ECRONICON OPEN ACCESS

EC DENTAL SCIENCE
Research Article

Body Mass Index and Children's Caries in Jeddah Specialty Dental Center, Saudi Arabia

Linda F Mirza[1,2], Ghaidaa T Ureiga[3], Ghadah A Malki[1] and Mohammad A Dahlan[1]*

[1]*Department of Pediatric Dentistry, Jeddah Specialty Dental Center - Ministry of Health, Jeddah, Saudi Arabia*

[2]*Department of Pediatric Dentistry, King Abdullah Medical Complex - Ministry of Health, Jeddah, Saudi Arabia*

[3]*Pediatric Dental Clinic, Private Practice, Jeddah, Saudi Arabia*

***Corresponding Author:** Mohammad A Dahlan, Department of Pediatric Dentistry, Jeddah Specialty Dental Center - Ministry of Health, Jeddah, Saudi Arabia.

Received: July 22, 2020; **Published:** August 31, 2020

Abstract

Dental caries is the most prevalent multifactorial infectious chronic disease that affects both sexes worldwide. Similarly, obesity and overweight are becoming major health threat in many parts of the world. Research that determine the relationship between Body Mass Index (BMI) and caries are sparse and inconclusive. Therefore, the aim of this study was to evaluate the BMI in a group of children aged (2 – 12 years) seen at Jeddah Specialty Dental Center to investigate possible effect of their BMI on caries experience. Study subjects were Saudi children divided into 2 groups based on their age: preschool (2 – 5 years) and schoolchildren (6 – 12 years). The participants were examined under standardized condition using optimal lighting, mouth mirror and a three-way-syringe to register the dental caries in primary and permanent dentition. WHO criteria (2013) was utilized to diagnose dental caries. After measuring the body weight in kilogram and the height in centimeter, children's BMI percentile value was calculated. The mean value of dental caries in the participated children was 7.15 (SD = 4.6). The majority of children (65.7%) had a BMI falling within normal weight. For preschool children sample, ANOVA did not show any statistically significant difference between all body weight categories in relation to caries experience. For schoolchildren sample, tests showed that there was a significant intergroup variability between the BMI categories with regard to caries experience in primary teeth (P = 0.01) and total caries (P< 0.001). For total sample, underweight children had significantly more effect than overweight on high caries lesion in primary teeth (P = 0.01) and total caries (P = 0.003). It was concluded that there is significant weak negative correlation between BMI and dental caries. Also, underweight children have significant effect on high caries outcome compared to other BMI categories.

Keywords: *Dental Caries; Body Mass Index; Prevalence; WHO (2013); Jeddah Specialty Dental Center*

Introduction

Dental Caries continues to be a significant health problem for many children worldwide. It infects both primary and permanent dentition [1]. It is 5 times more common than asthma, 4 times more common than early childhood obesity, and 20 times more common than diabetes [2]. The infection and pain caused by dental caries can impair weight gain [3], lead to learning and eating problems, and increase school absenteeism, thus negatively affecting children's quality of life [4].

Much like dental caries, body mass index (BMI) reports are continuously growing within the last decades; meanwhile, obesity and overweight are becoming major health threat in many parts of the world. Over 4 million people die each year as a result of being overweight or obese according to the global burden of disease [5]. Data released by the World Health Organization (WHO) in 2014 indicates that the prevalence of obesity in countries like Saudi Arabia, United State of America, and New Zealand are 35.6%, 33.9% and 26.5% respectively [6].

