

Evaluating the risk factors that link obesity and dental caries in 11–17-year-old school going children in the United Arab Emirates

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ABSTRACT

Objective: The objective is to study the effect of obesity on dental caries among schoolchildren in Sharjah, United Arab Emirates. **Materials and Methods:** The sample comprised 803, 11–17-year-old schoolchildren. The study was in the form of a randomized cross-sectional manner. Method used was two questioners. The first assessed socioeconomic and general health and the second detailed their demographic, oral hygiene, and dietary habits. Dental examination included dental caries assessment using the World Health Organization 1997 criteria and gingival health valuation. Clinical examination consisted of height, weight, and body mass index (BMI). Data analysis was done by descriptive, univariate, and multiple regressions. **Results:** In this sample, 75% had dental caries and the mean decayed, missing, and filled teeth (DMFT) was 3.19 (standard deviation: 2.9). Obesity was seen in 15% of the adolescents and the mean BMI was 21. The link between DMFT and BMI, when evaluated using univariate analysis, showed a significant correlation ($r = 0.097$, $P = 0.006$), indicating that the rise in BMI by 10 points resulted in an increase in DMFT by 0.57. However, in the multivariate analysis, a significant relationship was observed only between father's education ($P < 0.001$), adolescent's age ($P < 0.001$), gender ($P = 0.008$), ethnicity ($P = 0.001$), and soft drink consumption with DMFT while BMI showed a significant association with age ($P < 0.001$), school fees ($P = 0.005$), obesity in family ($P < 0.001$), and soft drink consumption ($P < 0.001$). **Conclusions:** Obesity and dental caries were not significantly associated. The most important predictor for obesity and dental caries was soft drink consumption.

Key words: Dental caries, obesity, soft drink consumption

INTRODUCTION

The shift toward modernization and growth in most part of the world, since the turn of the millennium,

has changed the diet pattern, work, and home lifestyle.^[1] This can be attributed to increased intake

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of carbohydrates and reduced consumption of dietary fibers.^[2] This had been termed as “nutrition transition” is considered the main culprit for most of the systemic medical problems such as hypertension and diabetes.^[3] The development of obesity apart from being genetic can also be attributed toward the recent behavioral and environmental change. Such changes, creating an “obesogenic” environment, resulting from technological advances can be considered to influence the development of obesity.^[4]

Incidence of obesity has increased significantly among the population of the Middle East region,^[5-7] including the United Arab Emirates (UAE).^[8,9] Recent research supports the objective of this study that is the relationship between dietary habits and obesity.^[10] Other studies demonstrate the effect of diet on periodontal health and dental caries. Based on the research available, we can assume that dental caries and obesity have common risk factors.^[11,12]

Inadequate exposure to fluoride and increased consumption of sugar are considered as main causative factors for dental caries in developing countries as opposed to a significant decline of the same in developed countries, this is based on studies going back to 30 years.^[1] Unfortunately, incidence and prevalence of dental caries in the country of the UAE is not well documented over the recent years; there is one study which reported dental caries prevalence to be 54% among children aged 12 and 65% among schoolchildren aged 15 years.^[13] Although research has well established the link between obesity and various systemic chronic conditions,^[4] the same cannot be said for obesity and dental caries. Since variation in results was observed among studies conducted in different regions of the world.^[14] Thus, the main objective of this research study is to assess the link between obesity and dental caries among 11–17-year-old children living in the emirate of Sharjah. The age range selected in the present study indicates approximately the beginning to the end of adolescents, where children are exposed to risk factors due to sudden change in their lifestyle which could influence the development of obesity and dental caries.

MATERIALS AND METHODS

A cross-sectional method of research was used. The participants targeted were 11–17 years old in secondary school. Both genders were targeted. The participants were chosen from both private and public education sector in the emirate of Sharjah. Ten schools

were selected of which six were private and four were public using random digit table. Out of the four public schools selected equal number were boys and girls schools (2 each). However, the private schools were classified according to the school fees as low, average, and high price. Two private schools from each category were selected considering proportional allocation. This research was approved by the Research Ethics Committee at Queen Mary University, London (Reference Number: QMREC2007/60). Valid and required approvals were sought from the Ministry of Health and Prevention and Ministry of Education in the UAE to conduct this study. The present research work was undertaken in agreement with the World Medical Association Declaration of Helsinki. Since all participants involved in this study were under 18 years of age, a written approval was attained from participants’ parents/guardians, and this consent procedure was agreed by the research ethics board. The clarity of the translation of the Arabic questionnaire to English was tested in a pilot study. The present research is based on the theoretical models that is already well established.^[15] Based on this model, three variables and their interrelationships were examined in this study and they are distal explanatory (sociodemographic characteristics), intermediate explanatory (health behavior), and adolescent health outcomes (oral health status and body mass index [BMI]).

