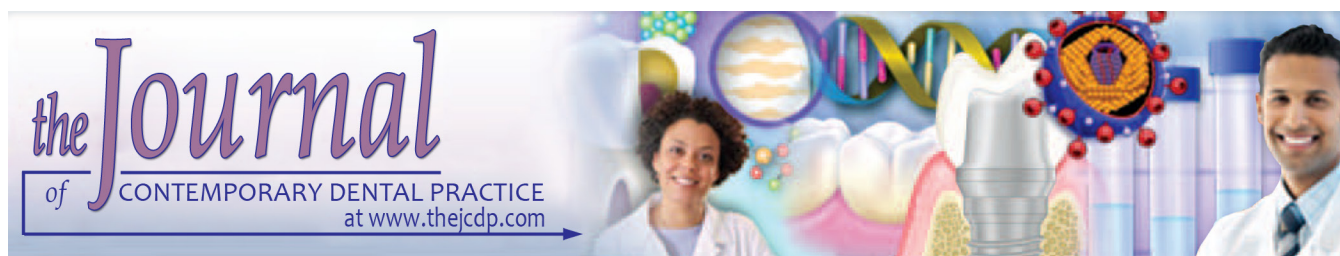


ORIGINAL RESEARCH



Relation between Dental Caries and Body Mass Index-for-age among Schoolchildren of Jazan City, Kingdom of Saudi Arabia

¹Mir FA Quadri, ²Bassam M Hakami, ³Asma AA Hezam, ⁴Raed Y Hakami, ⁵Fadwa A Saadi, ⁶Layla M Ageeli
⁷Wafqah H Alsagoor, ⁸Mohammad A Faqeeh, ⁹Mohammed A Dhae

ABSTRACT

Objective: To analyze and report the type of relation present between dental caries and body mass index (BMI)-for-age among schoolchildren in Jazan region of Kingdom of Saudi Arabia.

Materials and methods: A cross-sectional study with multi-staged random sampling technique was designed to recruit the sample of schoolchildren. Caries was examined using the World Health Organization recommended “decayed and filled teeth”/“decayed missing and filled teeth (dft/DMFT)” method. The BMI-for-age was calculated using the value obtained from body weight and height (kg/m²) of each child. The obtained results were plotted on age- and gender-specific percentile curves by the Centers for Disease Control and Prevention and categorized accordingly. Chi-squared test was conducted to analyze the relation between BMI-for-age and dental caries. Logistic regression was performed to judge the predictor variables. The p-value <0.05 was considered as significant.

Results: A total of 360 children were part of this study with equal recruitment from both genders. The mean dft/DMFT value for girls (2.52) was more than that for boys (1.88); and the (p = 0.00) calculated value was statistically significant. Most of the children had normal BMI-for-age (60.6%) and very few were obese (4.7%). Dental caries, fast food, and snacks between meals were significant independent predictor variables for BMI (p <0.05). Dental caries was a strong predictor, and the analysis showed that children with untreated caries had 81% (odds ratio = 0.19; confidence interval = 0.65, 0.58) higher chance of suffering from low BMI.

Conclusion: To conclude, this is the first study attempted to see the relationship between BMI-for-age and dental caries among schoolchildren in Jazan city of Kingdom of Saudi Arabia. Negative relation between dental caries and BMI should warrant health promoters about dental caries as a reason for low BMI in a subset of children.

Clinical significance: High and alarming percentage of untreated dental caries demonstrates the oral health needs among the schoolgoing children in Jazan region. Public health dentists should develop and implement prevention programs so that the oral health issues among schoolchildren are addressed.

Keywords: Cross-sectional study, Dental caries, Jazan, Kingdom of Saudi Arabia, Obesity, Schoolchildren.

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INTRODUCTION

Dental caries among schoolchildren is the most common oral disease, and epidemiological surveys over the last 20 years have reported a substantial increase in its rate of progress.^{1,2} Studies conducted in Kingdom of Saudi Arabia have also confirmed a high prevalence of dental caries among similar age population residing in different regions of this country.³⁻⁶ One such study conducted in the Jazan region of Kingdom of Saudi Arabia showed that around 90% of the schoolchildren had at least one untreated decayed teeth in their oral cavity.⁷

Likewise, the high prevalence of obesity among schoolchildren is also a serious global public health problem.⁸ Obese children will grow into obese adults,

¹Department of Dental Public Health, College of Dentistry, Jazan University, Jazan, Kingdom of Saudi Arabia