Several researchers have identified the link between dental caries and BMI in childhood and among adolescent, and have suggested that obese children are at an increased risk for dental caries [7-9]. In contrast to the studies reporting a relationship between caries and high BMI, multiple articles have shown weak or no association between dental caries and obesity [10, 11]. In a case-control analysis, authors have answered the question whether early childhood caries (ECC) was associated with underweight or overweight. They found a significant number of children, age 3-6 years, with Sever-ECC are underweight [12]. Additional proposal has also concluded that there is no evidence to support that overweight or at risk for overweight children and youth, age 2-18 years, are at increased risk for dental caries. Interestingly, they provide some, but inconsistent, evidence that overweight status may be associated with a decreased risk for dental caries [13]. Considering the aforementioned contradictory considerations, it can be speculated that the role of BMI with respect to dental caries still needs further clarification.

Purpose of the Study

The purpose of this study was to evaluate preschool and schoolchildren's BMI to investigate possible effect of their BMI categories on dental caries experience. This is the first investigation that determines the effect of children's BMI on tooth decay in Jeddah Specialty Dental Center (JSDC), Jeddah, Saudi Arabia.

Materials and Methods

This cross-sectional study was carried out on Saudi children seen at JSDC in North Jeddah, Saudi Arabia. Families living in this area are representing different socio-economic profiles. The dental and physical examinations of the children were only conducted with the written consent of the parents. Children with systemic disease, prolonged illness and those who had undergone orthodontic treatment were excluded from the study. The dental exam was performed by 3 calibrated dentists of the Department of Pediatric Dentistry, JSDC. The 95% confidence interval for interexaminer and intraexminar reliability was 0.95, and 0.98, respectively. The estimated sample size was reviewed by a biostatistician and validated using Statistical Package for Social Sciences (SPSS) - IBM version 24 based on the hypothesized population and the prevalence data of dental caries in Makkah region [14]. The study was granted ethical approval by the Ethics Committee of the Medical Research and Studies Department, Directorate of Health Affair in Jeddah, Ministry of Health, Saudi Arabia.

Study subjects were divided into 2 groups based on their age: preschool (2 – 5 years) and schoolchildren (6 – 12 years). The participants were examined under standardized condition using optimal lighting, mouth mirror and a tooth-drying device to register the dentition status using the dft for primary dentition and DFT for permanent teeth (D/d = decayed, F/f = filled, T/t = teeth). WHO criteria (2013) was utilized to diagnose dental caries (dependent variable) [15]. The prevalence and the mean of dental caries were recorded for dft, DFT and total caries (dft + DFT). The advantage of the total caries value is the determination of the total carious lesion independent of the type of the dentition.

To calculate the BMI (independent variable), anthropometric measurements of all participants were taken in the waiting area by one investigator. Body weight in kilogram and height in centimeter were measured using a mechanical scale and stadiometer (Detecto, Webb City, MO, USA). Subjects were asked to step up and stand straight barefoot on the scale to ensure accurate reading. Children's BMI percentile values were generated using a web-based calculator on a Center for Disease Control and Prevention (CDC) website (http://apps.

nccd.cdc.gov/dnpabmi/Calculator.aspx). Based on the age and sex-specific CDC 2000 growth charts, the weight status of the children was categorized by the following BMI percentile: underweight (BMI < 5th percentile), normal weight (BMI 5th - < 85th percentile), overweight (BMI 85th - < 95th percentiles) and obesity (BMI ≥ 95th percentile) [16,17].

Statistical analyses

The Shapiro-Wilk test was used to assess for normality assumption. The data for all variables was not normally distributed therefore, non-parametric, analysis of variance (ANOVA) tests were used throughout. Kruskal-Wallis and Mann-Whitney tests were carried out to compare the difference between BMI categories in relation to caries experience for preschool, schoolchildren and total sample. Chi-square test was used where appropriate. Spearman's correlation coefficient was used to explore association between variables. All data were calculated and analyzed at $\alpha = 0.05$ level of significance. .

Result

Of the 847 included subjects at the baseline, 642 children met the inclusion criteria (Figure 1). The mean value of dental caries in the participated children was 7.15 (SD = 4.6) with a mean of 6.68 (SD = 4.6) in primary dentition and1.05 (SD = 1.6) in permanent dentition. The majority of children (65.7%) had a BMI falling within normal weight. Around 15% of the children were underweight. The rest of the subjects were almost equally distributed i.e. 9.6% overweight and 9.5% obese. Data of BMI and caries status for the participated children is shown in Table 1.

