of sugar. High sugar intake was associated with normal weight, overweight, abdominal obesity, diabetes and hypertension. Absolute predictors of high sugar intake were diabetes and normal body weight.

1. Introduction

Sugars are carbohydrates and were discovered thousands of years ago likely related to the discovery of sugar cane [1,2]. The WHO defines free sugar as "Free sugars include monosaccharide and disaccharides added to foods and beverages by the manufacturer, cook or consumer, and sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates [2]. Importantly, sugar intake is known to be associated with weight gain or obesity [3], type 2 diabetes and premature death [4–7]. Free sugar intake may also decrease intake of healthy nutrients [5]. Therefore, the WHO recommendations are to reduce the intake of free sugars throughout the life course [5]. Added sugar was not a significant component of the human diet until the advent of modern food-processing methods. Since then, the intake of sugar has raised steadily[8]. There has been an increase in the added sugar to the US diet through the mid-1990s. Steyn and McHiza conducted a review about the outcomes of the nutrition transition in Sub-Saharan Africa (SSA) and its association with overweight and obesity. One of their conclusion was that high sugar intake was noted in 17 countries in SSA [9]. Importantly, high prevalence of dental caries

* Corresponding author at: Department of Medicine and HIV Metabolic Clinic, Milton Keynes University Hospital NHS Foundation Trust, Eaglestone, Milton Keynes, Buckinghamshire, UK.
E-mail address: elziber@yahoo.com (M.H. Ahmed).

https://doi.org/10.1016/j.dsx.2017.09.001
1871-4021/

was noted in preschool Sudanese children and this was attributed to high sugar intake [10].

Between 2005 and 2010 approximately 13% of adult's total caloric intakes came from added sugars, most of the calories came from foods rather than beverages which were consumed at home [11]. All these percentages lead to the conclusion that consumption of sugars has been increasing through the years; according to the United States Department of Agriculture, the global consumption of sugar increased from approximately 155 million metric tons in 2009 to 173 million metric tons in 2015 [12]. Therefore, it is not surprising we see significant variability in sugar intake in different parts of the world and between adult and children. For example, sugar intake in Hungary and Norway was estimated to be around 7–8% of total energy intake. While sugar intake in United Kingdom and Spain was estimated to be 16–17% [12]. Importantly, Sugar intake in children can range between 12% (Denmark, Slovenia and Sweden) and about 25% in Portugal. The intake in urban population (10.3% in South Africa) is higher than in rural population (7.5% in South Africa) [2].

There are strong epidemiological and clinical evidences linking Sugar- Sweetened Beverages (SSBs) and obesity, an increased consumption of sugar sweetened beverages is associated with a higher risk of developing obesity in children and adults [13]. Evidence also suggests that in addition to weight gain, higher consumption of SSBs is associated with the development of metabolic syndrome and type 2 diabetes [14]. According to a fact sheet released by the WHO in 2015, the increasing intake of foods and drinks high in free sugars is positively associated with increased unhealthy weight and negatively associated with intake of important micronutrients [15], low satiety, and incomplete compensation for total energy [16]. All these excess calories can lead to overweight and obesity [17]. According to the WHO guidelines, less than 10% of total energy intake should be from free sugars for a person of healthy body weight consuming approximately 2000 calories per day [18], which approximately equal to 200 calories. Excess sugar intake in India was linked to a rapidly increasing prevalence of obesity, metabolic syndrome and type 2 diabetes mellitus [19]. Importantly, it was shown that decrease in sugar intake was associated with decrease in obesity, insulin resistance and risk of type 2 diabetes [20,21]. The incidence of obesity and type 2 diabetes with excess sugar intake can equally affect men and women [22].

Several large population-based studies have shown that the incidence of type 2 diabetes mellitus was higher with higher intake of both sugar-sweetened soft drinks and fruit drinks [23,16,24]. Despite the increase in the prevalence of obesity and type 2 diabetes in Sudan; the level of sugar consumption was never being investigated. Therefore, the main aim of this study was to assess sugar intake among Sudanese individuals.

2. Materials and methods

2.1. Study design

A descriptive cross-sectional study composed of questionnaires for primary data collection. The study was conducted in Khartoum, Sudan, during the period from September 2015 to December 2015. The study enrolled 323 participants. Inclusion criteria those in current employment, normal weight, overweight and obese individuals. Exclusion criteria were pregnant ladies, excess alcohol intake and individuals with repeated hospital admission or those in any form of artificial feedings. Individuals who fulfill inclusion criteria were approached in their place of work at no obligation at all to complete the study and prior approval of their managers were also obtained, after they being consented the questionnaires were completed.

2.2. Sample size calculation

2.2.1. Sample size

The sample size was determined through the following formula

$$n = \frac{z^2 pq}{(d^2)} \times deff$$

Where:

n = the initial sample size.

z = the critical value for achieving $(1-\alpha)$ % confidence level, here we use z = 1.96.

p = the anticipated population proportion which is often chosen from previous studies.

q = 1 − p.

d = the desired margin of error.

Deff = design effect which is a factor when using complex sampling design like cluster or stratified often chosen as 2.

While the total number of targeted population (population study) N = 840 the sample would be adjusted by:

$$\text{The ultimate sample size} = \frac{n^*}{1 + n^*/N}$$

$$\text{Ultimate n} = \frac{486}{1 + 486/840} = 308$$

2.3. Statistical methods

Descriptive statistics including frequency distribution tables were used in this study. Data was cleaned and entered and analysed by SPSS programme (Version 22, Michigan, IBM, USA). Chi square, and T-Tests for associations between sugar intake and different variables were assessed, in addition to logistic regression analysis. For all test, a p-value <0.05 was considered significant.

2.4. Ethical consideration

The study was approved by the ethical committee of the University of Medical Sciences and Technology. Written consent was obtained from all participants before the start of data collection. Participants were given the full opportunity to refuse or quit at any time during the study.

2.5. Data collection

Sugar intake was assessed using Beverage Intake Questionnaire. The Beverage Intake Questionnaire was used and tested previously in several studies and showed to be reliable including different ethnic populations [25,26]. Respondents were grouped by the total intake of added sugars into two groups, one group with sugar intake more than 200 calories per day and other group with sugar intake less than 200 calories per day. The data collection was collected through pretested designed questionnaire, gathered demographic information, including BMI and waist circumference. In Sudan, the sugar added to food is not properly quantified by majority of food manufactures. In addition, the term added sugar can be used to mean free sugar, sugar and syrups added to food and honey made of sugar mixed with food or drinks. Most of consumption of sugar can be in tea or cold beverage that regularly served in tropical weather in Sudan. Sudanese traditional sweets are very common and popular in Sudan especially; Basta, Tahnia and mokhbaza, which contain high amounts of sugar, but the problem with traditional sweets, is that the exact amount of calories cannot be calculated because Manufactures are not

Please cite this article in press as: E.F. El-Sayed, et al., Sugar intake in Sudanese individuals was associated with some features of the metabolic syndrome: Population based study, Diab Met Syndr: Clin Res Rev (2017), http://dx.doi.org/10.1016/j.dsx.2017.09.001