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Oral hygiene practices, dental knowledge, dietary habits and their relation to caries among male primary school children in Al Hassa, Saudi Arabia

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Abstract: *Objectives:* To assess the frequency of consumption of cariogenic foods, oral hygiene practices and dental health knowledge among Saudi male primary school children in relation to socio-demographics and to find the possible predictors for dental caries among them. *Subjects and methods:* The cross-sectional descriptive study included 1115 Saudi male selected by multistage random sample from 18 public primary schools. Subjects were interviewed by closed ended questionnaire gathering data regarding frequency consumption of some cariogenic foods, oral hygiene practices and dental health knowledge. Students were submitted to dental screening to detect the clinically evident caries lesion. *Results:* The clinically decayed tooth was diagnosed in 68.9% of the included children, more in urban and younger students. Caries affected the subjects consumed cariogenic foods at greater frequency compared with caries-free children. Only 24.5% of the students brushing their teeth twice or more per day, and 29% of them never received instructions regarding oral hygiene practices. Miswak as an alternative and/or additional method of dental cleaning was used by 44.6%. Stepwise logistic regression analysis revealed that maternal working conditions, large family size and poor oral hygiene practices were the chief predictors for dental caries among the included school children. *Conclusion:* The poor oral hygiene practices, lack of parental guidance and appropriate dental health knowledge with frequent exposure to cariogenic foods in addition to socio-demographics are the main risk factors for dental decay among the surveyed students.

Key words: dental caries; dental knowledge; dietary habits; oral hygiene practice; Saudi Arabia; school children

Introduction

Over the past two decades, many developed countries have experienced dramatic decline in dental caries prevalence among children and adolescents (1). The reasons for this improvement are complex but involve lowering in sugar consumption, improved oral hygiene, the use of fluoridated toothpaste, effective utilization of oral health services and establishment of school-based preventive programmes (2). These significant improvements are coupled with increase in oral health awareness, dental knowledge and attitudes of both children and parents (3).

On the contrary, the prevalence and severity of dental caries have been increasing in several developing countries, especially in those countries where preventive programmes have not been implemented (4).

Oral diseases, including caries, are major health problems (2). Their impact on individuals and communities in terms of pain and suffering, functional impairments and reduced quality of life are considerable (5), and they are the fourth most expensive to treat in most industrialized countries (1). In many low income countries, the treatment of dental caries in children alone would exceed the total child healthcare budget (5).

In Saudi Arabia, the dental health services are provided through the Ministry of Health, the biggest provider of health care '186 of the country's 314 hospitals and 1756 health centres and dispensaries'. Each region has a dental clinic that act as a referral centre for the dental clinics attached to the health centres and hospitals (6). Additionally, the Ministry of Education provides both preventive and curative primary care through school clinics (740 clinics) incorporating dental services with referral to the secondary level of care (7). Other government sectors include the health facilities of military, National Guard, universities, large multinational corporations such as Aramco Oil Company and specialist hospitals.

Despite the previously mentioned extensive and free of charge network of dental health services; dental caries is considered as a major public health problem among children in Saudi Arabia (8–12). Previous studies have shown high prevalence of caries in both preschool and school-aged children (8–15). In one study in Riyadh, the prevalence of caries among 6-year-old children was 77.7% in their primary teeth (13), 14 years later; another study demonstrated a prevalence of 94.4% among similar age group (12).

Caries prevalence of 96% among primary school children attending military schools was reported in the Western province (9), in Jeddah (8) caries prevalence of 83% was also reported among the included primary school children, while in Riyadh, only 3% of the included primary school children were caries free (10).