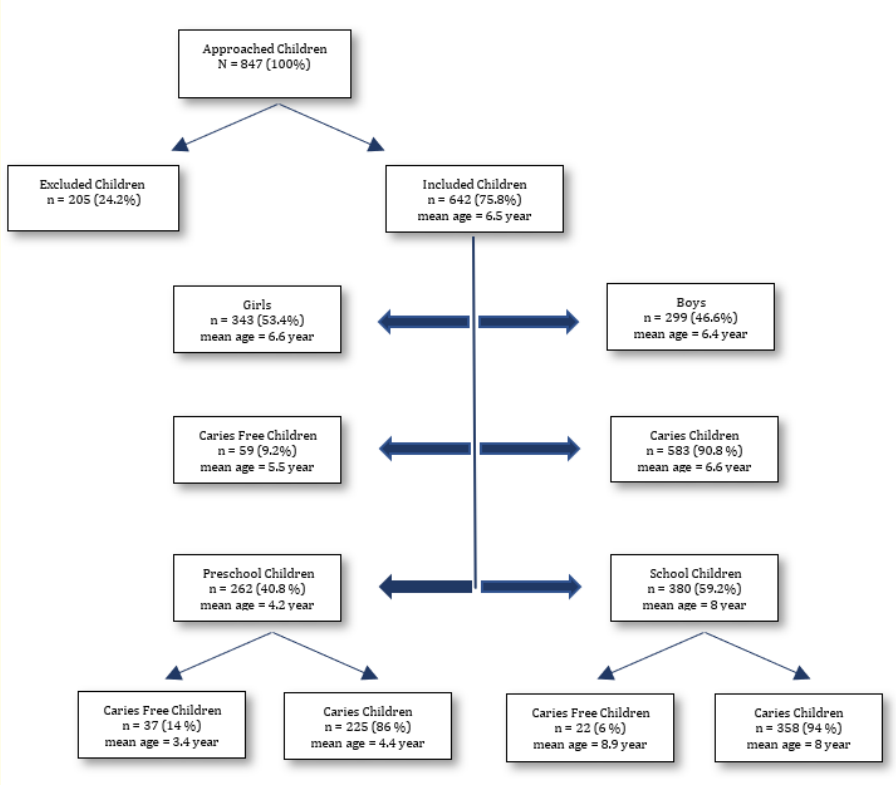

Figure 1: *Description of the sample by gender, caries status and age.*

BMI	Caries Status		Total
	Caries-Free	Caries	
Normal Weight	35 (59%)	387 (66%)	422 (65%)
Underweight	6 (10%)	91 (16%)	97 (15%)
Overweight	11 (19%)	51 (9%)	62 (10%)
Obese	7 (12%)	54 (9%)	61 (10%)
Total	59 (100%)	583 (100%)	642 (100%)

Table 1: *BMI category in relation to caries status in children age between 2 - 12 years (n = 642). Prevalence of caries-free appear to be less in underweight children than other BMI categories. On the other hand, the prevalence of caries was more in underweight children compared to overweight and obese children but not to normal weight.*

For schoolchildren sample, Kruskal Wallis test showed that there was a significant intergroup variability between the BMI categories with regard to caries experience in primary teeth (P = 0.01) and total caries (P< 0.001). Mann Whitney test showed that normal weight children had statistically significant effect on low dft (P = 0.01) and on low total caries (P = 0.001) compared to underweight. Interestingly, underweight children had more significant effect than overweight on high dft and total caries with P-value = 0.01 and = 0.001, respectively. Moreover, underweight children had statistically more significant effect than obese on high dft (P = 0.005) and on high total caries (P = 0.000). Unexpectedly, the mean of total caries with obese children was lower than normal weight children; 5.6 and 6.9, respectively; with statistically significant P-value = 0.03 (Table 2). Our data for schoolchildren subjects observed weak, inverse, and significant correlation between BMI and dft (Spearman's rho, - 0.166; P< 0.01), and between BMI and total caries (Spearman's rho, - 0.221; P< 0.01). For preschool children sample, ANOVA did not show any statistically significant difference between all body weight categories in relation to caries experience.

