EFFECT OF ORAL HYGIENE PRACTICES ON DENTAL CARIES RISK FACTORS AMONG ADOLESCENTS

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ABSTRACT

Oral hygiene practice is known for its significant importance in lowering dental caries risk. To assess the risk factors affecting dental caries, including gender and oral hygiene practices such as regular tooth brushing, use of fluoridated toothpaste, and use of mouthwash. This comparative cross-sectional study included 300 participants visiting a dental clinic in Jeddah, Saudi Arabia. A questionnaire was used to assess demographic data and oral hygiene habits. Tests were conducted to measure salivary secretion rates, buffering capacities, lactobacilli levels, *Streptococcus mutans* (MS) counts, plaque indices, and erosion scores. Gender was associated with buffering capacity, MS count, plaque index, and erosion scores. High buffering capacity and MS counts were significantly more common among boys than girls. Moreover, the mean plaque index was higher among boys than girls. Regular tooth brushing and mouthwash use were associated with salivary secretion rates. High lactobacilli were more common among those using non-fluoridated toothpaste than those using fluoridated toothpaste. Oral hygiene habits can affect dental caries risk and therefore recommendations are to implement oral hygiene health education programs to reduce dental caries rates in adolescents.

Key words: Dental caries, Dental caries risk factors, Oral hygiene, Saudi Arabia.

Introduction

Dental caries involve the progressive breakdown of tooth enamel. This is partly due to bacteria present on teeth, which metabolize fermentable carbohydrates and produce an acidic medium that causes tooth decay [1-3]. Although tooth decay is preventable, it is still the most common chronic disease among children and adolescents. It is four times more common than bronchial asthma among those aged 12–19 years [4]. Dental caries prevalence was 45.8% and 13% in primary and permanent teeth respectively among youth aged 2-19 years [5]. Moreover, according to the global burden of disease 2017, untreated tooth decay in permanent teeth is the commonest health condition [6]. Dental treatment is very expensive even in high income countries, representing 5% of total health expenditure and 20% of out of pocket health expenditure [7]. Current guidelines for the management of tooth decay include the reduction of cariogenic bacterial agents, remineralization of lesions, and the use of restorative treatments. There has been a recent shift in caries management from a purely surgical approach to more preventive approaches [8]. Many factors affect caries development of resistance, such as socioeconomic status, dietary patterns, and lifestyle choices [9]. Dental caries are largely attributed to unhealthy behaviors, such as poor diet and inadequate oral hygiene [10].

Proper oral hygiene helps to preserve dental health, which affects systemic health and quality of life [11]. Poor oral hygiene is the main predictor of tooth decay among schoolchildren [12]. Furthermore, oral hygiene status plays a key role in the prevalence of dental caries among schoolchildren aged 12 years [13]. If children acquire *Streptococcus mutans* (MS) during their formative years, there is a high chance they will develop dental caries; however, this can be partially prevented by effective oral hygiene and a non-cariogenic diet. These measures help to control plaque, which can compensate for early bacterial exposure and ultimately limit caries development [14]. In addition, caries development was associated with older age, the proportion of teeth with visible plaque, and the presence of MS [15]. There is a lack of research on the relationship between oral hygiene practices and dental caries among adolescents' years in Saudi Arabia. The aim was to assess the risk factors affecting dental caries, including gender and oral hygiene practices such as regular tooth brushing, use of fluoridated toothpaste, and use of mouthwash.

Materials and Methods

This comparative cross-sectional study included 300 adolescence aged 15-18 from a dental clinic in Jeddah, Saudi Arabia. An electronic database was performed using PubMed and Google Scholar to gather background information and data related to the research question and determine the knowledge gap. A questionnaire was used to assess demographic data and oral hygiene habits. In addition, tests were conducted to measure salivary secretion rates, buffering capacities, lactobacilli levels, MS counts, plaque indices, and erosion scores.

Buffer capacity was expressed as 1 for high, 2 for medium, and 3 for low, while MS count and lactobacilli were expressed as 1 for very low, 2 for low, 3 for medium, and 4 for high.

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS), version 25. Results were analyzed using the chi-square test, Monto Carlo test, Fisher exact test, and Student's t-test. All tests were two-tailed, and a p-value of <0.05 was considered statistically significant.

Results and Discussion

Of the 300 participants, 150 (50%) were girls. A total of 129 (43%) of their mothers had university or postgraduate education, while 191 (63.7%) of their fathers had university and postgraduate education **(Table 1)**.