Studies defining the roles of exposure to cariogenic foods, oral hygiene practices, and dental knowledge and their relation to dental caries among school children in Saudi Arabia are scarce (13, 14) and little is known about these factors compared with data obtained from developed countries (1, 3). Such knowledge is an indication of the efficiency of the applied dental health education programmes and the preventive school health services in general (2, 16). This study provides baseline information for future comparison regarding possible factors that underlie the high prevalence of caries among primary school children in Al-Hassa, Saudi Arabia. Consequently, the objectives of this study were to assess the frequency consumption of cariogenic foods, oral hygiene practices and dental knowledge among Saudi male primary school children in relation to socio-demographic differentials and to find the possible predictors for dental caries among them.

Population and methods

Setting

The study was carried out in Al-Hassa Governorate located in the Eastern province of Saudi Arabia. The total number of public primary schools was 134 distributed as follows: 22 Hegar 'Bedouin scattered communities', 74 urban and 38 rural. The total students enrolled in these schools were about 398 400 as registered in year 2006 according to the local Directorate of Education. The number of students enrolled in the fifth and sixth grades mounted to 11 584 students.

Those in Hegar were excluded for the sake of convenience in the transportation process. The schools in the urban areas were located mainly in Hofuf and Mubraz, while those in the rural areas were located in the Northern and Eastern villages.

Study design and sampling

In this cross-sectional descriptive study, a total estimated sample size would be 814 subjects, assuming the expected frequency of caries among this age group (total population of 11 584) of 60% (8) with a 95% confidence and 80% power. To overcome the sampling error of using cluster sampling, a 30% was added, with a total sample size of 1058.

An updated list of all public primary schools in Al-Hassa was used as the sampling frame. Each school received a number and 18 schools were randomly selected 'eight rural and 10 urban'. A proportionate sampling was applied as

regard the urban/rural distribution using appropriate sampling fraction.

It was not allowed for male investigators to access female students according to Saudi community traditions, in addition, there were no female investigators to be recruited during conduction of the study at our institution.

Data collection tools and techniques

The study was carried out during the period from January to May 2007; selected students were subjected to:

Data collection using structured questionnaires

Field pretest involved 185 primary school children of the same grades beyond the sample size using the nearby primary schools for proper phrasing, sequencing and conduction of data collection tools; two forms were used.

1 The first one used to gather data regarding socio-demographic variables: current residence, age in years, parental educational and occupational status and family size. These formats were sent to guardians at home to complete.

2 Personal interview with closed ended questionnaire form: the questionnaire items evolved after careful review of literature that handing similar domains (9, 10, 13, 14) regarding:

- Dietary habits: inquires regarding frequency of consumption of potentially cariogenic food items during the previous week of the interview 'carbonated soft drinks and other sugar drinks, candy/sweets, chewing gums, chocolate, doughnuts, biscuits and similar foods'. Scoring was assigned to each frequency using a scale of five points 'never or rarely' and zero for several frequency/day, with a total score of 30.
- The practiced oral hygiene habits 'rinsing of mouth after meals (1 = yes, 0 = no), having a personal tooth brush (1 = yes, 0 = no), usage and frequency of tooth brush and tooth paste (rarely = 0, once/week = 1, once/day = 2, twice a day = 3 and greater than twice/day = 4), other methods of tooth cleaning and whether received instructions and supervision at home for oral hygiene practice (1 = yes, 0 = no) with a total score of eight for this category.
- The final part of the questionnaire dealt with assessing the dental health knowledge in (yes, no, do not know format) role of rinsing of mouth following meals in aiding caries prevention, presence and the role of bacteria in dental caries, excessive consumption of sugary foods and their role in dental caries development, using sharp objects in tooth cleaning and its role in gum damage, necessity of visiting dentist for periodic follow up for sound oral health and periodic tooth brush change. Correct replies received score of one while no and do not know responses received nil with a total score of 12.

Questionnaire reliability analysis

The total inter-item reliability of the structured questionnaire included the 17 items by using alpha coefficient yielded a content reliability score of 0.79, while for the dietary habits it was low (0.68), practiced hygiene practice (0.70) and for dental knowledge (0.78). The results of pilot testing revealed a very low coefficient for the dietary domain, which required elimination of some questions related to the detailed eating practice in the form of portions consumed.