Case Summaries - 72 months or more				
Child's BMI		dft	DFT	Total Caries
Underweight	N	50	45	50
	Mean	7.9600	1.3556	9.1800
	Median	8.0000	1.0000	9.0000
Normal weight	N	239	228	245
	Mean	6.1172	1.0789	6.9714
	Median	6.0000	.0000	7.0000
Overweight	N	38	42	43
	Mean	5.5263	1.1905	6.0465
	Median	5.0000	.0000	5.0000
Obese	N	39	40	42
	Mean	5.1538	.9250	5.6667
	Median	5.0000	.0000	5.0000
Total	N	366	355	380
	Mean	6.2049	1.1099	7.0132
	Median	6.0000	.0000	7.0000

Table 2: *Summary of children's BMI and caries experience in schoolchildren. Mean and median value of dft and total caries for normal weight children were less than underweight however, they were more than overweight and obese children.*

For total sample (preschool and schoolchildren), the test showed that there was significant difference between children's BMI categories regarding dft (P = 0.02) and total caries (P = 0.003). Similar to schoolchildren sample, normal weight children had significant effect on less dft (mean rank = 251) and on less total caries (mean rank = 253) compared to underweight children with P-value = 0.05 and = 0.02, respectively. Underweight children hadsignificantly more effect than overweight and obese children on high dft (P = 0.01) and on high total caries (P = 0.003). On the other hand, obese children had significantly higher effect on low total caries (mean = 6) than normal weight (mean = 7.2) with P-value = 0.05. Surprisingly, overweight sample showed significant effect on low total caries than normal weight children with P-value = 0.04. Our result for total sample showed significant, weak, and negative correlation between BMI and dft (Spearman's rho, - 0.123; P< 0.01), and between BMI and total caries (Spearman's rho, - 0.148; P< 0.01).

Discussion

TThe aim of this study was to examine the possible effect of different BMI categories on dental caries experience in children 2 – 12 years of age seen at JSDC, Saudi Arabia. Our observation was that in preschool children caries experience did not differ among BMI categories. Comparably, no association was largely found in studies from United States, South America and Europe [18]. Findings from national surveys that examine the association between caries status and overweight in 2 – 18 years old US children indicate no relationship between weight status and dental caries in children 2 – 5 years of age [13].

In schoolchildren our data did, however, find significant difference among BMI groups regarding caries experience. Measures of dft and total caries were significantly less in our normal weight subjects compared to underweight. Additionally, underweight children had significant effect on high dft and total caries compared to overweight and obese. A descriptive analysis of the association between caries frequency and overweight was conducted in Germany in 6- to 11- year- old elementary school. The authors concluded that children with normal weight had significantly lower caries scores in the primary and permanent dentition than overweight children [8]. The mean of total caries in obese group in our schoolchildren population was significantly less than normal weight. This is in agreement with Alghamdi and Almahdy study in 2017 which evaluated the relationship between dental caries and BMI in boys living in Saudi Arabia. They found that obese schoolchildren, those with higher socioeconomic status and who used fluoridated toothpaste were more likely to be with healthy teeth [19].

