

OBESITY AND RELATED ORAL HEALTH VARIABLES AMONG A GROUP OF YOUNG ADOLESCENTS

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ABSTRACT

INTRODUCTION: Obesity and dental caries both are multifactorial diseases that impact adolescent's health and psychosocial development. They both share common, modifiable, influences such as diet and lifestyle.

OBJECTIVES: the aim of this study was to assess young adolescents' obesity and dietary habits association with dental caries experience and stimulated salivary flow rate.

MATERIALS AND METHODS: In a cross-sectional comparative study designs, fifty obese adolescents with mean age of 13.0±0.54 years and fifty normal weight adolescents with mean age of 12.87±0.45 years were selected from preparatory schools in Alexandria. They were clinically examined with respect to dental caries, as well as answered a questionnaire concerning sociodemographic background, oral hygiene practice, 24-hour dietary recall and food frequency questionnaire. Body mass index (kg/m²) for age and flow rate of stimulated whole saliva (ml/min) was determined. Total cariogenic food exposure time was calculated.

RESULTS: The obese subjects exhibited significant higher mean score of DMFS (4.84±3.65 for male - 5.00±2.04 for female) vs. 0.76±1.39 for male - 0.44±2.71 for female in normal weight group (p= 0.011) and (p= 0.001) respectively. Obese group had lower flow rate of stimulated whole saliva (1.74±0.75 ml/min for male-1.80±0.65 ml/min for female) vs 2.86±0.70 for males- 2.83±0.65 for females in normal weight group (p=0.001) and (p=0.018) respectively. Obese subjects exhibited significant higher cariogenic food total exposure time with mean of 155.60±59.56 min/day vs. 50.40±34.58 min/day (p<0.001). No significant difference existed between the two groups regarding different food groups consumption except for grain group according to the American Academy of Pediatric Dentistry (AAPD) recommendations. In a multiple stepwise linear regression model for DMFS predictors, DMFS was significantly associated with lower flow rate of stimulated whole saliva (p < 0.001), cariogenic food total exposure time, added sugar and milk group consumption.

CONCLUSIONS: Obese young adolescents are more likely to suffer from dental caries and lower salivary flow rate compared to normal weight ones. They are more liable to consume cariogenic snacks and grain group food items.

KEYWORDS: Obesity, salivary flow, dental caries, dietary habits, cariogenic food total exposure time.

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INTRODUCTION

Obesity can now be considered the fastest growing health related problem in the world. An increasing prevalence of obesity is well documented in all ages and ethnicities worldwide (1). The disease is not a problem exclusive of adults from developed countries, since the proportion of children and adolescents with excessive fat accumulation has increased significantly in developing countries as well (2). In Egypt, 5% of males and 6% of females were classified obese adolescents by the Egyptian Demographic and Health Survey (EDHS) (3) at 2014.

Obesity and dental caries both are multifactorial diseases that impact children's and adolescents' health and psychosocial development. They both share common, modifiable, influences such as diet and lifestyle (4). Dental caries and its sequelae are among the most prevalent health problems facing infants, children, and adolescents (5). The dietary habits of children and adolescents are a significant contributor to obesity and dental caries epidemics. According to Burt and Pai (6) systematic review in 2001, dental caries and frequent ingestion of refined carbohydrates are highly correlated. Changes to diet and lifestyle since the mid-1990s may have helped to account for the rising prevalence in dental caries and obesity since that time as a result of increased affluence and access to high caloric carbohydrate-rich foods and drinks (7).

Although there are clinical studies demonstrating a relationship between obesity and dental caries (8-10) contradictory results were also suggested (11, 12). The finding that obese adolescents exhibit a lower flow rate of stimulated whole saliva compared to normal weight controls is interesting and may add new information explaining a possible link between obesity and dental caries. Eliana Pannunzio et al (13), who conducted a study in 2010 in Brazil on 7-10 years old school children, found that only normal weight group had normal values of stimulated whole saliva in comparison to the decreased values in obese children. Contrary results were found by Hashizume et al (14) in 2015 who found no difference in salivary flow or composition before and 6 months after bariatric surgery.

Despite the increased interest in obesity and studies reporting its prevalence, etiology and management, there has been little understanding of how they affect the oral health of young adolescents. The aim of this study was to test the null hypothesis that obesity and dietary habits are not associated with dental caries experience and stimulated salivary flow rate in young adolescents.

MATERIALS AND METHODS

A cross-sectional analytical design was carried out. The required sample size was calculated using Epi-info software and accordingly an estimated sample of 50 young adolescents (25 boys and 25 girls) per group was considered adequate.