Screening for dental caries

Following interview, the screening for dental caries was conducted using simple dental examination in the classroom setting using the World Health Organization (WHO) diagnostic criteria for oral health survey (17). The examination was conducted by certified single male dentist to avoid possible inter-rater variability; the number of clinically decayed teeth was recorded. The decayed, missing and filled (DMF) index was not used, as it was not expected to find missing and filled teeth in large numbers among these age groups (6) and previous studies in Saudi children have reported decay as the major component of dmf/DMF score (8–10, 13).

In addition, the practical difficulty in assessing other components as the examination was carried out in the classrooms or computer laboratories that forced us to limit the assessment process to the presence or absence of cavitations. Moreover, the study's objective was not to estimate the prevalence of caries but to classify the included children regarding the outcome dependent variable 'caries'.

Data management and processing

For data validity, 69 subjects were excluded because of low or missing responses related to socio-demographic forms compiled by the student's guardians 'those who were excluded from analysis composed of 38 students with cavitations, enrolled in urban schools and within the age group of 12–14 years'.

Data entry and processing was carried out using SPSS version 12 software (Chicago, IL, USA). Both descriptive and inferential data analyses were generated using the appropriate statistical tests of significance 'chi-square, *t*-test and Mann–Whitney test for the included scores'. Stepwise logistic regression

'Forward method' was generated to determine the possible predictors that may be associated with caries by inclusion of significant independent variables revealed by univariate analysis against the dependent variable 'caries'.

For performing multivariate analysis, scores obtained were categorized into dichotomy. The 75th percentile score of each category included in the questionnaire was used to classify the included students as follow: dietary habits; score of ≥20 were of higher risk, oral hygiene practices; score of ≥6 were considered sound practices and a score of ≥8 to asses dental health knowledge was considered 'good'. Confidence interval of 95% and $P < 0.05$ were considered valid and convenient.

Ethical considerations

Permission was obtained from the local School Health and Education Directorate authorities. Prior orientation of the teaching and administrative school staff was carried out. Before commencing the procedures of interviewing and dental screening, a brief orientation of students was carried out.

Results

The study included 1115 Saudi male primary school children with age ranged from 10 to 14 years 'mean 11.91 ± 1.0', urban/rural ratio of 1.6:1, 37.5% were in the fifth grade and 62.5% in the sixth grade.

Decayed teeth were clinically evident in 68.9%. Dental lesions were significantly higher among urban school children [Odds ratio (OR) = 1.4, $P = 0.001$], and younger students (<12 years, OR = 2.2) compared with other age categories included.

Dental caries were significantly higher among students with low parental educational status, high maternal illiteracy (OR of 1.7), and clustering of paternal education below secondary level. Students with dental lesions had less working mothers and were belonged to big-sized families (>6 persons per family) ($P = 0.001$) (Table 1).

Self-reported cariogenic food consumption in the previous week before the interview revealed that caries affected children were significantly consuming sweets/candy, carbonated soft drinks, cakes, cookies, and other packaged food, juices

Table 1. **Dental caries distribution according to socio-demographic variables of surveyed subjects**