Malik and Bakir conducted a study in the UAE, among 5–17 years old, reporting obesity at 10%.^[16] The sample size for the present study was calculated according to this, also taking into account, the study done on obesity among school going children in the UAE.^[9] The sample size was calculated, accordingly (based on these studies), using STATA 9 (Stata Corp LLC, Texas, USA). The difference in the mean decayed, missing, and filled teeth (DMFT) between obese and nonobese children was found to be 0.5 standard deviation (SD).^[17] To calculate this value, an alpha level of 0.05 (two-sided) and power of 90% were used. A rough size of 650 participants was deemed appropriate. This was considered a big enough sample size to provide small confidence interval for the different outcomes. However, taking nonresponse and refusals into consideration, a sample size of 803 participants was confirmed. Participants in whom obesity was considered to be due to systemic factors were not included in the present study. Ten schools were randomly chosen using random digit table. Both private (6) and public (4) sectors were included in the study.

Separate questionnaires were constructed for the participants and their guardians. The questionnaire was developed to obtain wide variety of variables from both participants and their guardians. Adolescent questionnaires were used to detail and assess the demographics, their diet and physical activity, oral hygiene status, and psychological behavior. The questionnaire for the guardians focused on the socioeconomic status and medical history. This was followed by oral examination to assess dental caries using DMFT index according to the World Health Organization criteria,^[18] and oral cleanliness was measured using the British Association for the Study of Community Dentistry (BASCD) criteria.^[19] Oral examination was performed under artificial light with the participant sitting up straight and facing the principal investigator. Disposable instruments were used for oral examination. Clinical data were collected based on two assessment forms. Initial height and weight were recorded using anthropometric measures using a digital weight and height scale. Calculation of BMI was based on the formula, BMI = Weight (kg)/Height (m²).

Statistical for the present data was done by IBM SPSS statistics for Windows, version 20.0, IBM Corp., Armonk, NY, USA, and descriptive analysis of the sample was performed. Whereas univariate analysis method was used to describe the relationship between explanatory variables and their outcomes, multivariate analysis helped to determine the joint effect of independent variables on dependent variables. Variables with significance at 5% level ($P < 0.05$) were deemed as risk factor.

RESULTS

The total number of participants in the present study was 803 out of which 50% were males. Nearly 40% were UAE nationals and 66% were attending private schools in the emirate of Sharjah. Tables 1 and 2 show the demographic distribution of the participants. Relationship between behavioral characteristics (diet, oral hygiene status, and physical activity) and demographics proved age, gender, and ethnicity to be important variables. According to the diet chart, 51% of the participants were reported to have three square meals (including breakfast) whereas 87% skipped the morning breakfast. The authors found that with the increase in age, consumption of dietary products such as milk, fruits, and vegetables reduced significantly, whereas soft drink consumption increases. Differentiation

Table 1: Description of the study sample

Variable	Mean (SD) / n (%)
Age	
Mean (SD)	12.8 (1.4)
Median	13
Age (years), n (%)	
10	17 (2.1)
11	146 (18.2)
12	169 (21)
13	223 (27.8)
14	176 (21.9)
15	46 (5.7)
16	20 (2.5)
17	6 (0.7)
Gender, n (%)	
Male	406 (50.5)
Female	396 (49.4)
Nationality, n (%)	
Emiratis	325 (40.5)
Other Arabs	278 (34.6)
Indians	135 (16.8)
Others	65 (8.1)
School type, n (%)	
Public	269 (33.5)
Private	534 (66.5)

SD: Standard deviation

Table 2: Demographic details of parents

Variable	Father, n (%)	Mother, n (%)
Age (years)		
Mean (SD)	44.69 (6)	38.92 (5.2)
Range	32-68	25-66
Median	44	38
Education		
No education	24 (3)	34 (4)
Primary	66 (9)	87 (11)
Secondary	77 (10)	99 (12)
High school	186 (24)	218 (27)
College/university	426 (55)	360 (45)
Occupation		
Manager	60 (7.5)	12 (1.5)
Professional job	111 (13.8)	23 (2.9)
Business/self-employed	139 (17.3)	4 (0.5)
Administrative	272 (33.9)	76 (9.5)
Education professional	43 (5.4)	79 (9.8)
Military/police	84 (10.5)	2 (0.2)
Elementary/nonskilled job	24 (3)	1 (0.1)
Unemployed/housewife	46 (5.7)	601 (74.8)
Deceased	24 (3)	5 (0.6)
Family income		
1000-3000 dhs	85 (11)	
3000-7000 dhs	222 (28)	
>7000 dhs	496 (62)	