Alpha error was assumed to be 0.05 and effect size = 0.85. One educational district was selected at random from a list containing all educational districts in Alexandria. Stratification of preparatory schools of the selected district into boys and girls schools was done. Two governmental schools were selected for the study; Alshaheed Mahmoud Sedky preparatory school for boys and Ahmad Badawy preparatory school for girls.

One hundred young adolescents with age ranged between 12-14 were selected from the previously mentioned schools after the approval of the Research Ethics Committee in the Faculty of Dentistry, Alexandria University. Parents of the selected adolescents signed an informed consent after explaining the nature of the study. Each subject answered a structured questionnaire concerning sociodemographic data that included age, gender, father and mother education and occupation, daily activity level, oral hygiene practices including tooth brushing and frequency. The data were collected between January and March 2015.

Intra examiner reliability of caries measuring procedure was assessed by examining 15 patients in two consequent visits with 48 hours interval. Kappa value was 0.947, which shows high strength of agreement.

Anthropometric measures: Body weight (kg) and height (cm) of the subjects were determined and body mass index (kg/m^2) was calculated. Body mass index (BMI) for age was determined by comparing the resultant BMI for age percentiles with the values according to obesity cut-off points proposed by WHO 2007 (15). Waist circumference was measured and the resultant value was compared to values according to obesity cut-off points proposed by Jolliffe and Janssen 2007 (16). Young adolescents were grouped according to BMI for age and waist circumference. Group 1 (obese) where young adolescents had BMI for age \geq 95th percentile and waist circumference in the obesity range and group 2 (normal weight) where young adolescents had BMI for age corresponds to 5th- 85th percentile and waist circumference on the normal weight range (15). Adolescents that received any antibiotic treatment during the last 3 months, smoking or under orthodontic treatment were excluded from the study.

Clinical examination: Dental caries was assessed using the DMFS index according to WHO criteria (17). Caries was recorded as present when a lesion in a pit and fissure or on a smooth surface had a frank cavity, undermined enamel, or a detectably softened floor or wall. Score of DMFS ranged between zero and 128 (excluding wisdom teeth). Whole saliva flow was stimulated by chewing on 1 cm piece of paraffin wax at a constant rate for five minutes. Stimulated whole saliva was collected over a 3 min period by the subject leaning forward and spitting saliva into the test tube once per minute. The flow rates were evaluated visually from graded test tubes (as ml/min) (18).

Dietary habits: 24 hour dietary recall: The collected data were compared to caloric needs and recommended daily amounts of different food groups according to American Academy of Pediatric Dentistry recommendations (AAPD) (19). Total cariogenic food exposure time was calculated by multiplying the frequency of cariogenic food exposure by 20 minutes (20). Food frequency questionnaire: Consumption of a certain food item once daily, twice daily and more than twice daily was considered high consumption, whereas consumption of a certain food item rarely or once weekly was considered low consumption (21).

Data were fed to the computer and analyzed using SPSS software package version 20.0. Qualitative data were described using number and percent. Quantitative data were described using range (minimum and maximum) mean and standard deviation. Comparisons between different groups regarding categorical variables were tested using Chi-square test and Monte Carlo probability. Comparisons between different groups regarding quantitative data were tested using t-test. Comparisons between the two studied groups were done using Z for Mann Whitney test. Significance of the obtained results was judged at the 5% level.

RESULTS

The study sample consisted of fifty obese adolescents (25 males and 25 females) with mean age of 13.0 ± 0.54 years and fifty normal weight subjects (25 males and 25 females) with mean age of 12.87 ± 0.45 years. In the obese group, males and females had a mean BMI for age of $36.05 \pm 4.71 \text{ kg}/\text{m}^2$ and $35.2 \pm 3.4 \text{ kg}/\text{m}^2$ respectively. In the normal weight group, male and female had a mean BMI for age of $18.7 \pm 1.5 \text{ kg}/\text{m}^2$ and $18.4 \pm 0.9 \text{ kg}/\text{m}^2$ respectively. Regarding waist circumference, in group 1 (obese), males and females had a mean waist circumference of $105.45 \pm 8.8 \text{ cm}$ and $108.4 \pm 10.2 \text{ cm}$ respectively. In the normal weight group, males and females had a mean waist circumference of $75.0 \pm 3.7 \text{ cm}$ and $70.68 \pm 4.97 \text{ cm}$ respectively.