Socio-demographics	Results of dental screening		
	Total no. (%)	Caries no. (%)	Univariate analysis OR (95% CI)
Overall	1115 (100.0)	768 (68.9)	
Residence			
Urban	683 (61.3)	489 (71.6)	1.4 (1.1–1.8)**
Rural	432 (38.7)	279 (64.6)	1 (ref)
Grade:			
5th grade	418 (37.5)	271 64.8)	0.9 (0.8–1.1)
6th grade	697 (62.5)	497 (71.3)	1 (ref)
Age groups			
10 to <12 years	373 (33.5)	296 (79.4)	2.2 (1.6–3.0)**
12 to <14 years	685 (61.4)	457 (66.7)	0.8 (0.6–1.1)
14 years	57 (5.1)	15 (26.3)	1 (ref)
Mother education			
Illiterate/read and write	353 (31.7)	264 (74.8)	1.7 (1.3–2.2)
Primary/preparatory	250 (22.4)	169 (67.6)	0.9 (0.7–1.3)
Secondary	247 (22.1)	157 (63.6)	0.7 (0.5–1.0)
University/higher	265 (23.8)	178 (67.2)	1 (ref)
Father education			
Illiterate/read and write	214 (19.2)	153 (71.5)	1.2 (0.8–1.6)
Primary/preparatory	256 (23.0)	192 (75.0)	1.7 (1.1–2.1)*
Secondary	277 (24.8)	176 (63.5)	0.7 (0.5–1.0)
University/higher	368 (33.0)	247 (67.1)	1 (ref)
Mother occupation			
Working	241 (21.6)	139 (57.7)	0.5 (0.4–0.7)**
Housewife	874 (78.4)	629 (72.0)	1 (ref)
Family size			
≤6/family	421 (37.8)	263 (62.5)	0.6 (0.5–0.8)**
>6/family	694 (62.2)	505 (72.8)	1 (ref)

OR, odds ratio; CI, confidence intervals; ref = reference group.
*$P < 0.05$.
**$P < 0.001$.

and other drinks and chewing gum at higher frequency compared with the caries-free subjects.

The total dietary scores were significantly higher among the caries-free subjects with subsequent lower exposure to the included potentially cariogenic foods ($P = 0.010$). Frequency consumption data revealed that 65.6% of students with caries were in the high risk '<75th percentile' with higher exposure to cariogenic foods compared with 29.1% among caries-free children (Table 2).

The oral hygiene practices about 53% of the included children stated 'none or irregular' rinsing of mouth after each meals as a method for oral cleaning. This practice was significantly lower among those affected with caries (57.8%) compared with caries-free children (31.2%) (OR = 2.8).

Those reporting tooth brushing with frequency of twice or more/day mounted to only 24.5% of the total students, significantly more among the caries-free students (44.4% versus 15.5% with caries, $P = 0.001$).

Also, 29.2% of them reported as being never received home-based guidance and/or instructions regarding oral hygiene practices in the form of tooth brushing; more among the caries-affected children (34.2% versus 18.2% of caries free).

Miswak as an alternative and/or additional method for dental hygiene was reported in 44.9% of the included subjects, higher among those affected with caries. The practice scores were significantly higher among the caries-free children; as 91 (26.2%) of them scored ≥75th percentile compared with only 89 (11.6%) among the caries affected children (Table 3).

Table 2. **Reported frequency of consumption some cariogenic food items 1 week before the interview among the surveyed subjects**