In total sample our observation was that children of underweight have higher caries than normal weight which is similar to reports by other investigators [20]. It is well established that dental caries and underweight have environmental components that cannot be ruled out. Therefore, the data is consistent with the hypothesis that common risk factors drive both disease process and suggest a complex picture [21-23]. Similar to normal weight, our data showed that overweight and obese children have significant less effect than underweight childrenwith regard to high caries experience in primary teeth and total caries. In 2016, Bhayat and colleagues determined the association between dental caries, BMI and dietary habits of 12 years boys from four geographically distinct schools in Medina, Saudi Arabia. They reported that overweight and obese children were less likely to have dental caries in comparison to the underweight participants (P =0.01) [24]. This interpretation is compatible with this study finding. Moreover, Habibullah., et al. found that underweight children were more likely to have dental caries in comparison to overweight patients (P = 0.02) [25]. On the other hand, study by Ashour., et al. showed that overweight and obese patients were 2.9 times more likely to have dental caries in comparison to underweight patients (95% CI = 1.2-4.9) [26].In contrast to the results we found concerning the effect of normal weight and underweight on dental caries, normal weight children have significant effect on increasing the total caries more than the effect resulting by overweight and obese children with P- value = 0.04 and = 0.05, respectively. This is in agreement with a study by Narksawat., et al. in 2009 who found that underweight and normal weight schoolchildren were more likely to have dental caries at least 1.9 times and 2.2 times, respectively compared to overweight and obese children [27].

Despite the significant correlation between children's BMI and caries exposure in our schoolchildren and total sample, Spearman's rho 2-tailed test showed weak and negative linear relationship between these variables. This result is in diss-agreement with Farsi and Elkhodary study in high school adolescents in Jeddah which found that there was a non-significant weak positive correlation between BMI and dental caries (Spearman's rho, 0.01; P, 0.737) [28].

The overall prevalence of dental caries in our sample was 90.8 % with a mean total caries of 7.1. This is considered high compared to the estimated result by Farooqi and his colleague in 2015 who detected caries in primary and permanent teeth among 73% of the screened children [29]. In cross-sectional study, Alhabdan., et al. reported that the prevalence of dental caries among primary school children in Riyadh, Saudi Arabia was 83% (95% CI 79.7–86.0%) [30]. In this current study dental caries prevalence in preschool and schoolchildren was 86% and 94%, respectively. Although the difference is not remarkable, this could be justified by higher sugar intake and beverages consumption with less parents' supervision during school age compared to preschool children. Many assessments were performed in Makkah region and it was concluded that the prevalence of dental caries in Jeddah was 79-91%, 66 – 79% in Makkah, and 58 – 68% in Rabagh, Saudi Arabia [31-37]. In 1995, Masoud reported a mean dmft (m=missing primary teeth) of 6.83 for 6-year-old children living in Makkah region [32]. Subsequently, in 1996, Alamoudi., et al. reported a caries prevalence of 73.9% for 6 – 9-year-old with a mean dmft of 4.23 and a mean DMFT (M=missing permanent teeth) of 1.85 [33]. Interestingly, our study showed that the caries prevalence of dft was 97.8% (mean = 6.6) and of DFT was 58.4% (mean = 1.0). Approximately 60% of our subjects were schoolchildren with a mean age of 8 years. This indicates that about two third of the participants pass through the transitional stage when many primary teeth exfoliate and newly, sound permanent teeth erupt; therefore, the prevalence and mean of DFT are lower than dft.

Limitation of the Study

Limitations of this study include radiographic diagnostic method was not used to detect dental caries. In addition, missing teeth were not evaluated. This could be because part of the investigated children were gradually receiving their permanent dentition so that no definite reason for the loss of the teeth can be made. Also, it is well documented that socioeconomic status, diet, and fluoride intake are considered potential confounders in causing dental caries [38-40]. However, assessment of these strong predictors was not done in our study. Therefore, further work could also include a detailed analysis of these factors as they may contribute to high dental caries.

Conclusion

There is significant weak negative correlation between BMI and dental caries. Underweight children have significant effect on high caries outcome compared to other BMI categories. The high caries rate in this age group (2 – 12 years) emphasis the urgent need for more prevention and therapeutic measurements in this specific region of Saudi Arabia.