²⁻⁹Department of Preventive Dental Sciences, College of Dentistry, Jazan University, Jazan, Kingdom of Saudi Arabia

Corresponding Author: Mir FA Quadri, Department of Dental Public Health, College of Dentistry, Jazan University, Jazan Kingdom of Saudi Arabia, e-mail: dr.faeq.quadri@gmail.com

and uncontrolled obesity may lead to conditions, such as high blood pressure, type II diabetes, stroke, cardiovascular disease, finally leading to disabilities and death.^{9,10} Increased rate of obesity among children has been recorded in developing countries of Middle Eastern, African, and Latin American regions.⁹ A nationwide study conducted in Kingdom of Saudi Arabia has reported obesity to be an emerging public health issue among children¹¹ and is reported to be rising at an alarming rate.¹² The World Health Organization (WHO) has documented that between the period from 1988 to 2005, obesity in Kingdom of Saudi Arabia has increased to a significantly high level.¹³

Thus, dental caries and obesity are both common childhood diseases that can have an impact on the overall development of children¹⁴ and are a burden to the health expenses of a nation.¹⁵ Ironically, both these diseases are multifactorial and share common risk factors, such as diet and lifestyle. Researchers in due course have evidently tried to gather data to analyze and report the link between these two diseases so that the public health programs when designed can be more effective and efficient. On conducting a literature search, it is seen that some of the studies reported a positive association,¹⁶⁻¹⁸ while there are some studies which have shown no association.¹⁹⁻²¹ Interestingly, some of the researches have also reported a negative association between dental caries and obesity among schoolchildren.²²⁻²⁴ A well-structured systematic review conducted in 2012 has concluded that dental caries is associated with both high body mass index (BMI) and low BMI.¹⁵ Apparently, there is no such available data in Jazan, and hence, this study is designed to analyze and report the type of relation present between dental caries and BMI among schoolchildren in the Jazan region of Kingdom of Saudi Arabia.

MATERIALS AND METHODS

Ethical Considerations

This study was endorsed by the Research Committee at College of Dentistry, Jazan University, Jazan, Kingdom of Saudi Arabia. The regional education office approved the visit to the schools for data collection. Parents' consent was also taken for the participation of their children in the study.

Study Design and Sampling

A cross-sectional study was designed to assess the relation between the variables. The study sample comprised children aged between 6 and 15 years attending schools in Jazan city of Kingdom of Saudi Arabia. Homogeneity of the sample was maintained by including only the Saudi nationals and excluding the expatriate children.

Children whose parents did not give consent and who reported to be suffering from other chronic medical conditions were excluded from this study. Sample size for this cross-sectional study was based on a previous and similar designed study, which was conducted in the same region.²⁵ The calculation was done with absolute precision (0.05), expected proportion (0.5), and estimated designed effect.¹ Multistaged random sampling technique was used, wherein three out of four districts in the Jazan region were randomly selected in the first stage. In the second stage, a list of schools in the region was obtained and two schools (one boy school and one girl school) from each district were randomly selected, making it six schools altogether. In the third stage, an admission list of schoolchildren from each school was obtained, and subjects whose parents gave consent were randomly recruited for this study.²⁶

Data Collection

Caries Examination

Specific days were selected and the schoolchildren were examined under light emitting diode, implementing standard infection control measures, such as the use of gloves, masks, and disposable diagnostic instruments. Caries status was examined using the WHO recommended decayed and filled teeth/decayed missing and filled teeth (dft/DMFT) method.¹⁶ Missing component was not considered in complex analysis so as to avoid the reporting bias in mixed dentition.²⁷

Obesity Examination

The BMI was calculated using the value obtained from body weight and height (kg/m^2) of each child. The obtained results were plotted on age and gender-specific percentile curves by the Centers for Disease Control and Prevention²⁸ and categorized according to the BMI percentiles obtained from the chart.

Underweight were children with BMI-for-age less than 5th percentile, normal weight children were with BMI-for-age between 5th and 85th percentile, overweight were with BMI-for-age between 85th and 95th percentile, and obese children were with BMI-for-age greater than 95th percentile. Interexaminer kappa value, for both caries examination (0.70) and BMI (0.80), was calculated.