Food items frequency	Dental caries: Present ($n = 768$) no. (%)	Dental caries: Free ($n = 347$) no. (%)	Total ($n = 1115$) no. (%)	Univariate analysis odds ratio (95% CI)
Sweets/candy				
<Twice/week	397 (51.7)	238 (68.6)	635 (56.9)	0.5 (0.4–0.7)**
3–6 times/week	198 (25.7)	76 (21.9)	274 (24.6)	1.2 (0.9–1.7)
Daily or several/day	173 (22.5)	33 (9.5)	206 (14.5)	1 (ref)
Carbonated drinks				
<Twice/week	278 (36.2)	176 (50.7)	454 (40.6)	0.6 (0.4–07)**
3–6 times/week	156 20.3)	52 (15.0)	208 (18.7)	1.5 (1.1–2.1)**
Daily or several/day	334 (43.5)	119 (34.3)	453 (40.6)	1 (ref)
Cakes/cookies/doughnuts				
<Twice/week	482 (62.8)	248 (71.5)	730 (65.5)	0.7 (0.5–0.9)*
3–6 times/week	149 (19.4)	60 (17.3)	209 (18.7)	1.1 (0.8–1.6)
Daily or several/day	137 (17.8)	39 (11.2)	176 (15.8)	1 (ref)
Ice cream/alike				
<Twice/week	617 (80.3)	275 (79.2)	892 (80.0)	1.1 (0.8–1.5)
3–6 times/week	72 (9.4)	35 (10.1)	107 (9.6)	0.9 (0.6–1.4)
Daily or several/day	79 (10.3)	37 (10.7)	116 (10.4)	1 (ref)
Juices and other drinks				
<Twice/week	585 (76.2)	281 (81.0)	866 (77.7)	0.8 (0.5–1.0)
3–6 times/week	60 (7.8)	33 (9.5)	93 (8.3)	0.8 (0.5–1.3)
Daily or several/day	123 (16.0)	33 (9.5)	156 (14.0)	1 (ref)
Chewing gums				
<Twice/week	640 (83.3)	303 (87.3)	956 (85.7)	0.7 (0.5–1.1)
3–6 times/week	44 (5.7)	21 (6.1)	65 (5.9)	0.9 (0.5–1.7)
Daily or several/day	84 (11.0)	23 (6.6)	94 (8.4)	1 (ref)
Chocolate				
<Twice/week	653 (85.0)	281 (81.0)	934 (83.8)	1.3 (0.9–1.9)
3–6 times/week	82 (10.7)	50 (14.4)	132 (11.8)	0.7 (0.8–1.1)
Daily or several/day	33 (4.3)	16 (4.6)	49 (4.4)	1 (ref)
Total dietary score	19.6 ± 2.5	22.7 ± 3.6	19.75 ± 3.61	$P = 0.010$*,†
Categories				
High risk	504 (65.6)	101 (29.1)	605 (54.3)	4.7 (3.5–6.2)**
Low risk	264 (34.4)	246 (70.9)	510 (45.7)	1 (ref)

CI, confidence intervals; ref = reference group.
*$P < 0.05$.
**$P < 0.001$.
†Mann–Whitney test of significance.

Table 3. **Stated oral hygiene practices of the included school children**

Stated dental hygienic practices	Dental caries			
	Present (n = 768) no. (%)	Free (n = 347) no. (%)	Total (n = 1115) No. (%)	Univariate analysis OR (95% CI)
Having a personal tooth brush				
Yes	502 (65.4)	256 (73.8)	758 (68.0)	0.7 (0.5–0.9)**
No	266 (34.6)	91 (26.2)	357 (32.0)	1 (ref)
Rinsing the mouth after meals				
No/Sometimes	443 (57.7)	143 (41.2)	586 (52.6)	2.8 (1.9–4.1)**
Always	324 (42.2)	204 (58.8)	528 (47.4)	1 (ref)
Usage of tooth brush for cleaning				
≤once/week	440 (57.3)	105 (30.3)	545 (48.9)	3.1 (2.3–4.1)**
Once/day	209 (27.2)	88 (24.4)	297 (26.6)	1.4 (0.8–1.5)
Twice or more/day	119 (15.5)	154 (44.4)	273 (24.5)	1 (ref)
Receiving instructions on oral hygiene				
Yes	505 (65.8)	284 (81.8)	789 (70.8)	0.5 (0.4–0.7)**
No	263 (34.2)	63 (18.2)	326 (29.2)	1 (ref)
Who gave these instructions*				
Father	95 (12.4)	69 (19.9)	164 (20.8)	0.6 (0.4–0.8)**
Mother	236 (30.7)	119 (34.3)	355 (45.0)	0.9 (0.6–1.1)
Elder sibling	58 (7.6)	23 (6.6)	81 (10.3)	1.5 (0.8–2.5)
Both parents	74 (9.6)	64 (18.4)	138 (17.5)	0.5 (0.3–0.7)**
Parents and elder sibilings	20 (2.6)	8 (2.3)	10 (1.3)	1.1 (0.5–2.8)
Parents and Relatives	9 (1.2)	1 (0.3)	13 (1.6)	4.1 (0.5–86.8)
Dentists	13 (1.7)	–	13 (1.6)	–
None	263 (34.2)	63 (18.2)	326 (29.2)	1 (ref)
Methods other than tooth brushing for cleaning:*				
Miswak	371 (48.3)	126 (36.3)	497 (44.6)	1.6 (1.3–2.2)**
Needles/pins	31 (4.0)	13 (3.7)	44 (3.9)	1.1 (0.5–2.2)
Pen/pencils	10 1.3)	5 (1.4)	15 (1.3)	0.9 (0.3–3.4)
Wooden stick	9 (1.2)	17 (4.9)	26 (2.3)	0.2 (0.1–0.6)**
Nothing	347 (45.2)	186 (53.6)	533 (47.8)	1 (ref)
Total oral hygine practices.	3.8 ± 1.3	4.1 ± 2.3	3.7 ± 1.8	P = 0.003**,†
Oral hygiene practice categories:				
Sound	89 (11.6)	91 (26.2)	180 (16.1)	0.4 (0.3–0.5**)
Poor	679 (88.4)	256 (73.8)	935 (83.9)	1 (ref)

