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The Relation Between Eating Habits, Oral Hygiene, Serum Calcium Level and Level of Dental Caries Among Young Adolescents

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ABSTRACT

Background: All over the world, increasing interest was directed to dental caries as one of the most prevalent oral diseases and the most important global oral health burdens among pupils. Eating habits and oral hygiene practices play a pivotal role in dental caries prevalence and management. **Objective (s) of study:** The main objective of this study was to highlight the relationship between dental caries level and eating habits of school adolescent pupils, in order to help healthcare providers develop appropriate program for dental caries prevention. However, some other risk factors were also studied. **Subjects & Methods:** Across sectional study involved 115 pupils at Al-Azhar institutions. The sample consisted of subjects of both genders (55 males and 60 females) aged from 12 to 15 years or more who had been diagnosed with dental caries according to DMFT index by a specialist dentist. The studied variables included socio-demographic characteristics, serum calcium level, eating habits and oral hygiene practices. **Results:** Results shows that 60% of study subjects have a moderate level of dental caries, while those with high and low levels were 19.1% and 13.9%, respectively. The majority of subjects with high level were females (83.3%). In the same time, high significant negative correlations between the level of dental caries and both of calcium level in serum (P=0.000) and eating habits score of all study subjects (p=0.024) were reported. Besides, although 76.5% of subjects of different levels were of middle socio-economic status, no significant difference was found (P=0.201). Similarly, most of study subjects with different levels were found to follow bad oral hygiene practices, i.e. brushing their teeth once daily, do not use interdental cleaning aids, do not rinse their mouths after meals, do not visit dentist for checkup, changing their tooth brushes only when broken and were not aware of tongue cleaning. However, no statistically significant differences were recorded. **Conclusion:** Female sex, unhealthy eating habits and bad oral hygiene practices threaten the dental health of young teens. Accordingly, oral health care and dietary behavior modification are recommended in order to improve the oral health status of young adolescents.

Keywords: Dental caries, Socio-demographic characteristics, Serum calcium, Dietary habits, Oral health care, Adolescents**.**

1. Introduction

All over the world, increasing interest was directed to dental caries as one of the most prevalent oral diseases and the most important global oral health burdens (He *et al.,* 2022) among pupils, with a prevalence of approximately 74% of Egyptian children (Abbass *et al.,* 2019), and 62.8% of Egyptian preparatory school children in particular (Abdel-Rasoul *et al.,* 2019). Adolescence remains a period of high risk for dental caries because it is a vital life stage in which children begin to develop self-performed oral health habits instead of relying solely on parental supervision (Wang *et al.,* 2021). In this regard, while the global caries prevalence was approximately 50% among 12–15-year-old adolescents, it was over 70% among 17-year-old adolescents (Ismail, 2022).

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Physiologically, dental caries is a bacterial infectious disease that affects the calcified tissue of the tooth and causes dissolution of the organic component and demineralization of the inorganic portion. It is caused by bacterial plaque deposition on the surface of the tooth (Teshome *et al.,* 2021). Dental caries, also known as tooth decay or cavities, is the breakdown of teeth due to acids made by bacteria (Albino and Tiwari, 2016). The cavities may be a number of different colors from yellow to black (Laudenbach and Simon, 2014).

Dental caries is a multifactorial disease. A variety of factors, including microbial, genetic, immunological, behavioral and environmental interact to contribute to dental caries onset and development (Aas *et al.,* 2008). Symptoms may include pain and difficulty with eating (Shitie *et al.,* 2021). Children with dental caries have difficulties in sleeping, playing, eating, performing academic activity and communication problems due to missing, discolored, or damaging teeth. Generally, it affects children's physical growth, self-esteem, and social development (Turton and Durward, 2017).

Differences in education, self-care practices, available dental resources, income, and access to health care might create more demand for better dental care and lead to lesser caries prevalence within people with high socioeconomic status (SES). Recent studies demonstrated that dental caries today can be looked at as a disease of poverty or deprivation. The greatest reductions in caries experience have been mainly enjoyed by the high SES. Therefore, when treatment programs are planned, caries experience can be expected to be more extensive and severe among lower SES populations who are now at higher risk (Ellakany *et al.,* 2021).

On the other hand, nutrition affects oral hygiene, and proper nutrition is also important during tooth development (Hujoel and Lingström, 2017). There are two types of foods, cariogenic foods and anti-cariogenic foods (Alkazemi and Saleh, 2019). Cariogenic foods include crackers, bread, cereals, potato crips, bakery, cookies, cake, French fries, banana, dried fruit, fruit juice, carbonated drinks, and sweets. The anti-cariogenic foods are milk, yogurt, cheese, meat, chicken, egg, fish, peanut, carrots, apples, and raw vegetables (Yardimci *et al.,* 2021).

