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## Research Article

### BODY MASS INDEX, DAILY OBESOGENIC DIETARY BEHAVIOR AND DENTAL CARIES IN CHILDREN AGED 4-13 YEARS, ABHA CITY, KINGDOM OF SAUDI ARABIA

**Malaz Mohamed ELrafie Mustafa\* and Sharifa Mohammed Ahmasani**

Department of Pediatric Dentistry and Orthodontic sciences, College of Dentistry,  
King Khalid University, Abha city, KSA

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#### ABSTRACT

Dental caries is multi-factorial disease affecting a wide range of population worldwide. It is regarded as the main source of toothache and tooth loss in children as well as adult populations. Obesity in children is a major public health issue, which is ranked as the fifth top cause of mortality globally. Obesity in children is assessed by body mass index (BMI) based on gender and age. Obesogenic dietary behavior in terms of increased intake of sugars, soft drinks and fast foods in conjunction with reduced activity and exercise resulted in growing populations of obesity worldwide. **Aim:** To study the association between body mass index (BMI), dental caries and daily obesogenic dietary behavior using the Sweet Sugar Score (SSS) in children attending pediatric dental clinics of King Khalid University, Abha city, KSA. **Materials & method:** Following consent; 152 child were examined according to WHO criteria for dental caries (DMFT and dmft), scored according their sugar sweet score (Excellent = 5 or less, 10 = good, 15 or more = watch-out zone), and BMI calculated for each child based on gender and age and ranked into either underweight (< 5th percent), normal-weight (5th-85th percent), at risk of being overweight (> 85th and < 95th percent) or overweight (> or = 95th percent). **Results:** Among 65 males and 87 females examined; 90.1% experienced dental caries, 16% were underweight, 71% were normal-weight, 5% were at risk of overweight, and 8% were overweight. Most of children (71%) when using sweet sugar score were categorized as "watch-out zone", 19% were "excellent", and 10% were "good". Dental caries was categorized into either (present/ absent) to test its association with both BMI and Sugar Sweet Score (SSS). Pearson Chi-Square was used to test the association between BMI, SSS and Dental caries. No association was found ( $p > 0.05$ ). **Conclusion:** The results of the present study showed a high rate of dental caries among participants (90.1%). However, it did not support the association between dental caries, daily obesogenic behaviour (SSS) and BMI in 4-13 years old children. Mean BMI was 16.6 kg/m<sup>2</sup>, with more than two third of participants being ranked as healthy weight. 71% of participants were in the "watch out zone" with increased daily obesogenic behaviour when SSS was used.

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#### INTRODUCTION

Dental caries is multi-factorial disease affecting a wide range of population worldwide. It is regarded as the main source of toothache and tooth loss in children as well as adult populations<sup>[1]</sup>. The term "caries" designates the course of the disease itself as much as its health impacts, namely, the destruction produced by the caries process<sup>[2, 3]</sup>. The World Health Organization's statement on oral health in 2003 and Global Oral Data Bank of WHO stated the worldwide spread of dental caries and confirmed that by the age of 12 only 15 to 30% of the population will be devoid of dental caries with an overall DMFT of 1.74<sup>[4-6]</sup>. It is highly prevalent in different

cities of Saudi Arabia affecting both genders and almost all age groups<sup>[7]</sup>.

Obesity is defined as "a condition of abnormal and excessive fat accumulation in adipose tissue to the extent that health may be adversely affected"<sup>[8]</sup>. Overweight in children is a major public health issue, which is ranked as the fifth top cause of mortality globally<sup>[9, 10]</sup>. Many health-related aberrations are linked to obesity including metabolic and endocrine disorders, cardiovascular, and musculoskeletal abnormalities<sup>[11]</sup>. Similarly, other complications can result from obesity such as compromised quality of life,<sup>[12]</sup> poor self-esteem,<sup>[13]</sup> and depression<sup>[14]</sup>. Obesity in Saudi children is a growing concern.