OR, odds ratio; CI, confidence intervals; ref = reference group.
*Categories are not mutually exclusive.
†Mann–Whitney test of significance.
**P < 0.001.

Responses of dental health knowledge revealed that caries-free children were more knowledgeable compared with those with caries as revealed by the total knowledge scores which were higher among the caries-free students (P = 0.001). About 48% of the caries-free subjects have an overall oral health knowledge scores of ≥75th percentile compared to 38.7% in the caries affected group (Table 4).

The final model of stepwise regression analysis using the forward method with the inclusion of independent variables that were significant at univariate analysis revealed that maternal occupational status (none working mothers), big family size and poor oral hygiene practices were the important predictors for the development of dental caries among the included children. Poor dental health knowledge and excessive exposure to cariogenic foods although they were significant in univariate analysis, they were not included in any of the regression models (Table 5). Also, young age and parental educational status were not revealed in the final model as predictors for the occurrence of caries among our sample.

Discussion

Epidemiological studies of dental caries in school children are numerous, however; many of these studies only analyse caries prevalence rates or through using the defined ratios in the bibliography (DMFT, dmft) (18). Dental caries is a disease in which cultural, hygienic habits are decisive, and the prevalence is highly linked to these factors (19). Determining these factors is of great importance as they demonstrated temporal and geographic stability and as a tool to tailor proper health

Table 4. **Subject responses regarding oral health knowledge distributed in relation to diagnosis of caries**

	Dental caries		
Knowledge items	Absent (n = 347) correct responses no. (%)	Present (n = 768) correct responses no. (%)	P-value
Rinsing of mouth after meals aids in caries prevention	326 (93.9)	691 (90.0)	0.051
Bacteria always present in our mouth	212 (61.1)	413 (53.8)	0.016*
Bacteria are responsible for dental caries	216 (2.2)	419 (54.6)	0.001*
Excessive sugar and candy can cause dental caries	267 (76.9)	464 (60.4)	0.001*
Tooth brushing prevents caries	284 (81.8)	501 (65.2)	0.001*
Sharp objects can damage our gums	284 (81.8)	651 (84.8)	0.219
Visiting a dentist every 6 months is essential for oral health	198 (57.1)	463 (60.3)	0.316
Tooth brush should be changed regularly	181 (52.2)	361 (47.0)	0.074
Total knowledge score	10.4 ± 1.5	9.6 ± 0.3	0.001*,†
Knowledge categories	No. (%)	No. (%)	OR (95% CI)‡
Knowledgeable	168 (48.4)	297 (38.7)	0.7 (0.5–0.9)*
Less	179 (51.6)	471 (61.3)	1 (ref)

*$P < 0.05$.
†Mann–Whitney test of significance.
‡Univariate analysis: OR, odds ratio; CI, confidence intervals; ref = reference group.