Table 1. demographic characteristics of the sample (n=300)

	N (%)
Gender	
Boys	150 (50.0)
Girls	150 (50.0)
Age	

13 years	1 (.3)
14 years	75 (25.0)
15 years	224 (74.7)
What education does your mother have?	
University and postgraduate	129 (43.0)
Secondary and preparatory	50 (16.7)
Others	121 (40.3)
What education does your father have?	
University and postgraduate	191 (63.7)
Secondary and preparatory	21 (7.0)
Others	88 (29.3)

Note. All variables are summarized as numbers and percentages.

Regarding oral hygiene habits, twice-daily tooth brushing, fluoridated toothpaste use, regular mouthwash use, and bruxism were higher among girls than boys (58.7% vs. 29.3%, 70.7% vs. 28.2%, 55.3% vs. 39.9%, and 13.3% vs. 6.7%, respectively) and the differences were statistically significant (p<0.001, <0.001, 0.008, and <0.001 respectively). Biting on hard objects and clenching were more prevalent among boys than girls (45.3% vs. 34.7% and 18.7% vs. 5.3%, respectively) and the differences were statistically significant (p<0.001) **(Table 2)**.

Table 2. Oral Hygiene Habits according to gender

	Boys	girls	P-value
	N (%)	N (%)	
3. How often do you brush your teeth?			
Never	2 (1.3%)	0 (0.0%)	**<0.001[a]**
Once or a few times a week	21 (14.0%)	3 (2.0%)	
Once a day	62 (41.3%)	21 (14.0%)	
Twice a day	44 (29.3%)	88 (58.7%)	
More than twice a day	16 (10.7%)	33 (22.0%)	
Other	5 (3.3%)	5 (3.3%)	
6. Do you use any toothpaste while brushing?			
Yes	146 (97.3%)	139 (92.7%)	0.064[b]
No	4 (2.7%)	11 (7.3%)	
7. What kind of toothpaste do you use?			
Fluoridated	42 (28.2%)	106 (70.7%)	**<0.001[a]**
Non-fluoridated	5 (3.4%)	0 (0.0%)	
Do not know	102 (68.5%)	44 (29.3%)	
8.Do you use any mouthwash regularly?			
Yes	59 (39.9%)	83 (55.3%)	**0.008[b]**
No	89 (60.1%)	67 (44.7%)	
9. Do you have any of the following oral habits?			

Bruxism	10 (6.7%)	20 (13.3%)	**<0.001** [b]
Clenching	28 (18.7%)	8 (5.3%)	
Biting on a hard object	68 (5.3%)	52 (34.7%)	
Other	44 (29.3%)	70 (46.7%)	

Note. All variables are summarized as number and percentage
The test of significance was carried out at a 0.05 level
[a] Monto Carlo test was used
[b] Chi-Square test was used
Significant results are in bold

When comparing dental history between boys and girls, dental visit attendance was slightly higher among girls than boys (98% vs. 96%), with no significant difference (p=0.501), while 6-month dental visits were significantly higher among boys (p=0.013) **(Table 3)**.

Table 3. dental history according to gender

	boys	Girls	P-value
	N (%)	N (%)	
10. Have you ever been to a dentist?			
Yes	144 (96.0%)	147 (98.0%)	0.501[c]
No	6 (4.0%)	3 (2.0%)	
11. If yes, how often do you visit a dentist?			
Every 6 months	35 (23.3%)	23 (15.3%)	**0.013**[a]
Every year	3 (2.0%)	10 (6.7%)	
Irregularly	29 (19.3%)	19 (12.7%)	
Only when in pain	66 (44.0%)	66 (44.0%)	
Other	17 (11.3%)	30 (20.0%)	

Note. All variables are summarized as number and percentage
The test of significance was carried out at a 0.05 level
[a] Monto Carlo was used
[c] Fisher exact test was used
Significant results are in bold

Descriptive statistics for saliva secretion rate, buffering capacity, MS count, lactobacilli level, and plaque index among our sample are shown in **Table 4**.

Table 4. saliva secretion rate, Buffer capacity, MS count, Lactobacilli, and Plaque index descriptive statistics.

	Mean (SD)	Median
Saliva Secretion rate	1.48 (1.04)	1.30
Plaque index	4.00 (3.10)	4.00
	Percent	
Buffer capacity Blue(high) / green(medium) /yellow(low)	37%/35.7%/9%	
MS count very low/ low/medium /high	38%/22%/13%/27%	
Lactobacilli very low/ low/medium /high	34.7%/25.7%/26.3%/13.3%	

Note. All variables are summarized as mean, standard deviation, and median.
Buffer capacity (1 high- 2 medium- 3 low).
MS count and lactobacilli (1 very low- 2 low- 3 medium- 4 high).