\*Corresponding author: Malaz Mohamed ELrafie Mustafa

Department of Pediatric Dentistry and Orthodontic sciences, College of Dentistry, King Khalid University, Abha city, KSA

Studies estimate that the prevalence of overweight is increasing in an alarming manner<sup>[11, 15, 16]</sup>.

Obesity in children is assessed by body mass index (BMI) based on gender and age<sup>[17]</sup>. Obesogenic dietary behavior in terms of increased intake of sugars, soft drinks and fast foods in conjunction with reduced activity and exercise resulted in growing populations of obesity globally<sup>[3, 18]</sup>. Obesogenic dietary behavior is suggested to be more prevalent amongst obese children/adolescents when compared to its consumption among those with normal weight. It is also well documented that dental caries is linked to sweetened diet<sup>[19, 20]</sup>. Consequently, poor dietary habits and increased sugar intake may be risk indicator for the development of obesity as well as dental caries<sup>[21]</sup>.

Recent studies have reported a dramatic shift in dietary habits in Saudi Arabia from vegetable and fruit based diet to a more refined and animal product based diet<sup>[22, 23]</sup>. While there are extensive researches on obesity prevalence rates in Kingdom of Saudi Arabia, data on obesogenic dietary behaviour patterns are limited<sup>[24]</sup>.

This study was conducted to assess the association between BMI, daily sugar intake and dental caries in Abha city, Kingdom of Saudi Arabia.

## MATERIAL AND METHOD

Ethical permission from Scientific Research committee of King Khalid University, College of Dentistry was obtained before the commencement of study. Consent from participants and/or parents was also taken. The study did not directly involve any treatment or active intervention.

The study design is a cross-sectional observational one that included 152 healthy children (Boys=65, Girls=87) aged 4-13 years who attended pediatric dental clinics of college of dentistry at King Khalid University for routine dental treatment.

Children who are medically compromised, on chronic medication or special health care need were excluded from the study.

Data including the age and gender of the child was collected through direct interview and a self-report questionnaire.

Body weight and height were recorded for each child using standardized digital weighing and height measuring scale to calculate the BMI (body mass index) following the formula:  $\text{Weight}/(\text{height})^2 = \text{kg}/\text{m}^2$ . Measurement of weight and height were taken without shoes, hats and with their regular dress. BMI was plotted after calculation for each child on a CDC-BMI for age and gender growth charts and curves (Centers for disease control and Prevention, USA) for both genders<sup>[25]</sup> to find the percentile ranking. Then children were categorized as the following; Underweight (less than 5th percentile), healthy weight (5th to < 85th percentile), at risk of being overweight (85th to < 95th percentile) and Overweight ( $\geq$  95th percentile). Diet was assessed by analyzing the daily sugar intake of each child using Sugar Sweet Score (SSS)<sup>[26]</sup> where children and/parents were asked to recall foods and beverages they consumed in the twenty-four hours prior to the interview. SSS utilizes a 24 hours recall diet frequency chart. In this chart, sugar and sugar containing diet together with its frequency of intake per day were marked. Sweet and/or sweet containing food was then categorized according to its consistency into either liquid, solid and sticky or slowly dissolving. Then a check was marked in the frequency column for each item and the overall number of marks then multiplied by 5, 10 or 15 for liquid, solid and slowly dissolving items respectively. Children were then categorized according to their sugar score obtained into either Excellent (5 or less), good (10) or watch-out zone (15 or more) (table 1.).

Dental Caries Status was evaluated following Dentition Status of WHO criteria mentioned in Basic Oral Health Survey Methodology 1997 and then DMFT/dmft was calculated<sup>[27]</sup>.

All the examinations were conducted by a single examiner using a regular dental diagnostic kit under the light of dental unit and then the questionnaire was filled by the same examiner.

**Statistical Analysis:** The data obtained was analyzed using Statistic Package for Social Science software, version 20.0 for windows (SPSS, Chicago, IL, USA).