Table 5. **Stepwise logistic regression models 'Forward method' between dental caries and significant independent variables revealed by univariate analysis**

Models and predictors	β-coefficient	Odds ratio (95% confidence intervals)	P-value*	% Predicted	Model chi-square	Model P-value*
Model 1						
Sound hygiene practices†	–0.215	0.81 (0.73–0.90)	0.000	18.644	68.4	0.033
Constant	1.162	3.198	0.000			
Model 2						
Family size (≤6 per family)‡	–0.313	0.73 (0.56–0.96)	0.006	68.6	23.588	0.020
Sound hygiene practices!	–0.205	0.82 (0.74–0.89)	0.016			
Constant	1.270	3.559	0.000			
Model 3						
Father education (<secondary)§	0.713	2.04 (1.29–3.31)	0.004			
Family size (≤6 per family)	–0.343	0.71 (0.54–0.94)	0.017	68.9	35.983	0.020
Sound hygiene practices!	–0.210	0.81 (0.73–0.89)	0.026			
Constant	0.673	1.961	0.008			
Model 4						
Age (<12 years)¶	0.711	2.26 (1.10–4.67)	0.010	69.7	40.881	0.017
Maternal work (working)**	–0.380	0.68 (0.49–0.97)	0.026			
Family size (≤per family)	–0.331	0.72 (0.54–0.95)	0.022			
Sound hygiene practices!	–0.214	0.81 (0.73–0.89)	0.030			
Constant	0.773	2.165	0.003			
Final model						
Maternal work (working)	–0.664	0.52 (0.35–0.76)	0.000	71.7	50.146	0.002
Family size (≤6 per family)	–0.415	0.66 (0.49–0.88)	0.005			
Sound hygiene practices!	–0.213	0.81 (0.73–0.90)	0.018			
Constant	1.174	3.235	0.000			

*Significant at $P < 0.05$.
Reference groups include:
†Poor oral hygiene practices.
‡Family size > 6.
§Father educational status (secondary or higher).
¶Age of the student (>12 years).
**Maternal occupational status (none working).

education campaigns to combat oral health problems especially among those who are in need (20). Studies carried out in Saudi Arabia have demonstrated that caries represents a particular problem amongst children (8–14).

The results of this study are consistent to other studies reporting that dental caries among Saudi children is high and several factors are suspected to be responsible for that increase. These factors include unhealthy dietary patterns, poor dental practices and service shortage coupled with pain-oriented health-seeking behaviour among populations of the developing countries (8, 11, 16).

Additionally, in many Arab countries, caries prevalence is increasing because of the recent economic growth with subsequent increase in consumption of refined sugars compared with the rest of the developing countries, especially African (19).

Also, the results of this study revealed that students with caries consumed cariogenic food at greater frequency compared with their caries-free peers. This is consistent with the results obtained from other cross-sectional studies (13, 14), which reported an association between poor oral hygiene habits and frequent sugar intake in Saudi children and caries prevalence. The main differences between our results and the previously mentioned were they either reporting sugar consumption in younger age group (14) or applying another methodological approach in quantifying the sugar consumption among 12- to 13-year-old children through inquiring of parents (13).

Studies carried out in other developing countries reported similar results; a study carried out in China on 12- to 18-year-old school students reported that about half of caries-affected participants had sweets every day (20). Another study in the Philippines using the food frequency and 24 h recall among 12 years school children reported that the sugar intake was three times more than WHO recommendations (21).

Reports have shown that a small percentage of variation in caries may be explained by dietary components since the introduction and the use of fluoridated toothpaste provide a dramatic decline in caries prevalence (22, 23), and the relation between sugars and dental caries is difficult to quantify because of inherent limitations of data collection methods used, and the oral hygiene practices were found to be the dominant variable explaining the major proportions of caries development (23, 24).