Data Availability

Data used to support this study are available on reasonable request from the corresponding author (Tel: +966 12 6074181; E-mail: mdahlan@moh.gov.sa).

Conflicts of Interest

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

Acknowledgment

The authors would like to thank Professor Khalid Zewawi for his support in statistical analysis as well as the following for their contribution in study conception and cared for study patients: Dr. Khalil Al-Abed, Dr. Merfal Al-Habab, and Dr. Samaher Bahamdin.

Bibliography

1. Aas JA., *et al.* "Bacteria of dental caries in primary and permanent teeth in children and young adults". *Journal of Clinical Microbiology* 46.4 (2008): 1407-1417.

2. [AAPD] American Academy of Pediatric Dentistry". *Early Childhood Caries (ECC)* (2015).

3. Acs G., *et al.* "Effect of nursing caries on body weight in a pediatric population". *The Pediatric Dental* 14.5 (1992): 302-305.

4. Edelstein B. "Children's experience of dental pain: a public policy and clinical policy issue". In Background paper prepared for the Mayday Fund and the Milbank Memorial Fund meeting on Preventing and Treating Children's Oral Pain. Washington DC (1999).

5. [WHO] World Health Organization. Health topics/obesity/overview (2020).

6. [WHO] World Health Organization. WHO reference: country comparison - BMI adults % obese, most recent (2014).

7. Thippeswamy HM., *et al.* "Relationship between body mass index and dental caries among adolescent children in South India". *West Indian Medical Journal* 60.5 (2011): 581-586.

8. Willershausen B., *et al.* "Relationship between high weight and caries frequency in German elementary school children". *European Journal of Medical Research* 9.8 (2004): 400-4004.

9. Reifsnider E., *et al.* "Childhood obesity and early childhood caries in WIC population". *Journal of Multicultural Nursing and Health* 10.2 (2004): 24-31.

10. Anwar S., *et al.* "Body mass index and dental caries". *Journal of Khyber College of Dentistry* 3.2 (2013): 30-33.

11. Gerdin EW., *et al.* "Dental caries and body mass index by socio-economic status in Swedish children". *Community Dentistry and Oral Epidemiology* 36.5 (2008): 459-465.

12. Vania A., *et al.* "Early childhood caries underweight or overweight, that is the question". *European Journal of Paediatric Dentistry* 12.4 (2011): 231-235.

13. Kopycka-Kedzierawski DT., *et al.* "Caries status and overweight in 2- to 18-year-old US children: findings from national surveys". *Community Dentistry and Oral Epidemiology* 36.2 (2008): 157-167.

14. General Authority for Statistics. Demographic Survey (2016).

15. [WHO] World Health Organization. "Oral health surveys: basic methods. fifth edition". World Health Organization (2013).

16. Kuczmarski RJ. "2000 CDC growth charts for the United States: methods and development". Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics (2002).

17. [CDC] Centers for Disease Control and Prevention. BMI for Children and Teens (2016).

18. Hooley M., *et al.* "Body mass index and dental caries in children and adolescents: a systematic review of literature published 2004 to 2011". *Systematic Reviews* 1.1 (2012a): 57.

19. Alghamdi AA and Almahdy A. "Association between dental caries and body mass index in schoolchildren aged between 14 and 16 years in Riyadh, Saudi Arabia". *Journal of Clinical Medicine Research* 9.12 (2017): 981-986.

20. Hooley M., *et al.* "The relationship between childhood weight, dental caries and eating practices in children aged 4-8 years in Australia, 2004-2008". *Pediatric Obesity* 7.6 (2012b): 461-470.

21. Subramaniam P and Singh D. "Association of age specific body mass index, dental caries and socioeconomic status of children and adolescents". *Journal of Clinical Pediatric Dentistry* 36.2 (2011): 175-179.