In group 1 (obese), 50% reported tooth brushing (figure1). Among those who reported brushing, 72% used to brush once daily and 28% used to brush twice daily (figure 2). In the normal weight group, the majority (64%) reported tooth brushing (figure1), among those who reported brushing, 53.1% used to brush once daily, 43.8% used to wash twice daily and 3.1% used to wash their teeth more than twice (figure 2). There was no statistical difference between the two studied groups with in the tooth brushing practice or the frequency ($p=0.157$) and ($p=0.339$) respectively

There was no statistical difference between obese males and females ($p=0.849$). In normal weight group, male and female adolescents had mean DMFS of 0.76 ± 1.392 and 0.44 ± 2 . In the normal weight group, females had a statistically higher DMFS than male ($p=0.009^*$). Obese males and females had a statistically higher DMFS than normal weight males and females ($p=0.011$) and ($p=0.001$) respectively as shown in table I.

In-group 1 (obese), male and female adolescents had mean DMFS of 4.84 ± 3.65 and 5.00 ± 2.04 respectively.

In group 1 (obese), male and female adolescents had mean values of salivary flow rate of $1.74 \pm 0.75 \text{ ml}/\text{min}$ and $1.80 \pm 0.65 \text{ ml}/\text{min}$ respectively. There was no statistical difference between obese male and female ($p=0.302$). In normal weight group, male and female adolescents had mean values of salivary flow rate of $2.86 \pm 0.70 \text{ ml}/\text{min}$ and $2.83 \pm 0.65 \text{ ml}/\text{min}$ respectively with no significant difference. Obese male and female had a statistically lower stimulated salivary flow rate than normal weight male and female ($p=0.001$) and ($p=0.018$) respectively as shown in table I.

Regarding the percentage of the different food groups intake in relation to the AAPD recommended daily amount, obese group consumed grain group significantly higher than normal weight group ($p<0.001$). The mean intake was 446.0

± 144.51% in the obese group and 170.24 ± 51.15% in the normal weight group as shown in figure 3.

Obese group reported significant high consumption of carbonated beverages (28% vs. 2%) (p<0.001), hard candies (50% vs. 8%) (p<0.001), biscuits (14% vs. 0%) (p<0.001), salty snacks (70% vs. 4%) (p<0.001), chocolate (18% vs. 0%) (p<0.001), white bread (88% vs. 46%) (p<0.001) and added sugar (92% vs. 46%) (p<0.001) compared to normal weight group as shown in figure 4.

Concerning the comparison between the two studied groups regarding total cariogenic food exposure time, the mean values were 155.60 ± 59.56 min/day in the obese group and 50.40 ± 34.58 min/day in the normal weight group. Obese group had a statistically longer cariogenic food total exposure time (p<0.001) as shown in figure 5

Multiple stepwise linear regression analysis for predictors of DMFS among study sample was performed (table II). DMFS was considered as the dependent variable and the following variables were considered independent: BMI for age, waist circumference, salivary flow rate, food groups consumption, cariogenic snacks consumption frequency, cariogenic food total exposure time. There were significant associations with cariogenic food total exposure time (SC=0.29), salivary flow rate (SC=-0.36), added sugar (SC=0.31) and milk group (SC=0.20). In a multiple stepwise linear regression model for stimulated salivary flow rate predictors, there was no significant association with any of the independent variables.

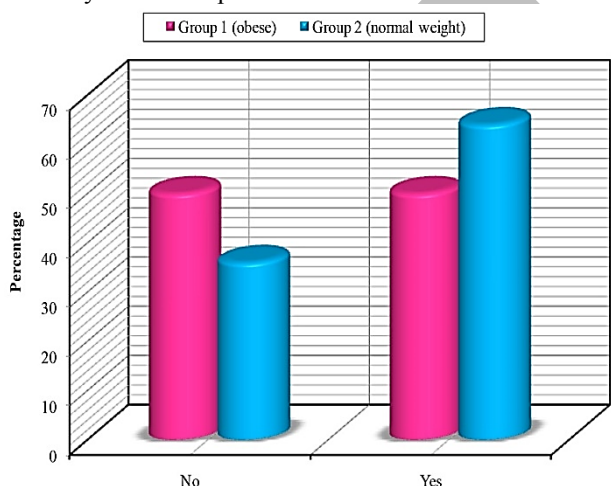


Figure 1: Comparison between the two studied groups regarding the tooth brushing habit.

