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ORIGINAL ARTICLE

Relationship of Dental Caries and Body Mass Index amongst School Children in Hail, Saudi Arabia: A Cross-Sectional Study

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ABSTRACT

Objective: To determine caries prevalence and its association with body mass index in school children between 9-12 years of age in Hail, Saudi Arabia. **Material and Methods:** This descriptive cross-sectional study included 524 school children 9-12 years of age. These children were selected from 9 Public schools in Hail Province. Dental caries was recorded as per criteria established by the World Health Organization using assessment form for children 2013. Children were weighed using an electronic scale nearest to 0.1 kg with children attired in light clothing and wearing no shoes. The height was measured using a stadiometer to the nearest full centimeter with the children in a standing position. Body Mass Index (BMI) was determined using the formula BMI = kg/m². **Results:** Caries prevalence in the population was 86%. The comparisons of mean DMFT between the groups demonstrate higher scores in the overweight group (mean=2.43) compared to normal weight (mean=1.85) and underweight children (mean=1.56) which is statistically significant (p=0.000). Bonferroni Post hoc test to compare the underweight and overweight group (p=0.000) and overweight and normal weight (p=0.000) were highly significant. **Conclusion:** A positive correlation of caries severity, namely DMFT, with BMI is established.

Keywords: Body Mass Index; Child; Dental Caries; Prevalence.

Introduction

Dental caries is an oral health concern affecting people of all ages and across the globe. Dental caries, when not treated, can lead to pain, swelling and loss of the tooth leading to poor growth in the child. Caries prevalence in Saudi Arabia is approximately 80% and 70% for deciduous and permanent dentition respectively [1].

The etiology of dental caries is multi-factorial in nature and identified risk factors include excessive consumption of refined carbohydrates, prolonged bottle feeding and poor oral hygiene [2]. Since dental caries may be related to irregular dietary patterns, a correlation between obesity and abnormal dietary intake is evident [3]. It may be inferred that caries and obesity may be associated. Multiple studies have described a positive link between dental caries and body weight, indicating that obese children had more caries than normal-weight children [4-6]. However, other studies have reported a negative association between caries severity and body weight [7,8].

Since obesity in childhood and dental caries are both public health issues requiring interventions related to diet, this study was planned to determine the prevalence of caries and its association with body mass index (B.M.I) in school children between 9-12 years of age in Hail region, Saudi Arabia.

Material and Methods

Ethical Clearance

Ethical approval was obtained prior to the commencement of the study vide code # DRC/003FA/19.

Study Design

This cross-sectional study was intended to assess the relationship between B.M.I and dental caries among school children residing in Hail Saudi Arabia. A total of 524 schoolchildren between 9-12 years of age were included in the study. Hail city is divided into 3 administrative areas. These three areas were designated as clusters. Three schools were chosen from each cluster through simple random sampling. Children from these selected schools and meeting the study criteria were included. All children and their parents were informed about the nature of the study and those children who provided informed consent were included. The study was conducted over two months from December 2019 to January 2020.

Data Collection

Based on a confidence level of 95%, prevalence of 80% and allowable error 5%; the sample size is calculated as 377 for a population size of 20000 between the age group of 9 to 12 years. However, we examined all children at the selected schools to reach a final sample of 524. All healthy children 9-12 years of age who provided informed consent and were present on the day of the examination were included in the study. Those children suffering from any medical conditions which affected their teeth were excluded.

The socio-demographic details of all study participants were recorded. Height and weight measurements were obtained prior to the dental examination. The children were examined on an upright chair in good natural daylight. Subjects were called individually to avoid crowding and prevent errors during examination and recording. A single examiner examined all students to avoid inter-examiner variability and was assisted by another trained person to record the findings. Intra-examiner consistency was carried out prior to the beginning of the study by examining a preselected group of 25 children twice in a time interval of two days. The kappa score was observed to be above 0.87.

Dental caries was recorded as per criteria established by World Health Organization using the Oral health assessment form for children 2013 [9]. The CPI probe was used to validate the visual evidence of caries on the occlusal, lingual and buccal surfaces.