22. Chopra A., *et al.* "The predisposing factors between dental caries and deviations from normal weight". *North American Journal of Medicine and Science* 7.4 (2015) :151-159.

23. Tinanoff N and Palmer CA. "Dietary determinants of dental caries and dietary recommendations for preschool children". *Journal of Public Health Dentistry* 60.3 (2000): 197-206.

24. Bhayat A., *et al.* "Association between body mass index, diet and dental caries in Grade 6 boys in Medina, Saudi Arabia". *Eastern Mediterranean Health Journal* 22.9 (2016): 687-693.

25. Habibullah M., *et al.* "Caries prevalence and its association with body mass index in children aged 4 to 10 years in Al Dulaymiah Qassim region of Saudi Arabia - a pilot study". *International Journal of Dental Sciences and Research* 6.2 (2018): 29-32.

26. Ashour NA., *et al.* "Association between body mass index and dental caries among special care female children in Makkah City". *Annals of Saudi Medicine* 38.1 (2018): 28-35.

27. Narksawat K., *et al.* "Association between nutritional status and dental caries in permanent dentition among primary schoolchildren aged 12-14 years, Thailand". *Southeast Asian Journal of Tropical Medicine and Public Health* 40.2 (2009): 338-344.

28. Farsi DJ and Elkhodary HM. "The prevalence of overweight/obesity in high school adolescents in Jeddah and the association of obesity association with dental caries". *Annals of Saudi Medicine* 37.2 (2017): 114-121.

29. Farooqi F., *et al.* "Prevalence of dental caries in primary and permanent teeth and its relation with tooth brushing habits among schoolchildren in Eastern Saudi Arabia". *The Strategic Management Journal* 36.6 (2015): 737-742.

30. Alhabdan YA., *et al.* "Prevalence of dental caries and associated factors among primary school children: a population-based cross-sectional study in Riyadh, Saudi Arabia". *Environmental Health and Preventive Medicine* 23.1 (2018): 60.

31. Al-Khateeb TL., *et al.* "Dental caries in children residing in communities in Saudi Arabia with differing levels of natural fluoride in the drinking water". *Community Dental Health* 7.2 (1990): 165-171.

32. Masoud I. "Prevalence and distribution of caries in the primary dentition in a cosmopolitan Saudi population". *Saudi Dental Journal* 7.1 (1995): 23-28.

33. Alamoudi N., *et al.* "Caries experience of children aged 6-9 years in Jeddah". *Saudi Arabia* 6.2 (1996): 101-105.

34. Gandeh MB and Milaat WA. "Dental caries among schoolchildren: report of a health education campaign in Jeddah, Saudi Arabia". *EMHJ-Eastern Mediterranean Health Journal* 6.2-3 (2000): 396-401.

35. Al Agili DE., *et al.* "Prevalence and socioeconomic determinants of dental sealant use among schoolchildren in Saudi Arabia". *Eastern Mediterranean Health Journal* 18.12 (2012): 1209-1216.

36. Qutob A. "A needs-based approach for health human resources planning for dentistry in Jeddah, Saudi Arabia". *University of Toronto* (2009).

37. Farsi N. "Developmental enamel defects and their association with dental caries in preschoolers in Jeddah, Saudi Arabia". *Oral Health and Preventive Dentistry* 8.1 (2010): 85-92.

38. Marshall TA., *et al.* "Dental caries and childhood obesity: roles of diet and socioeconomic status". *Community Dentistry and Oral Epidemiology* 35.6 (2007): 449-458.

39. Sheiham A and James WP. "Diet and dental caries: the pivotal role of free sugars reemphasized". *Journal of Dental Research* 94.10 (2015): 1341-1347.

40. Walsh T., *et al.* "Fluoride toothpastes of different concentrations for preventing dental caries". *Cochrane Database of Systematic Reviews* (2019).

Volume 19 Issue 9 September 2020