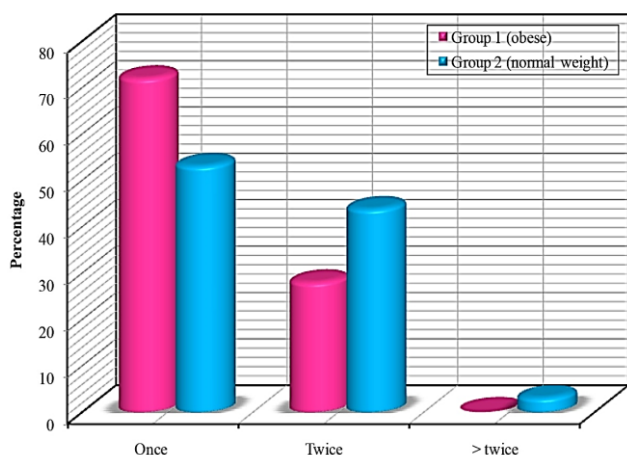


Figure 2: Comparison between the two studied groups regarding the frequency of tooth brushing.

Table 1: Comparison between the two studied groups regarding DMFS and salivary flow rate.

		Group 1 obese		t (P)	Group 2 control		t (P)
		male	female		male	female	
DMFS	Min - Max	0.00 - 12.00	2.00 - 8.00	0.191 (0.849)	0.00-4.00	0.00-8.00	2.757*(0.009*)
	Mean±SD	4.84±3.65	5.00±2.04		76±1.392	44±2.71	
t (p)					2.6 (0.011)*	8.5 (0.001)*	
Salivary flow rate	Min - Max	1.00 - 3.00	1.20 - 3.50	2.201 (0.302)	1.00-3.70	1.00-3.50	0.168 (0.868)
	Mean±SD	1.74±0.75	1.80±0.65		2.86±0.70	2.83±0.65	
t (p)					5.4 (0.001)*	2.5 (0.018)*	

t: independent samples t-test
* P < 0.05 (significant)

Table 2: Multiple stepwise linear regression analysis of DMFS predictors.

Model	Unstandardized Coefficients	SE	Standardized Coefficients	t	P
(Constant)		1.58		0.21	.831
Flow rate	0.34	0.30	-0.36	4.60	.000*
Milk group	-1.38	0.00	0.20	2.81	.006*
Total exposure	0.01	0.00	0.29	3.45	.001*
Added sugar	1.45	0.38	0.31	3.77	.000*
Model R2	56%				
Model significance	F=23.5; P < 0.01				

* P < 0.05 (significant)

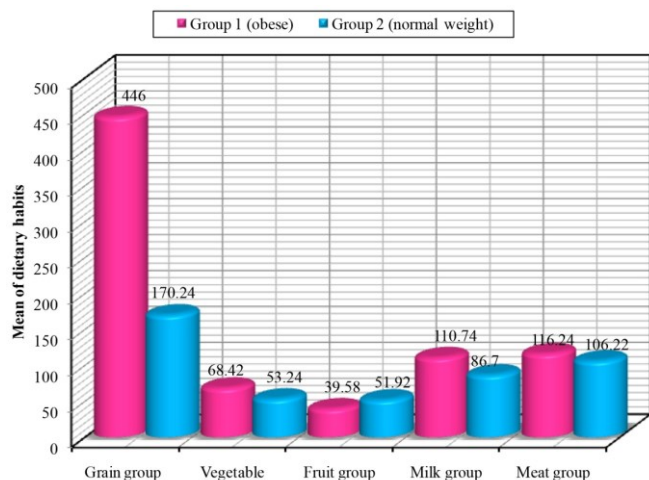


Figure 3: Comparison between the two studied groups regarding the percentage of different food groups intake in relation to the AAPD recommended daily amount

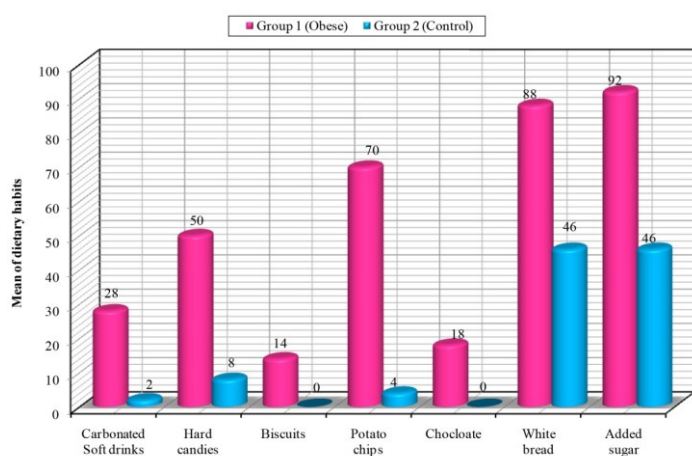


Figure 4: Comparison between the two studied groups regarding frequency of cariogenic snacks.