SD: Standard deviation

between genders demonstrated that girls tended to skip breakfast and preferred sweets and more

carbohydrates in their diet while boys tended to skip lunch and dinner. Increased frequency of drinks (soft drinks) was found to be more prevalent among boys. As opposed to the Arabs, the Indian population was found to have more regular meals and a healthy and well-nourished diet. The Arab world diet was found to be less healthy and consisted more of fast food, sweets, and foods rich in carbohydrates.

Physical activity frequency was reported to have reduced with age ($P = 0.002$) while sedentary lifestyle increased by age ($P < 0.001$). One to 4 h daily was reported to be of sedentary activity among Arab population. Activity levels were 66% among boys and 61% among girls. As comparison, boys were found to be more physically active (exercising three times/week) than girls (once/week) ($P < 0.001$).

Regarding oral hygiene status, 97.5% of females were regular in their good hygiene while compared to 89.4% of males in the study sample. According to the data obtained from the questionnaire, the Arab population brushed their teeth less commonly as opposed to other nationalities. UAE nationals' visits to the dentist were regular and consumed fluoride supplements [Table 3]. Dental visits were found to be least among the Indian population. Oral cleanliness as measured by the BASCD criteria indicated that 95% of the participants demonstrated a score of 1–6 which states that at least 1–6 regions of the oral cavity (upper left, upper middle, upper right, lower left, lower middle, and lower right)

have visible plaque/gingivitis. Remaining 5% has a score 0 (healthy gums) [Table 4].

The prevalence percentage for obesity and overweight were 14.7% and 23.5%, respectively, and was found to be highest in the Arab population [Table 5]. The prevalence percentage for dental caries was recorded at 72% with a mean DMFT score of 3.19 (SD: 2.9), with 25% caries free [Table 6]. This was once again, recorded as being highest with the Arab population as compared with participants of other nationalities. Mean BMI was recorded at 21. Univariate analysis method was used to calculate an association between DMFT and BMI ($r = 0.097$, $P = 0.006$). The analysis showed that with each extra 10 points in BMI, there was an increase of 0.57 in DMFT score. Multivariate regression models were used to determine the health outcome of BMI and DMFT. Variables such as fathers' education ($P < 0.001$), age of the participants ($P < 0.001$), soft drink consumption ($P < 0.001$), gender ($P = 0.008$), and ethnicity ($P = 0.001$) were all significantly associated with the net value, according to the DMFT predictive value. Similarly, the BMI predictive model demonstrated a similar association of age ($P < 0.001$), school fees ($P = 0.005$), obesity (in the family) ($P < 0.001$), and soft drink consumption ($P < 0.001$) [Table 7].

DISCUSSION

The present study focuses on the interrelationship of various risk factors of obesity and dental caries

Table 3: Chi-square test analysis of oral hygiene habits by nationality

Variable (oral hygiene)	Nationality				P
	Emirati	Other Arabs	Indian subcontinent	Others	
Toothbrushing					
Yes	307 (94.5)	248 (89.2)	133 (98.5)	62 (95.4)	0.002
No	18 (5.5)	30 (10.8)	2 (1.5)	3 (4.6)	
Brushing frequency					
None	13 (4)	24 (8.6)	1 (0.7)	2 (3.1)	<0.001
Once	63 (19.4)	88 (31.7)	27 (20)	17 (26.2)	
Twice	175 (53.8)	127 (45.7)	97 (71.9)	35 (53.8)	
Three times	74 (22.8)	39 (14)	10 (7.4)	11 (16.9)	
Brushing time					
None	13 (4)	22 (7.9)	1 (0.7)	2 (3.1)	<0.001
Morning	56 (17.2)	59 (21.2)	30 (22.2)	12 (18.5)	
Evening	14 (4.3)	38 (13.7)	0	7 (10.8)	
Morning and evening	242 (74.5)	159 (57.2)	104 (77)	44 (67.7)	
Dental visit last 12 months					
Yes	161 (49.5)	141 (50.7)	34 (25.2)	35 (53.8)	<0.001
No	164 (50.5)	137 (49.3)	101 (74.8)	30 (46.2)	
Fluoride tablet					
Yes	100 (30.8)	47 (16.9)	11 (8.1)	7 (10.8)	<0.001
No	225 (69.2)	231 (83.1)	124 (91.9)	58 (89.2)	

in 10–17-year-old school going children and mean age being 12.8 years (SD: 1.4), residents in Sharjah city, UAE. The demographic characteristics of the parents include mean age of fathers and mothers being 44.69 (SD: 6) and 38.92 (SD: 5.2), respectively. Majority of the parents had university education (55% fathers

and 45% mothers) with a family income of >7000 AED in 62% of the sample.