One of the most significant nutritional dangers in adolescence is poor eating habits, such as skipping meals, eating lots of fast foods, as well as following fad diets. These habits encourage insufficient calcium intake and, as a result, growth retardation in children and adolescents. Poor consumption of fruit and excess consumption of fast foods, salt, sugar/sweets, drinking tea more than 3 times a day and immediately after meals were the main unhealthy eating behaviors among adolescents (Abdel-Hady *et al.,* 2014; Bouziani *et al.,* 2018). Indeed, healthy eating behaviors in adolescence are important to prevent health problems including dental caries.

Similarly, following healthy oral hygiene practices is essential to prevent dental caries as well as all preventable oral diseases. Studies confirmed that dental caries is almost entirely preventable. Prevention is achieved through inexpensive methods such as limiting sugar intake and brushing teeth twice daily with fluoride toothpaste. Microbial dental plaque is one of the most important etiological factors for dental caries), and tooth brushing is considered the simplest individual preventive measure for plaque control, and it is effective in the long-term preservation of oral health (Patil *et al.,* 2014; World Health Organization, 2017; Raviteja *et al.,* 2017).

Despite the high prevalence of dental caries in the Egyptian population, only a few epidemiological studies of dental caries among Egyptian adolescents have been published, especially those focusing the relationship between it and nutritional status. Therefore, this study was carried out.

2. Subjects and Methods

This study was a cross-sectional one that involved 115 pupils at Al-Azhar institutions with convenient sampling from those who were suffering from dental caries and diagnosed according to DMFT Index (Decayed, Missed, Filled Tooth) by a specialist dentist. The sample size was identified according to (Thompson, 2012). It consisted of pupils of both gender (55 males and 60 females) aged from 12 to15 years or more. The protocol was fully explained to the pupils and informed consent was obtained from their parents. The following exclusion criteria were applied: Children under 12 years and children with diabetes. Data were collected from September 2021 and completed in February 2022. Dental caries was assessed using the Decayed, Missed, Filled Tooth (DMFT) index as described by the World Health Organization. Decayed tooth was defined by presence of a lesion in a pit/fissure or on a smooth surface with a detectable softened floor, undermined enamel, softened wall or temporary filling. On proximal surfaces, the probe had to enter the lesion with certainty. When in

doubt, the carious lesion was not recorded. Stained pits or fissures that caught the probe, but did not have undermined enamel, softened floor or walls were not included as carious lesions. A tooth was considered filled if it had a permanent restoration and it was considered missing due to caries if there was history of pain and or presence of a cavity prior to extraction (World Health Organization, 2013). An individually face to face interview was carried out with pupils and each interview took about 45-60 minutes.

Socio-demographic characteristics were evaluated by the valid and reliable socio-demographic scale for health research in Egypt. This scale has seven domains with a total score 84 and it classifies individuals into four sections including a low, low, moderate, and high level of SES. It contains information on the level of education, employment status, culture, place of residence, family property; the number of children receiving education, to what extent income meets the needs of the family, the type of government support that the patient receives (El-Gilany *et al.,* 2012).

Dietary assessment was also done using a valid and reliable scale and questionnaire which showed a respectable reliability in assessing the pupils' eating habits and identifying their attitudes towards food. The scale consists of 11 questions about important oral health-related eating habits. The score assigned to each response ranges from 1 to 4 with the maximum score assigned to the healthiest one. Hence, the total score is 44 (Turconi *et al.,* 2008).

Moreover, a basic questionnaire on oral health was used through the present study. It contained about 12 questions to know the extent of personal hygiene of the pupils. The average time of interview was 10–15 min (Bhuiyan *et al.,* 2020).

Data were analyzed using SPSS version 25 (SPSS Inc., Chicago, IL, USA). Quantitative data were presented as mean ± SD, median and interquartile range and qualitative data were presented as frequencies and percentages. The Chi-square and Monte Carlo exact tests were used to assess associations between qualitative variables. According to type of quantitative data, the Mann-Whitney U test and the Kruskal-Wallis H test were carried out to compare non-parametric data and one way ANOVA for parametric data among the different groups. Spearman correlation was used to correlate DMFT score with eating habits score, and total serum calcium among studied pupils. The level of significance was considered at p value <0.05.