**Table 1** Calculation of Sugar Sweet Score

Form	Frequency	Points
<b>Liquid</b>		
soft drinks, fruit drinks, cocoa, sugar and honey in beverages, nondairy creamers, ice cream, sherbet, gelatine desert, flavoured yoghurt, pudding, custard, popsicles	—	$\times 5 =$
<b>Solid and sticky</b>		
cake, cupcakes, donuts, sweet rolls, pastry, canned fruit in syrup, bananas, cookies, chocolate candy, caramel, toffee, jelly beans, other chewy candies, chewing gum, dried fruit, marshmallows, jelly, jam	—	$\times 10 =$
<b>Slowly dissolving</b>		
hard candies, breath mints, antacid tablets, cough drops	—	$\times 15 =$
<b>Total sweet score: —</b>		
Interpretation sweet score:		
5 or less: excellent		
10: good		
15 or more: “watch out” zone		
<b>Interpretation sweet score</b>		
<b>Total sweet score:</b>		
5 or less: excellent		
10: good		
15 or more: “watch out” zone.		

Mean and standard deviations were calculated for each clinical parameter. Pearson Chi-Square was used to test the association between Dental caries & BMI and similarly between Dental Caries & Sweet Sugar Score (SSS) from the collected data.

## RESULTS

A total of 152 children attending pediatric dental clinics of King Khalid University were enrolled in the study, out of which 65 (42.76%) were males and 87 (57.23%) were females. Participants' age ranged between 4-13 years with a mean of 8.4 years.

Dental caries was classified into either (present \ absent) to test its association with both BMI and Sugar Sweet Score (SSS). Mean DMFT, dmft were found to be 1.1 and 4.3 respectively. Only 15(9.9%) of the participant being devoid of caries (Absent) and 137 (90.1) having dental caries (Present).

Mean BMI of the examined participants was 16.6kg/m<sup>2</sup>, 71% were ranked as healthy weight (71%), 16% were underweight, 8% overweight and 5% at risk of overweight. The mean Sugar sweet score was 17.8 with 71% of children been categorized as "watch out zone" while 19% were "excellent" and only 10% were "good."

Pearson Chi-square was used to test the correlation between dental caries (DMFT/dmft values) and BMI categories, but no association has been found (P <0.05). (Table.2). Similarly, Pearson Chi-Square was also applied to test the correlation between Dental Caries and Sugar Sweet Score (SSS) and it revealed non-statically significant association (P > 0.05) (Table 3.).

**Table 2** Correlation between Dental caries (DMFT) and Body Mass index of children using Pearson Chi-Square Tests

Correlation between BMI and DMFT value			
		BMI Value	DMFT Value
BMI Value	Pearson Correlation	1	-.102
	Sig. (2-tailed)		.209
	N	152	152
DMFT_Val	Pearson Correlation	-.102	1
	Sig. (2-tailed)	.209	
	N	152	152

**Table 3** Correlation between SSS and Dental Caries using Pearson Chi-Square Tests

Variables	Test	DMF Value	SSS value
DMFT_Value	Pearson Correlation	1	0.157
	Sig. (2-tailed)		0.053
	N	152	152
SSS value	Pearson Correlation	.157	1
	Sig. (2-tailed)	.053	
	N	152	152

Among the "healthy weight" children (108), 100 (92.6%) were experiencing dental caries, while 72.7% of the obese children experienced dental caries (Table 4.).

96.6% of children scored as "Excellent" by SSS experienced dental caries, whereas the 89.9% of the "watch out zone" category experienced the same.

**Table 5** Presence/Absence of Dental caries among different SSS categories

BMI Categories	Caries Categories		Total
	Caries Absent	Caries Present	
Under Weight	3	22 (88%)	25
Healthy Weight	8	100 (92.6%)	108
At Risk of over weight	1	7 (87.5%)	8
Over weight (obese)	3	8 (72.7%)	11
Total	15	137	152

## DISCUSSION

The main objective of the current study was to assess the association between dental caries, body mass index and daily sugar intake of 4-13 years children attending pediatric dental clinics of KKKU.