While assessing the relationship between dietary habits with obesity in the present study, 51% had regular meals with included breakfast. According to Brugman *et al.*,^[20] having three main meals during the day is more beneficial as it helps to reduce the tendency and frequency of snacking. They also reported that an imbalanced diet is a significant factor for obesity.^[21] Similar results were reported by Cho *et al.*,^[22] who proved the association between skipping meals (especially breakfast), poor nutrition in the diet, and subsequent obesity. Several other studies showed the same association. Kranz *et al.*,^[23] arrived at the result that quality of diet decreases with an increase in age. Similar association (with increase in age) was also found with milk, fruits, and vegetables but soft drink consumption increased. Skipping meals (such

Table 4: Prevalence, mean, and standard deviation of gingivitis and visible plaque

Variable	n (%)	Mean	SD
Visible plaque			
0 (healthy gum/no gingivitis)	40 (5)	5.04	1.73
1-5 (region)	205 (25.5)		
6 (all the region)	558 (69.5)		
Unhealthy gums/gingivitis			
0 (no plaque)	40 (5)	5.02	1.74
1-5 (region)	210 (26.1)		
6 (all the region)	553 (68.9)		

SD: Standard deviation

Table 5: Prevalence of obesity and overweight by demographic variables

Variables	Weight groups			P
	Normal n (%)	Overweight n (%)	Obese n (%)	
Total weight group	496 (61.8)	118 (14.7)	189 (23.5)	-
Family history of obesity				
Yes	123 (24.8)	56 (29.6)	67 (56.8)	<0.001
No	373 (67)	133 (23.9)	51 (9.2)	
Gender				
Male	242 (59.6)	103 (25.4)	61 (15)	0.40
Female	254 (64)	86 (21.7)	57 (14.4)	
Nationality				
Emirati	211 (64.9)	62 (19.1)	52 (16)	0.04
Other Arabs	154 (55.4)	78 (28.1)	6 (16.5)	
Indian subcontinent	89 (65.9)	35 (25.9)	11 (8.1)	
Others	42 (64.6)	14 (21.5)	9 (13.8)	
School type				
Public	176 (65.4)	52 (19.3)	41 (15.2)	0.14
Private	320 (59.9)	137 (25.7)	77 (14.4)	
Mother education				
No	20 (58.8)	10 (29.4)	4 (11.8)	0.49
Primary	58 (66.7)	18 (20.7)	11 (12.6)	
Secondary	69 (69.7)	15 (15.2)	15 (15.2)	
High school	127 (58.3)	55 (25.2)	36 (16.5)	
College	219 (60.8)	91 (25.3)	50 (13.9)	
Father education				
No	16 (66.7)	4 (16.7)	4 (16.7)	0.21
Primary	51 (77.3)	12 (18.2)	3 (4.5)	
Secondary	44 (57.1)	20 (26)	13 (16.9)	
High school	121 (65.1)	41 (22)	24 (12.9)	
College	255 (59.9)	104 (24.4)	67 (15.7)	
Income				
1000-3000 dhs	54 (63.5)	19 (22.4)	12 (14.1)	0.97
3000-7000 dhs	138 (62.2)	54 (24.3)	30 (13.5)	
>7000 dhs	304 (61.3)	116 (23.4)	76 (15.3)	

Chi-square test analysis of weight group by demographic variables

Table 6: Prevalence, mean, and standard deviation of decay, missing, and filled teeth

Oral health status	n (%)	Mean (95% CI)	SD
Total DMFT			
DMFT=0	197 (24.5)	3.19 (3.00-3.40)	2.97
DMFT ≥1	606 (75.5)		
Total D (decayed teeth)			
D=0	228 (28.4)	2.75 (2.56-2.95)	2.76
D ≥1	575 (71.6)		
Total M (missing teeth)			0.26
M=0	771 (96.0)	0.05 (0.03-0.07)	
M ≥1	32 (4.0)		
Total F (filled teeth)			1.04
F=0	659 (82.1)	0.38 (0.31-0.46)	
F ≥1	144 (17.9)		