3. Results

According to DMFT scale for dental caries, the study subjects were divided into three categories; low, moderate and high dental caries. Table (1) represents distribution of study subjects according to this scale, while the later tables (2-7) show the results of socio-demographic, serum calcium, eating habits and oral hygiene practices evaluation:

3.1 Distribution of study subjects according to dental caries category:

It was found that the majority of study subjects (60%) has a moderate level of dental caries, while 19.1%, 1.7%, 13.9%, 5.2% were of high level, very high level, low level and very low level of dental caries, respectively (Table 1).

Table 1: Distribution of study subjects according to DMFT scale (n=115)

	Category	DMFT Scale (n=115)	
		N	%
Dental caries	**Very low**	6	5.2
	Low	16	13.9
	Moderate	69	60.0
	High	22	19.1
	Very high	2	1.7
	Total	115	100.0

3.2 Demographic characteristics and socioeconomic level of study subjects:

Table (2) is showing that most of subjects who had very low to low level of dental caries were males (68.2%). Approximately half of subjects with moderate dental caries were also males (52.2%) while the majority of subjects with high level of dental caries were females (83.3%) with a statistically significant difference (P=0.001).

No statistically significant difference was found among different categories of dental caries regarding age (P=0.877). Age of studied pupils ranged from 12 to 15.9 years with a mean of 13.3 ± 1.03.

Moreover, most of pupils of different categories of dental caries were of middle socio-economic status; very low /low (72.7%), moderate (72.5%) and high/very high (91.7%), with no statistically significant difference (P=0.201).

Table 2: The relation between the level of dental caries and sex, age and socioeconomic level of study subjects (n=115)

Variables			DMFT Scale			
			Very low/ low (n=22)	Moderate (n=69)	High/very high (n=24)	Total (n=115)
Sex	Male	n	15	36	4	55
		%	68.2%	52.2%	16.7%	47.8%
	Female	n	7	33	20	60
		%	31.8%	47.8%	83.3%	52.2%
Test of significance			$\chi 2$= 13.514			
P value			0.001*			
Age (Years)	Mean		13.2	13.3	13.5	13.3
	SD		.94	1.03	1.12	1.03
	Minimum		12	12	12	12
	Maximum		14.9	15.4	15.9	15.9
	Median (IQR)		13.3(12.3-13.9)	13.1(12.4-14.1)	13(12.6-14.3)	13.1(12.6-14.1)
Test of significance			Kruskal-Wallis H=0.262			
P value			0.877			
Social status	Low	n	6	15	1	22
		%	27.3%	21.7%	4.2%	19.1%
	Middle	n	16	50	22	88
		%	72.7%	72.5%	91.7%	76.5%
	High	n	0	4	1	5
		%	0.0%	5.8%	4.2%	4.3%
Test of significance			Monte Carlo Exact Test			
P value			0.201			

3.3 Serum calcium level of study subjects

Table (3) is illustrating the relationship between the level of dental caries (diagnosed according to DMFT scale) and serum calcium level of study subjects. It can be noticed that the mean of calcium in serum of subjects with high/ very high level of dental caries (7.34±0.65 mg/dl) was significantly (P=0.000) lower compared with its mean in subjects with both moderate and low/ very low levels (8.67±0.61 and 8.68±0.39 mg/dl, respectively). At the same time, a highly significant negative correlation between the level of dental caries and calcium level in serum (P=0.000) was reported (Table 4).

Table 3: The relation between the level of dental caries and serum calcium level of study subjects (n=115)

Variables		DMFT Scale			
		Very low/ low (n=22)	Moderate (n=69)	High/very high (n=24)	Total (n=115)
Total serum calcium (mg/dl)	Mean	8.68	8.67	7.34	8.39
	Std. Deviation	.39	.61	.65	.7952
	Minimum	7.9	7.2	6.8	6.8
	Maximum	9.3	9.9	9.3	9.9
	Median (IQR)	8.8(8.3-8.9)	8.7(8.3-9.2)	7.1(7-7.3)	8.6(7.9-8.9)
Test of significance		Kruskal-Wallis H =39.127			
P value		0.000*			

Table 4: Correlation between DMFT scale and serum calcium level of study subjects (n=115)