Since dental caries and BMI both denote diet related health outcomes; the association between these two parameters is to be expected. The dramatic Shift in dietary habits and lifestyle during the last twenty years to a more refined, high caloric, carbohydrate based diet and beverages may account for the global rise in dental caries rate and overweight.<sup>[28, 29]</sup>

Our study showed a high rate of dental caries among participants (90.1%) with a higher mean of decayed, missing and filled teeth in primary dentition (dmft =4.3) when compared to permanent one (DMFT=1.1). Similar results were obtained by Khan SQ. *et al.* in 2013, who reported a high DMFT, dmft scores in Saudi population based on their meta-analysis study<sup>[7]</sup>. On the other hand, some studies showed low caries prevalence with low DMFT and dmft scores<sup>[3, 30]</sup>.

As stated by World Atlas data, Saudi Arabia is on the top 29 most obese countries worldwide, which is attributed to reduced regular exercise and/or physical activities along with increased intake of fast food, and the use of outsized community serving dishes<sup>[31]</sup>. Our study showed a mean BMI of 16.6 kg/m<sup>2</sup>, and more than two third of participants (71%) were ranked as "healthy weight", with only 13% constituting the "overweight" and "at risk of overweight" categories.

The present study found no statistically significant association between DMFT and BMI (P = 0.053). Same results were found by Tramini *et al.*<sup>[32]</sup> and Pinto *et al.*<sup>[33]</sup>, where no correlation between dental caries and BMI was detected. In contrary, contemporary national records from Sweden showed a positive correlation between dental caries and BMI, and suggested that dietary malpractice in early childhood anticipated caries development in teenage years.<sup>[34]</sup> similar results were obtained from acurrent systematic review and meta-analysis conducted by Hayedn *et al.*<sup>[35]</sup> that found a significant association between childhood obesity and dental caries. Kopycka-Kedzierawski *et al.*<sup>[21]</sup> study revealed an inverse relationship between BMI and caries experience in 6-11 years children; where overweight children were having a reduced dental caries rate when compared to their normal weight counter part. This might be owing to the point that both obesity and dental caries are attributed to many hereditary and environmental influences.

An additional important factor that has an impact on obesity as well as dental caries is obesogenic dietary behavior in form of increased daily sugar intake. Ludwig *et al.*<sup>[36]</sup>, in a longitudinal study, concluded that childhood obesity was associated with

the intake of sugars sweetened beverages. However, our study found no significant correlation between dental caries (DMFT/dmft) and daily obesogenic behavior as dictated by SSS. However, the present study showed an increased consumption of sugar and carbohydrate based diet with 71% of children being in the "watchout zone" when SSS was used. This lack of association between the daily sugar intake and dental caries might be attributed the other factors having an impact in the caries etiology such as fluoride levels in drinking water which was found to correlate significantly with caries experience in Saudi Arabia<sup>[37]</sup>. This result is in accordance with the findings of systematic review by Burt and Pai<sup>[38]</sup> which suggested that the relationship between sugar consumption and dental caries is less prominent in modern era of fluoride exposure. Other intraoral influences such as presence of retentive areas and salivary flow and function might play an important role in altering caries activity<sup>[39]</sup>.

## CONCLUSION

The results of the present study showed a high rate of dental caries among participants (90.1%). However, it did not support the association between dental caries, daily obesogenic behaviour (SSS) and BMI in 4-13 years old children. Mean BMI was 16.6 kg/m<sup>2</sup>, with more than two third of participants being ranked as healthy weight. 71% of participants were in the "watchout zone" with increased daily obesogenic behaviour when SSS was used.

## Recommendations

Further longitudinal studies are needed to assess the association between dental caries, obesity and daily obesogenic dietary behaviour, since they share common risk determinants. Even if the association between these parameters was not clear; our obligation as health care providers is to provide the needed advices to get the optimal SSS and BMI for our pediatric patients.

## Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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