SD: Standard deviation, CI: Confidence interval, DMFT: Decay, missing, and filled teeth

Table 7: Independently significant variables associated with decay, missing, and filled teeth in multivariate analysis

Variables	Coefficient (95% CI)	P
Oral hygiene		
Visit the dentist	-0.651 (-1.061--0.241)	0.002
Tooth brushing	0.840 (0.017-1.663)	0.045
Dietary habits		
Soft drinks	0.310 (0.149-0.472)	<0.001
Milk	-0.131 (-0.263--0.001)	0.051
All three main meals	-0.570 (-0.980--0.160)	0.006
Tea and sugar	0.124 (0.011-0.260)	0.071
Socioeconomic status		
Age	0.420 (0.272-0.5677)	<0.001
Father education	-0.354 (-0.535--0.174)	<0.001
Gender	0.415 (0.018-0.812)	0.04
Arab	0.749 (0.328-1.171)	0.001
BMI	0.057 (0.016-0.098)	0.006
All significant variables		
Age	0.344 (0.197-0.491)	<0.001
Soft drink	0.307 (0.162-0.453)	<0.001
Father education	-0.333 (-0.512--0.153)	<0.001
Dental visit	-0.538 (-0.927--0.148)	0.012
Gender	0.544 (0.141-0.947)	0.008
All three main meals	-0.523 (-0.917--0.128)	0.009
Tea and sugar	0.149 (0.019-0.279)	0.024

BMI: Body mass index, SD: Standard deviation, CI: Confidence interval

as breakfast) was found to be more predominant in girls (in the present study). This was attributed as a weight control method. However, at the same time, this led to an increase in consumption of mid-morning snacking with high sugar content. Girls skipping breakfast probably is the reason for preference of carbohydrates and sweets among girls while compared to boys in the present study. Brugman *et al.*^[20] reported similar results in their study. According to them,

Dutch girls (4–15 years), in order to maintain their weight and body image, skipped breakfast often. In contrast, in our study, we observed boys skipping lunch/ dinner. This could be due to their involvement in outdoor and sporting activities, which could have resulted in higher intake of soft drinks in boys. Hence, the present study concluded that snacking was more common among boys rather than girls.

Another important factor in the present study is the significant difference in preferences of diet and food stuff among different nationalities. While the UAE nationals like their sweets, carbohydrates, and fast food, they tended to have less fruits and vegetables according to Al-Hosani and Rugg-Gunn;^[24] this could be due to their high monetary status. Indian population in the UAE were found to have more fruits and vegetables in their diet. This was attributed to the fact that majority of the Indian population is vegetarian unlike the UAE nationals and Arabs. The present study confirmed the results of Vartanian *et al.*,^[25] which indicated that increased soft drink intake could reduce milk intake as observed in the present study.

Physical activity in females was linked to cultural and social restrictions according to Henry *et al.*^[26] with the modernization of the world and the change of the traditional Bedouin style living to modern society, let to environmental changes such as the city development and safety of roads. This has greatly affected the opportunities for physical activities.^[27] Weather restrictions in the UAE (extreme hot and humid) make it difficult for children to walk to school or play outdoors. Advanced technology in the form of gaming gadgets, in combination with weather restrictions of the country, makes the children prefer more indoor activities such as video games.^[26] According to the results of the present study, 60% of the teenagers had 1–4 h/day of sedentary lifestyle while 27% had 8 h of such lifestyle. This was again different between nationalities and was found to be higher in the UAE population and least among Indians. Probability factors could be the high dependence on maids among UAE nationals.

Girls had regular brushing habits when compared to boys. This could be due to increased consciousness about personal hygiene among girls as also reported by Rise *et al.*^[28] and Kuusela *et al.*^[29] Both the studies demonstrated that brushing habits were better among 11-year-old girls in 22 European countries and Canada. Adolescents going to public school tend to visit dentist more often as oral care is free for children belonging to UAE nationality. However, children in the private

schools and the expat population seek treatment in the private sector which is more expensive. Fluoride use, as one of the preventive measures implemented by the Ministry of Health, UAE, was popular among public schools. The present study reported gingivitis being present in 95% of the children examined while only 5% of them had healthy gums. The findings are in correlation with previous studies done on schoolchildren in Sharjah, UAE, also reporting a high percentage of children with gingivitis.^[30]