DISCUSSION

We here demonstrate that obese young adolescents suffer from higher caries experience and lower stimulated salivary flow, but with no direct association. Dietary habits, especially duration and amount of sugar consumption, have more influence on caries experience.

Childhood overweight and obesity are global problems that are on the rise due to modernization and change in lifestyle (4). Childhood obesity and childhood dental caries are coincidental in many populations, probably due to the common confounding risk factors such as food intake frequency, cariogenic diet, and poor oral health (5). The most convenient and commonly used tool to screen for overweight/obesity is the BMI (kg/m²), a measure of body weight adjusted for height. Due to differential changes in height and weight during growth and development, BMI percentiles specific for age and sex are used to describe childhood weight status. The Centers for Disease Control and Prevention have published standardized BMI charts to determine BMI percentiles for children and adolescents (15). Waist circumference shows a close correlation with the amount of visceral adipose tissue, which has been shown to be metabolically more active and to secrete far greater amounts of cytokines and hormones compared with subcutaneous adipose tissue (16).

The present study demonstrated a significant difference between DMFS score between the obese adolescents and

the normal weight ones. However, multiple stepwise linear regressions showed that there was no statistically significant association between BMI-for-age and DMFS.

This is in line with the results of the study done by Elangovan et al, (11) which showed a higher prevalence of caries in obese subjects but with no significant correlation. Kantovitz et al (22) in a systematic review regarding the relationship between obesity in childhood found that only one study with high level of evidence showed direct association between obesity and dental caries.

On the other hand, Hilgers et al (23) in 2006 found that the mean caries average for permanent molars significantly increased with increased BMI, even after adjusting for age and gender. Moreover, Caudillo-Joya et al (24) in Mexico in 2014 found that higher BMI was significantly associated with dental caries prevalence and severity in the permanent dentition.

One possible explanation to different results concerning association between dental caries and obesity could be that biological, genetic, environmental and behavioral factors influence BMI percentile and DMFS individually and collectively, but also that the association between obesity and dental caries might be weak and vary over time as well as between different regions due to different preventive fluoride program addressed to the children.

The finding that obese adolescents exhibit a lower flow rate of stimulated whole saliva compared to normal weight controls is interesting and may provide a possible explanation of the relation between obesity and dental caries. In the current study salivary flow rate was significantly lower in both male and female obese subjects. Multiple stepwise linear regression analysis showed a strong negative association between salivary flow rate and DMFS score. This is in line with the findings by Yamashita et al (25) and Knas (26). Contrary results were found by Hashizume et al (14) who found no difference in salivary flow or composition before and 6 months after bariatric surgery.

Whether there is a direct or indirect effect of obesity that affects negatively the flow rate is unclear. Obese subjects have been reported to exhibit a significant enlargement of parotid glands probably by an enhanced storage of adipocytes in the parotid parenchyma whereas the submandibular glands seem to remain unaffected. Based on that, proinflammatory cytokines derived from adipocytes as well as macrophages, accumulated in adipose tissue (25) may negatively affect the function of salivary glands due to chronic low-grade inflammation in the gland. Moreover, the negative effect of obesity on salivary glands may be related to stress hormones linked to hypothalamic-pituitary-adrenal axis that may negatively influence the function of saliva glands as well (27).

The relationship between nutrition and dental caries is complex because it is a multifactorial disease. National and population-based surveys have found that adolescents often fail to meet dietary recommendations for overall nutritional status and for specific nutrient intakes. Many adolescents receive a higher proportion of energy from fat and/or added sugar and have a lower intake of fruits, vegetables, dairy products than is recommended (28). This was in line with the present study result where the early adolescents fail to meet their recommended amount of different food groups. Vegetables, fruits and meat were consumed less than recommended while Grains (mostly white bread and

bakery) were consumed 4 times than the recommended amount. Starches can increase the cariogenic properties of sugars if they are consumed at the same time. The stickiness of starch enhances the retention time of sugars, resulting in a prolonged pH drop (29).