Children were weighed using an electronic scale (Weight Scale GS58 - 1694, Beurer GmbH, Uttenweiler, Germany) nearest to 0.1 kg while. The children wore light clothing and no shoes. The height was measured using a stadiometer (Helsevesen Free - Standing stadiometer) to the nearest full centimeter with the children in standing position. Then, BMI was determined using the formula BMI = kg/m^2.

Statistical Analysis

Collected data were summarized by frequency, percentage, mean, standard deviation and confidence interval. Association between B.M.I and DMFT was found by chi-square test and ANOVA with Bonferroni post hoc analysis. The Spearman correlation coefficient was calculated to find a correlation between B.M.I and DMFT. The association between dental carries and B.M.I was found by the chi-square test. Statistical analysis was set at a significance level of $p<0.05$.

Results

A total of 524 children were examined, of which 329 students (62.8%) were male and 195 (37.2%) were females. One hundred forty-six students were underweight, 229 were normal weight and 149 were overweight. The study results show that caries prevalence among the population is about 86%. However, when caries prevalence was compared with BMI (Table 1), no statistically significant differences were observed between the weight categories ($p = 0.912$).

Table 1. Caries prevalence *versus* BMI.

Body Mass Index	N	Dental Caries			
		Present		Absent	
		N	%	N	%
Underweight	146	125	85.6	21	14.4
Normal Weight	229	197	86.0	32	14.0
Overweight	149	130	87.2	19	12.8
Total	524	452	86.3	72	13.7

Chi-square test p=0.912, Not Significant.

The DMFT scores as per the different weight categories are provided in Table 2. The comparisons of mean DMFT between the groups demonstrate higher scores in the overweight group (mean = 2.43) compared to normal weight (mean = 1.85) and underweight children (mean =1.56) which is statistically significant. ($p = 0.000$) as shown in Table 3. Bonferroni Post hoc test to compare the underweight and overweight group ($p = 0.000$) and overweight and normal weight ($p = 0.000$) were highly significant. However, the comparison between underweight and normal weight was insignificant ($p = 0.066$) (Table 4).

Table 2. DMFT *versus* BMI according to different weight categories.

Body Mass Index	N	DMFT							
		0		1.0		2.0		3-6	
		N	%	N	%	N	%	N	%
Underweight	146	21	14.4	45	30.8	67	45.9	13	8.9
Normal Weight	229	31	13.5	43	18.8	112	48.9	43	18.8
Overweight	149	18	12.1	8	5.4	68	45.6	55	36.9
Total	524	70	13.4	96	18.3	247	47.1%	111	21.2

DMFT = Decayed, Missing, Filled Teeth Index.

Table 3. Comparison of mean DMFT *versus* various weight categories.

Weight Categories	N	Mean	SD	95% CI for Mean		p-value
				Lower Bound	Upper Bound	
Underweight	146	1.56	1.00	1.40	1.72	0.000*
Overweight	149	2.43	1.39	2.20	2.65	
Normal Weight	229	1.85	1.12	1.70	1.99	
Total	524	1.93	1.22	1.83	2.04	

*HS: Highly Significant; SD = Standard Deviation; CI = Confidence Intervals.

Table 4. Comparison of DMFT between the groups (Bonferroni post hoc test).

Weight Categories		Mean difference	Std. Error	p-value
Underweight	Overweight	-.8679	0.1365	0.000*
	Normal Weight	0.2855	0.1242	0.066#
Overweight	Normal Weight	0.5824	0.1234	0.000*

*HS: Highly Significant; #NS: Not Significant.

The Spearman correlation coefficient was performed to determine the association between DMFT and BMI and was found to be significant (p=0.000).