The percentage of overweight and obesity in the present study was 23.5% and 14.7%. This was calculated using IOTF cutoff point among students. However, Al-Haddad *et al.*,^[8] in a similar study, reported a lower value. However, in their study, they used a US cutoff point to calculate the prevalence rates. Moreover, the study was conducted among the population of Ras al-Khaimah, another emirate in the UAE. The results of this study (6–16 years) reported 9% for overweight and 8% for obesity. It is not possible to compare due to the differences in the time period, ages, reference value, and location of the participants. In Abu Dhabi, Dubai, and Al-Ain,^[16] the prevalence rate for overweight and obesity is to be 22% and 14% (5–17 years old) in comparison to 25% (overweight) and 15% (obesity) in males and 22% (overweight) and 14% (obesity) for females in the present study. Similar studies conducted by El-Hazmi and Warsy^[31] and Al-Isa^[32] reported higher prevalence of overweight and obese in females while compared to males. However, in the present study, although not significant, the percentages of overweight and obesity were higher in boys when compared to girls.

A study conducted by Jebb *et al.*^[33] reported a racial difference in the prevalence of obesity in the United Kingdom. Reasons to explain this discrepancy across various ethnic groups and nationalities are challenging and complex. One can say that this could be deference in lifestyle among different nationalities. Similarly, we observed that a higher proportion of UAE nationals were obese when compared to Indians living in the UAE. Based on our study and previous prevalence studies, overweight and obesity among participants in the UAE is high.^[8,9] One way of explaining this (as mentioned earlier) could be the high monetary status in the UAE as compared to other middle eastern countries. Thus, the people of the UAE are able to afford a more affluent yet sedentary lifestyle and eating habit. According to Knai *et al.*,^[34] economic growth and modernization has led to a change in the dietary pattern with increased risk to health issues

but at the same time improving living standards. In our study, the type of the school (private/public) the participants were enrolled in did not reflect their economic status, and hence, we could not find a difference in obesity values between them.

In the present study, 72% of 11–17-year-old children in Sharjah, UAE, were affected by dental caries, and findings similar to this have been reported by El-Nadeef *et al.*,^[13] indicating dental caries prevalence to be 54% among children aged 12% and 65% among children aged 15 years in the UAE. Adolescents living in the UAE belonging to other Arab countries had the highest mean DMFT of 3.73, with a prevalence of 82%, as compared to UAE citizens (DMFT = 3.01, 69%). Indian adolescents in the UAE had the lowest mean DMFT of 2.38 and a prevalence of 58%. Similar dental caries difference due to ethnicity has also been studied by Dye *et al.*,^[35] they stated that this could be due to the fact that different cultural backgrounds influence different dietary habits.

The present study assessed the correlation among dental caries and obesity by examining the risk factors common to both. A positive association was found between the two using the univariate analysis; however, when applying multivariate regression analysis, the results showed that BMI lost its significance when other variables (economic status, food habits, and oral cleanliness status) were considered and the other covariates were controlled. Fathers' educational level and intake of carbonated beverage and juices were identified as significant risk factor for development of dental caries. Therefore, in this study, we could observe that a lower level of parental education had an influence on the child's food choices and lifestyle. Marshall *et al.*^[36] conducted a similar study in the US among 5–7 and 8–11 years old. In this study, they also explored the association of obesity with dental caries and the risk factors. According to them, families with low income, low parental education, overweight mothers, and increased soft drink consumption ($P < 0.05$) had increased dental caries rate. However, in the final statistical analysis, mothers' education was the only significant variable.

Multivariate regression analysis on BMI predictive model showed a positive significance with age, school fees, obesity in family, and soft drink consumption. Individuals' genes have been implemented as risk factors for obesity.^[37] The present study showed the same. Any bias need to be removed, with caution, as the history of overweight in the family, was

self-reported by the participating adolescents. A positive significant link was suggested by the present study between soft drink consumption and BMI. According to Malik and Bakir,^[16] with similar findings, the explanation is that soft drinks are a high source of sugar. This intake can replace the necessary nutritious food in the diet. Thus, they tend to provide empty calories in small volumes by increasing the overall energy intake.^[38] Furthermore, they decrease/replace the consumption of milk.^[25] In our study, soft drink alone is an important factor in calorie intake and in development of obesity and dental caries.

CONCLUSIONS

The present study concluded that correlation was found between obesity and dental caries using univariate analysis. However, soft drink was the main contributing factor for both obesity and BMI, according to the multivariate model.

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Conflicts of interest

There are no conflicts of interest.

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