In both groups, milk (mostly milk with added sugar or yogurt with added honey) was the only food group to meet their recommended amount. In this study, consumption of milk group had a statistically significant association with DMFS score. This association is believed to be due to the addition of sweetened coco powder or added sugar to the milk or consumption of yogurt with added honey. This was in contradiction to the results by Zaki et al (30) who concluded that caries-free children showed significantly higher milk consumption. Milk might be classified as cariogenic due to lactose content (4.8g per 100g milk), but there is much evidence that lactose is the least cariogenic of the common dietary sugars. In addition, the high concentrations of calcium and phosphorus in milk will help to prevent dissolution of enamel (which is largely calcium and phosphate) and other factors principally casein, is likely to have a protective as well. Thus, it is possible that milk could be caries-promoting (due to the lactose content), caries preventing, or somewhere between these two (31).

The result of this study showed that cariogenic food total exposure time was significantly higher in the obese group and also had a statistically significant association with DMFS score. After consumption of cariogenic food item, pH drops beyond the critical value. The critical pH is the pH at which saliva and plaque fluid cease to be saturated with calcium and phosphate, thereby permitting the hydroxyapatite in dental enamel to dissolve. This critical value is generally accepted to be about 5.5. This drop continues for about 20 minutes. Then the pH gradually rises till it reaches the neutral value (32).

In the concurrent study, obese group reported high consumption of carbonated beverages, hard candies, biscuits, salty snacks, chocolate, white bread and added sugar compared to normal weight group.

Many carbonated beverages contain phosphoric, citric, and carbonic acids. Several studies have shown a deleterious effect on enamel after exposure to cola-type soft drinks. The demineralization of hydroxyapatite by the acids present in soft drinks can eclipse the effects of the acids generated by oral flora from the sugars present in the drinks (33).

In a study by Almushayt et al (34) they found that child who consumed salty snacks frequently may have a chance of about 5.68 to 6.54 times to develop caries more than the child who did not eat salty snacks at all. These snacks are most commonly well accepted by children as they are easily available, and sold in both small and big stores. These snacks are cheap in price and used as part of rewarding children. Sometimes they are used as a supplementation for other more healthy food (34).

Added sugar had a significant association with DMFS scores. These are sugars, which are added by the consumer to foods to alter the flavor, taste, or texture of the food. Added sugars include white or brown sugar, honey and molasses (35). Frequent consumption of added sugar, which is a form of fermentable carbohydrates, particularly in the absence of adequate oral hygiene, may not allow time for sufficient buffering of the tooth environment or remineralization via salivary action (36).

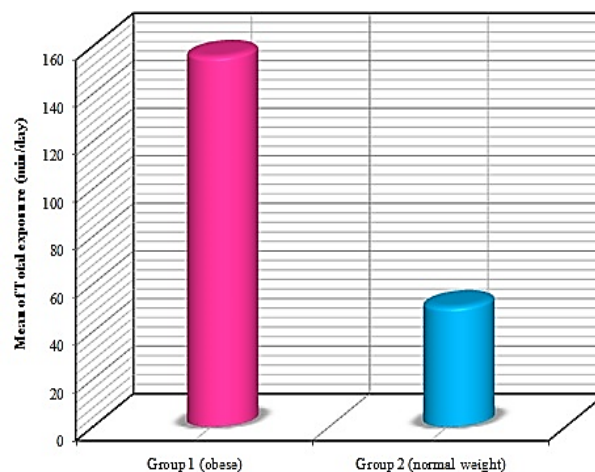


Figure 5: Comparison between the two studied groups regarding cariogenic food total exposure time.

Although the results of the study did not prove the direct association between obesity and caries experience, it still provides valuable evidence on the relation between obesity and oral health through the harmful dietary habits. As members of dental health team, it is critical that dentists maintain awareness of this problem and participate in the assessment and prevention of obesity. Providing nutritional counseling, weight control and parents education may potentially lower the risk for dental caries in young adolescents while improving their general health.

However, several limitations in our study should be taken into consideration in the future studies. The first limitation was the cross-sectional design of the study; a cause-effect over a limited period of time could not be established. Another limitation is that there was no accessibility to private schools to study different social levels to assess its effect on dietary habits. Assessing dietary habits by the 24-hour dietary recall is an added limitation to the study as it relied on participant memory. One more limitation was the fact that the examiner was not blind to the group he was examining which might introduce some bias.

CONCLUSIONS

Obese young adolescents had significantly higher scores of DMFS and lower stimulated salivary flow, but with no significant direct association. DMFS was significantly associated with cariogenic food, total exposure time, added sugar consumption, milk group consumption and lower salivary flow.

STATEMENT OF CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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