Discussion

The prevalence of childhood obesity is rising all over the world. This worldwide pandemic increase is attributed at least in part to globalization with its focus on fast food, sedentary lifestyles, economic prosperity and increased screen time, among others. The prevalence of obesity in children in Saudi Arabia was estimated to be 18% among girls and 18.4% among boys, which in comparison to the WHO-based national prevalence rate of obesity reported in 2004, indicates a doubling of the obesity rate in 10 years. The prevalence of obesity in adolescents (age 11 and above) was greater than in children, which was statistically significant [10].

There is a chance for obese children to grow into obese adults. For example, the Saudi National Survey for health information 2014 demonstrated 28.7% of Saudis were Obese and the obesity rate increases with age, with 48% of Saudis in the age group of 55 to 64 years being obese [11].

Unhealthy eating habits, frequent snacking, excessive intake of soft drinks or sweetened fruit juices, increased consumption of fatty foods and fermentable carbohydrates are common risk factors for dental caries and obesity in children [12]. This would suggest a commonality or association between caries and obesity. If commonality is thus established, it would allow for interventions to be planned based on a common risk approach.

In the present study among the 524 school children, 27.9% were underweight, 43.7% were normal weight and 28.4 % were overweight. We found the prevalence of caries to be highest in overweight children (87.2%), followed by normal-weight children (86%) and underweight children (85.6%). However, the differences in caries prevalence was not statistically significant (p=0.912).

The mean DMFT for the underweight, normal and overweight categories is 1.56, 1.85 and 2.43, respectively. Therefore this means that although the prevalence of caries did not differ between the three groups, the disease burden was positively correlated to BMI. These findings were in accordance with another study [13] where significant variations between mean DMFT scores of normal weight children compared with overweight and obese children were observed. A study by Farsi et al. [14] concluded the overall caries experience was inversely proportional to BMI and waist circumference. However, this study considered caries prevalence and not disease burden, which may explain the conflicting findings.

Our findings contrast with a study by Habibullah et al. [8], who found that underweight children were at greater risk for caries than normal and overweight children in the Al Qassim region. Similarly, in another investigation in Jazan region, children with untreated caries were more likely to be from the low BMI category [15]. Similar results have been reported in Indonesia [16]. There are also studies where no correlation between DMFT and BMI was established [17,18].

In our study, the relationship between different weight groups was analyzed by Bonferroni post-hoc analysis (Table 4). The comparison between the underweight and overweight groups (p=0.000) and between overweight and normal weight (p=0.000) was highly significant.

The data from studies relating BMI to caries prevalence or severity is confounding for multiple reasons. BMI and dental caries share a complex relationship due to the multi-factorial nature of caries etiology. Hence it is difficult to describe a cause-and-effect relationship between them. Nevertheless, there can be no denial that multiple factors such as age, gender, socio-economic status, consumption of sugars and saliva have a bearing on poor oral health and obesity [19,20].

Hayden et al. [21] discussed the need for standardized definitions for assessing BMI and demonstrated that when these were employed, a small association between obesity and caries may be established in permanent dentition. A positive association between BMI and caries [22] is also established by this study from India. Our study collaborates to this body of evidence, especially in the association of caries and BMI being more pronounced in permanent dentition.

Some limitations can be observed in this study, such as the cross-sectional nature of the study precludes the establishment of cause and effect relationship, and although caries diagnosis was based on meticulous clinical technique, bitewing radiographs were not used in the present study, which may have led to the underestimation of the caries experience as interproximal caries may remain undetected.

Conclusion

Within the limitations of our study, a positive correlation of caries severity, namely DMFT, with BMI is established. It is essential that dentists are aware of this association. Even when a conclusive positive correlation between caries and BMI is not established, preventive wisdom dictates we present health education focused on the nutritional value of foods and diet counseling.

Future research should include longitudinal studies with attention to confounders such as tooth brushing, diet, snacking frequency, socio-economic status and demographic information to allow for establishing a causal relationship between BMI and caries. Having well-defined protocols and establishing standardized definitions for BMI involving larger samples with radiographic investigations will go a long way in allowing evidence to be compared between studies and further our understanding of the relationship between BMI and caries.

Authors' Contributions

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All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.

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None.

Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

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