High buffering capacity was more common among boys than girls (48% vs. 27%, respectively; p=0.001), while the median was equal in both girls and boys (2 i.e. medium). In addition, high MS count was more common among boys than girls (35% vs. 19%, respectively; p=<0.001). Plaque index was also higher among boys than girls (2.55 [1.21] vs. 2.03 [1.19] and 4.69 [3.49] vs. 3.31 [2.48] respectively), with significant differences (p<0.001 and p<0.001, respectively). In addition, the median of MS count and plaque index was also higher among boys than girls (2 vs. 1.5 and 5 vs. 3, respectively) **(Table 5)**.

Table 5. saliva secretion rate, Buffer capacity, MS count, Lactobacilli, Plaque index, and Erosion score according to gender.

	Mean (SD)	Median	P-value
Saliva Secretion rate			
Boys	1.59 (0.85)	1.50	0.073[a]
Girls	1.37 (1.20)	1.00	

	Plaque index		
Boys	4.69 (3.49)	5.00	**<0.001ᵃ**
Girls	3.31 (2.48)	3.00	
	Percent	**Median**	**P-value**
Buffer capacity			
Boys Blue(high) / green(medium) /yellow(low)	48%/44%/8%	2.00	**0.001ᵇ**
Girls Blue(high) / green(medium) /yellow(low)	27%/63%/10%	2.00	
MS count			
Boys very low/ low/medium /high	26%/28%/11%/35%	2.00	**<0.001ᵇ**
Girls very low/ low/medium /high	50%/16%/15%/19%	1.50	
Lactobacilli			
Boys very low/ low/medium /high	26%/28%/11%/35%	2.00	0.129ᵇ
Girls very low/ low/medium /high	35%/27%/21%/17%	2.00	

Note. All variables are summarized as mean, standard deviation, and median.
The test of significance was carried out at a 0.05 level
ᵃ Student T-test was used
ᵇ Chi-square test was used
Significant results are in bold
Buffer capacity (1 high- 2 medium- 3 low).
MS count and lactobacilli (1 very low- 2 low- 3 medium- 4 high)

The saliva secretion rate was higher among those who regularly brushed their teeth (1.52 [1.09] vs. 1.18 [0.56], respectively), and the difference was statistically significant (p=0.004). However, the other indices showed non-significant differences concerning tooth brushing frequency **(Table 6)**.

Table 6. saliva secretion rate, Buffer capacity, MS count, Lactobacilli, Plaque index, and Erosion score according to regular toothbrushing.

	Mean (SD)	Median	P-value
Saliva Secretion rate			
Regular toothbrushing	1.52 (1.09)	1.33	**0.004ᵃ**
Non regular toothbrushing	1.18 (0.56)	1.00	
Plaque index			
Regular tooth brushing	3.90 (3.00)	4.00	0.137ᵃ
Non-regular toothbrushing	4.72 (3.76)	4.50	

	Percent	**Median**	**P-value**
Buffer capacity			
Regular toothbrushing Blue(high) / green(medium) /yellow(low)	37%/53%/9%	2.00	0.743ᵇ
Non regular toothbrushing Blue(high) / green(medium) /yellow(low)	39%/56%/6%	2.00	
MS count			
Regular toothbrushing very low/ low/medium /high	38%/22%/13%/27%	2.00	0.945ᵇ
Non regular toothbrushing very low/ low/medium /high	36%/19%/14%/31%	2.00	
Lactobacilli			
Regular toothbrushing very low/ low/medium /high	35%/26%/26%/13%	2.00	0.920ᵇ
Non regular toothbrushing very low/ low/medium /high	33%/22%/31%/14%	2.00	

Note. All variables are summarized as mean, standard deviation, and median.
The test of significance was carried out at a 0.05 level
ᵃ Student T-test was used
ᵇ Chi-square test was used
Significant results are in bold
Buffer capacity (1 high- 2 medium- 3 low).
MS count and lactobacilli (1 very low- 2 low- 3 medium- 4 high).

High lactobacilli were more common among those using non-fluoridated toothpaste than those using fluoridated toothpaste (40% vs. 12%, respectively), and the difference was statistically significant (p=0.040). In addition, the median of lactobacilli was also higher among those using non-fluoridated toothpaste than those using fluoridated toothpaste (3 vs. 2). However, the other indices showed non-significant differences concerning fluoridated toothpaste use **(Table 7)**.

Table 7. saliva secretion rate, Buffer capacity, MS count, Lactobacilli, Plaque index, and Erosion score according to Using fluoridated toothpaste.