Data Management and Processing

All data information was entered into a computer with IBM Statistical Package for the Social Sciences (version 21). Chi-square test was conducted to analyze the relation between the means of BMI and dental caries. Multiple logistic regression models were also analyzed to judge

Table 1: Dentition status among male and female schoolchildren

Dentition status	Gender		Total (%)	p-value*
	Boys (%)	Girls (%)		
Primary	10 (5.6)	9 (5)	19 (5.3)	>0.05
Mixed	159 (88.3)	160 (88.9)	319 (88.6)	
Permanent	11 (6.1)	11 (6.1)	22 (6.1)	
d	157 (87.2)	114 (63.3)	271 (75.2)	0.00*
f	21 (11.6)	13 (7.2)	34 (9.4)	
D	152 (84.4)	164 (91.1)	316 (87.7)	0.00*
M	4 (2.2)	3 (1.6)	7 (1.9)	
F	7 (3.8)	6 (3.3)	13 (3.6)	

*Chi-square test with $p \leq 0.05$ is considered as significant

the predictors for BMI. The $p < 0.05$ was considered as significant for all the statistical tests performed.

RESULTS

A total of 360 (n) out of the approached 400 schoolchildren were part of this study, indicating a response rate of 90%. The study had an equal number of recruitment from boy and girl schools (n = 180). Children with mixed dentition were high in number (88.6%) when compared with primary (6.1%) and permanent dentition (5.3%). There

were no significant differences with the type of dentition among both the genders (Table 1). The mean dft/DMFT value for girls (2.52) was more than boys (1.88), and the $p = 0.00$ calculated was statistically significant (Table 1).

The analysis of BMI revealed that most of the children had normal (60.6%) BMI and very few (4.7%) were obese (Table 2). No statistical difference ($p > 0.05$) of BMI among different age groups was observed (Table 2). With the dependent and independent variables as continuous, a correlational statistics was performed and the results revealed a negative correlation between dft/DMFT ($R = -0.17$, $p = 0.002$) and BMI, among the schoolgoing children in the Jazan region. Comparing the means between categorized dependent and independent variables using chi-square test suggested that untreated decayed permanent teeth had significant relation with the change in the BMI (Table 3).

A logistic regression model was created with normal BMI as reference category and dental caries as the predictor variable. Frequency of sweet food, fast food, soft drinks, snacks between meals consumed by the subjects were kept as covariates (Table 4). Results showed that dental caries, fast food, and snacks between meals were significant independent predictor variables for BMI ($p < 0.05$).

Table 2: Body mass index compared in different age groups

Body mass index	Age groups (n %)			Total (%)	p-value*
	6–9 years (%)	9–12 years (%)	12–15 years (%)		
Underweight	30 (28.6)	32 (26.9)	40 (29.4)	102 (28.3%)	0.06
Normal	61(58.1)	71 (59.7)	86 (63.2)	218 (60.6%)	
Overweight	4 (3.8)	10(8.4)	9 (6.6)	23 (6.4%)	
Obese	10 (9.5)	6 (5.0)	1 (.7)	17 (4.7%)	

*Chi-square test with $p \leq 0.05$ is considered as significant

Table 3: Caries experience among the four BMI strata

dft/DMFT	Body mass index	Mean \pm SD	p-value
d	Underweight	1.95 \pm 0.80	0.96
	Normal	1.97 \pm 0.85	
	Overweight	1.90 \pm 0.76	
	Obese	2.00 \pm 0.79	
f	Underweight	1.77 \pm 0.54	0.45
	Normal	1.50 \pm 0.53	
	Overweight	2.00 \pm 0.00	
	Obese	3.00 \pm 1.41	
D	Underweight	2.02 \pm 0.90	0.00*
	Normal	2.09 \pm 0.78	
	Overweight	1.77 \pm 0.54	
	Obese	1.87 \pm 0.82	
M	Underweight	2.20 \pm 1.30	0.31
	Normal	1.13 \pm 0.35	
	Overweight	1.77 \pm 0.80	
	Obese	2.50 \pm 0.70	
F	Underweight	2.40 \pm 0.54	0.36
	Normal	1.50 \pm 1.00	
	Overweight	2.66 \pm 1.10	
	Obese	1.00 \pm 0.54	

*p \leq is considered as significant; SD: Standard deviation

Table 4: Multivariate analysis to check the effect of potential risk factors for BMI

Variable	df	p-value	Body mass index [#]			
			Beta	Adjusted OR	95% CI	
					Upper	Lower
Snacks between meals	1	0.02	0.99	0.37	0.16	0.84
Sweet	1	0.59	0.28	1.33	0.61	2.88
Soft drinks	1	0.13	0.56	0.57	0.29	1.09
Fast food	1	0.02	0.17	1.18	0.71	1.95
Untreated caries	1	0.00*	-1.64	0.19	0.06	0.58

[#]Multinomial logistic regression with normal BMI as reference category; *p < 0.05 is considered as significant

All the variables put together and adjusted for age showed a significant predictor model with the $p = 0.01$. The Nagelkerke R^2 value suggested that 11% of the outcome variable, i.e., BMI, was predicted by the predictor variables. Children consuming sweet food had 33% [odds ratio (OR) = 1.33; confidence interval (CI) = 0.61, 2.88] more chance of a rise in BMI. Dental caries was among the strong predictors (Table 4), and analysis showed that children with untreated caries had 81% (OR = 0.19; CI = 0.65, 0.58) higher chance of suffering from low BMI (Table 4).