The previous statement is consistent with our findings, as faulty dietary habits prevalent among caries affected children as revealed by univariate analysis were not found as predictors to dental caries in any of the models generated by stepwise logistic regression.

The present study showed that only 24.5% of surveyed children brushing their teeth twice or more per day, which is low, compared with other developed countries (1) and developing countries like China (20) and Jordan (18). Daily tooth brushing behaviours and age when brushing started with parental supervision have been reported by several studies as strong predictors to caries prevention (16, 25, 26).

Another finding revealed by this study is the lack of proper guidance and instructions in relation to oral hygiene practices as one-third of those with caries claimed of never received any guidance and instructions at their homes. This figure is low compared with similar study from China where nearly half of the included sample claimed of never received any oral health instructions (20).

In addition to tooth brushing practice, rinsing of the mouth after meals with water as a method of cleaning was stated in 47.4% of our sample, which is lower than those reported in Chinese children, where 73.3% of the sample reported regular rinsing of mouth with water after meals (20).

Among our sample, 44.6% reported using Miswak 'the chewing stick' for tooth cleaning. Several studies have reported the widespread use of Miswak in Saudi Arabia as an alternative or additional method of dental cleaning. In a study included 3117 subjects of ≥15 years old, in 10 region of Saudi Arabia; 50% were reported to use Miswak (26, 27), while another study in other regions reported that 75% of the male and 66% of female populations used Miswak regularly (27).

In many circumstances the use of Miswak may hinder the necessity for tooth brushing practices among Saudi population (26). The previous statement explains the link between usage of Miswak and high OR for caries among our sample.

This study revealed that oral health knowledge scores were more among those who were caries free, but this relation was not revealed in the logistic regression model as a predictor against caries development, similar results were reported in other studies carried out on primary school children in Saudi Arabia (28), India (29) and Mexico (18).

Also, our results are consistent with those reporting that among Saudi children, oral hygiene routines are introduced relatively late in life and oral health knowledge and awareness is low and correlated with educational level of the parents (30).

This study demonstrated that sound oral health practices mainly in the form of tooth brushing coupled with parental guidance and instruction are main predictors against the development of caries as revealed in both univariate and multivariate analysis.

This in agreement with other studies using multivariate regression analysis in order to control for the possible effect of

socio-economic status, and revealed that low decayed and missing teeth scores were found in adults when respondent had preventive dental care habits (16, 31).

Urban residence, low parental educational status especially maternal, parental occupational categories and high number of children per family (26–30, 32), were all reported to be associated with high caries prevalence. These are consistent with our results revealed in stepwise regression final model. Of particular interest, those children belonged to working mother were less caries prone. This could be explained by the fact that in Saudi Arabia working mother are usually highly educated where the letter might be a proxy to sound oral health knowledge and practices that influence oral health status of their children.

The results of our study are in accordance with previous studies which reported that risk factors which would make an individual more caries prone are many, including poor oral hygiene habits, dietary habits which are considered as strong predictors for the development of new caries, in addition to demographic factors, which a clinician can often overlook, could also play a role in caries predictability (33).

Conclusions

Poor oral hygiene practices, lack of parental guidance, socio-demographics together with the lack of appropriate dental health knowledge and frequent exposure to cariogenic foods are the main risk factors for dental decay among the surveyed students.

Recommendations

- Schools can provide a supportive environment for promoting oral health by provision of guidelines for the recommended hygiene practices, inclusion of essential oral health knowledge within the educational curricula and control of risky behaviours, such as intake of sugary foods and drinks.
- Schools can also provide a platform for the provision of both preventive and curative oral healthcare services.
- Health education messages targeting the parents to raise their awareness regarding dental knowledge and sound hygiene practices should be planned and implemented.

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