	Mean (SD)	Median	P-value
Saliva Secretion rate			
Using fluoridated toothpaste	1.45 (1.18)	1.00	0.540ᵃ
Using non fluoridated toothpaste	1.77 (0.37)	1.80	
Plaque index			
Using fluoridated toothpaste	3.57 (3.02)	3.00	0.082ᵃ
Using non fluoridated toothpaste	6.00 (4.18)	5.00	

	Percent	Median	P-value
Buffer capacity			
Using fluoridated toothpaste Blue(high) / green(medium) /yellow(low)	32%/55%/13%	2.00	0.220[b]
Using non fluoridated toothpaste Blue(high) / green(medium) /yellow(low)	20%/40%/40%	2.00	
MS count			
Using fluoridated toothpaste very low/ low/medium /high	43%/20%/10%/ 26%	2.00	0.684[b]
Using non fluoridated toothpaste very low/ low/medium /high	40%/40%/0%/2 0%	2.00	
Lactobacilli			
Using fluoridated toothpaste very low/ low/medium /high	35%/30%/22%/ 12%	2.00	**0.040[b]**
Using non fluoridated toothpaste very low/ low/medium /high	0%/20%/40%/4 0%	3.00	

Note. All variables are summarized as mean, standard deviation, and median.
The test of significance was carried out at a 0.05 level
[a] Student T-test was used
[b] Chi-square test was used
Significant results are in bold
Buffer capacity (1 high- 2 medium- 3 low).
MS count and lactobacilli (1 very low- 2 low- 3 medium- 4 high).

Saliva secretion rates were higher among those who did not report regular mouthwash use than those who did (1.62 [1.21] vs. 1.32 [0.8], respectively), and the difference was statistically significant (p=0.011). However, the other indices showed non-significant differences concerning regular mouthwash use.

Tooth decay is teeth damage causing cavities, abscesses and even tooth loss [16]. Oral health problems affect mainly the poor and low socioeconomic members in society [17]. This comparative cross-sectional study was conducted at a dental clinic and included 300 adolescents aged 15-18 years. We aimed to assess the risk factors for dental caries concerning oral hygiene practices.

Gender was significantly associated with buffering capacity, MS counts, and plaque indices while regular tooth brushing and mouthwash use were associated with salivary secretion rates. Lactobacilli levels were related to fluoridated toothpaste use.

In terms of gender, we found significant differences between boys and girls regarding twice-daily tooth brushing, fluoridated toothpaste use, regular mouthwash use, and bruxism, all of which were higher among girls than boys. Conversely, biting on hard objects and clenching was higher among boys than girls. Consequently, it can be concluded that girls are more committed to dental hygiene, possibly due to concerns about the appearance of their smile. This finding supports a study that reported that females had better dental knowledge and oral health practices than males [18]. In addition, another study concluded that men had a higher prevalence of dental caries [19]. In the present study, high buffering capacity and MS counts were more common among boys than girls. Moreover, the mean plaque index was higher among boys than girls. These findings support a previous study that reported a relationship between gender and dental caries [20].

We found that the saliva secretion rate was significantly higher among participants who regularly brushed their teeth. Inadequate brushing was considered as a risk factor for tooth decay as this causes rapid plaque formation [21]. Furthermore, in the current study, lactobacilli levels were significantly higher among those using non-fluoridated toothpaste. A study by Stecksén-Blicks & Gustafsson reported that fluoridated toothpaste use was associated with low dental caries and low mean lactobacilli, which is similar to our findings [22]. Not getting enough fluoride was also considered a risk factor for developing tooth caries as fluoride prevents cavities and can even reverse early tooth damage [23]. Furthermore, the saliva secretion rate was significantly higher among those who did not regularly use mouthwash. This finding is similar to that of a study that reported that mouthwash increases salivary flow [24].

This study verified risk factors affecting dental caries, including gender and oral hygiene practices like regular tooth brushing, fluoridated toothpaste use, and regular mouthwash use. Therefore, we highly recommend the implementation of oral hygiene health education programs, especially among adolescents and younger children.

The limitations of this study include bias introduced with self-report questionnaires and lack of clinical dental exams.

Conclusion

Better oral hygiene attitudes were found among girls. Gender was associated with buffering capacity, MS counts, and plaque indices. Regular tooth brushing and mouthwash use were associated with higher salivary secretion rates. Lactobacilli levels were affected by fluoridated toothpaste use, so we highly recommend more oral hygiene health education programs to educate adolescents on the importance of home dental care. There is a lack of research on the relationship between oral hygiene practices and dental caries among adolescents aged 15-18 years in Saudi

Arabia. Therefore, further studies are needed to assess oral health problems based on clinical examinations and comprehensive detailed interviews.

Ethics statement: This study was approved by the Research Ethics Committee of the Faculty of Dentistry #218-01-21. Parents granted consent on behalf of their children before data collection.

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