DISCUSSION

There is a good amount of literature available demonstrating the relationship between dental caries and BMI among schoolchildren.²⁹ However, this is the first such study to be performed among schoolchildren residing in Jazan, Kingdom of Saudi Arabia. The vision of this study is to facilitate the health promotion and program planning of two of the most prevalent diseases among the school-going children in Kingdom of Saudi Arabia.^{6,11} With its multistage random technique, the sample of this study represents overall child population in the Jazan region. It is reported in the literature that the overall prevalence of obesity among schoolchildren in Kingdom of Saudi Arabia is high,³⁰ which surprisingly does not match with the current study sample of Jazan region. In this study, it is seen that the prevalence of normal weight (60.6%) was more in comparison to obese (4.7%). This can be attributed to the difference in lifestyle of people residing in Jazan with regard to other developed places of Kingdom of Saudi Arabia.

On observing the prevalence of dental caries among the sample, mean dft/DMFT value was high overall; and gender analysis revealed high value for girls when compared with boys. This result is in concordance with studies conducted in Kingdom of Saudi Arabia,^{4,7} and some of them were performed in the same region as the current study.^{7,25,31} The prevalence rate of dental caries in this study was seen to be much higher than the studies conducted in developed nations in the world, such as Sweden³² and Italy³³; and also to studies conducted

in developing nations, such as India,³⁴ Mexico,³⁵ and China.³⁶

The relation between BMI and dental caries among schoolchildren is determined for the first time in the Jazan region of Kingdom of Saudi Arabia. This study portrays a negative correlation, hence, reporting that the schoolchildren with high untreated caries exhibited low BMI values. A negative correlation was also reported by studies with similar design conducted in developed countries, such as the United States³⁷ and Scotland³⁸ as well as in developing nations, such as Philippines,²² Taiwan,²⁴ Thailand,³⁹ Brazil,⁴⁰ Mexico,⁴¹ and India.⁴² It is likely that due to the untreated caries and its associated symptoms, the appetite of children is affected. There is sufficient evidence that obesity and caries are more likely to be caused by common potential risk factors like the lifestyle, between meal snacks, and frequency of sugared foods.⁴³ It is also shown that there is high prevalence of obesity among schoolchildren in the developed regions of Kingdom of Saudi Arabia³⁰; henceforth, there is a possibility that the population of Jazan region adopts a different lifestyle and food habits in comparison to the more developed regions of Kingdom of Saudi Arabia. There is also a good possibility that the high prevalence of dental caries is therefore, not because of food habits but most probably due to poor oral hygiene, lack of oral health knowledge, or poor oral health literacy among the population and their peers.²⁵ This explains the negative correlation between BMI and dental caries among schoolchildren in the Jazan region of Kingdom of Saudi Arabia. Logistic regression conducted with BMI as the dependent variable showed that dental caries is a strong predictor of BMI in the current sample. Thus, severe caries prevalence is a potential risk factor affecting the weight loss among the schoolgoing children in the Jazan region of Kingdom of Saudi Arabia. However, there are chances that the results may vary if similar study is performed in other developed parts of Kingdom of Saudi Arabia.

Different geographical areas in one country can have variable potential risk factors for a disease⁴⁴⁻⁴⁶; thus, the health promoters and policymakers should plan their interventions accordingly. This study marks a

path for further investigation to be done to understand the increased prevalence of dental caries among the schoolchildren in the Jazan region of Kingdom of Saudi Arabia. As this is a cross-sectional study, it limits itself in portraying the cause and effect relationship. In future, longitudinal studies should also be conducted to provide better evidence of the relationship between dental caries and BMI-for-age among the schoolgoing children in Kingdom of Saudi Arabia.

CONCLUSION

To conclude, this is the first study attempted to see the relationship between BMI and dental caries among schoolchildren in the Jazan region of Kingdom of Saudi Arabia. Negative correlation between dental caries and BMI should warrant health promoters about dental caries as a reason for low BMI in a subset of children.

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