Variables	DMFT Scale	
	Spearman rho	P value
Total serum calcium	-.468	**0.000***

3.4 Eating habits of study subjects

The relation between the level of dental caries and eating habits of study subjects was exhibited in table 5. A statistically significant difference among different categories of caries was noticed regarding eating breakfast (P=0.042), as 58.3% of study subjects with high/ very high caries sometimes eat breakfast and 8.3% only of them always eat breakfast. In contrast, only 50% from study subjects with low/very low caries always eat breakfast. Regarding the beverage consumed at breakfast, more than two thirds of study subjects with high/very high level of caries (70.8%) used to consume chocolate as a drink at breakfast compared to 34.8% and 36.4% with moderate and low/very low levels, respectively. On the other hand, only 8.3% of subjects with high/very high level of caries used to consume milk products compared to 13 and 27.3% with moderate and low/very low levels, respectively. These differences were significant, as P=0.019. A statistically significant difference among different categories of caries was noticed also regarding which the subjects consume at breakfast (P=0.047), as most of study subjects with high/ very high caries (75%) used to consume pizza, focaccia and toast compared to 47.8% and 54.5% with moderate and low/ very low levels, respectively. On the other hand, only 20.8% with high/very high level of caries used to consume sausages and cheese compared to 27.3% with low/very low level.

No statistically significant differences among different categories of caries were noticed regarding whether the subject eat at least 2 portions (200 g) of either fruits or vegetables every day or not (P=0.070). However, it is worth noting that 75% of subjects with high/ very high caries did not use to consume 200 g of either fruits or vegetables every day and only 25% of them had this healthy habit.

Statistically, there were significant differences (P=0.000) among different categories of caries regarding eating a cake or a dessert at meals. Most of study subjects with high/very high level of caries (75.0%) were found to often eat a cake or a dessert at meals compared with 13.6% with low/ very low level. In the same time, 12.5% of study subjects with high/very high level of caries were found to sometimes eat a cake or a dessert at meals compared with 40.9% with low/ very low level.

As for having the three main meals (breakfast, lunch and dinner) every day, significant differences (P=0.003) among different categories of caries were noticed, as 58.3% of study subjects with high/very high level of caries did not use to have the three meals daily, while 63.6% with low/ very low level often have them.

The present findings also revealed the direct relation between the carb content of diet and the severity of caries. In this regard, the diet of 91.7% of subjects with high/very high level of caries was based mainly on high carb diet compared to 53.6 and 50% with moderate and low/very low levels, respectively. Generally, the differences were significant (P=0.008). Moreover, and regardless of the caries level or the absence of significance (P=0.150), the snacks of 50.4% of the total subjects consisted mainly of sweets, chocolate, ice creams or cakes, while the snacks of 40% of them consisted of fried potatoes, popcorn, peanuts or soft drinks, while 9.6% used to eat biscuits, crackers or bread. Between meals, 70.8% of study subjects with high/ very high caries level used to have soft drinks compared to 20.3 and 4.5% with moderate and low/ very low levels, respectively. Those with high/ very high caries level who used to drink mineral water between meals were about 16.7% compared to 39.1 and 54.5% with moderate and low/ very low levels, respectively, while those used to drink fruit, fruit juice or fruit milk shakes between meals were about 12.5, 40.6 and 40.9% with high/ very high, moderate and low/ very low levels, respectively (P=0.000).

Table 5: The relation between the level of dental caries and eating habits of study subjects (n=115)

Eating habits			DFMT Scale			
			Very low/ low (n=22)	Moderate (n=69)	High/very high (n=24)	Total (n=115)
Do you eat breakfast?	**Sometimes**	**n (%)**	6 (27.3) %	28(40.6%)	14(58.3%)	48(41.7%)
	Often	**n (%)**	5(22.7%)	17(24.6%)	8(33.3%)	30(26.1%)
	Always	**n (%)**	11(50.0%)	24(34.8%)	2(8.3%)	37(32.2%)
Test of significance				$\chi2$= 9.901		
P value				**0.042***		
Which beverage do you consume at breakfast?	**Chocolate**	**n (%)**	8(36.4%)	24(34.8%)	17(70.8%)	49(42.6%)
	Tea/Coffee	**n (%)**	4(18.2%)	14(20.3%)	4(16.7%)	22(19.1%)
	Fruit juice	**n (%)**	4(18.2%)	22(31.9%)	1(4.2%)	27(23.5%)
	Milk products	**n (%)**	6(27.3%)	9(13.0%)	2(8.3%)	17(14.8%)
Test of significance				$\chi2$= 15.105		
P value				**0.019***		
At breakfast you eat:	**Pizza/Focaccia/Toast**	**n (%)**	12(54.5%)	33(47.8%)	18(75.0%)	63(54.8%)
	Biscuits/Cakes/Crackers	**n (%)**	4(18.2%)	23(33.3%)	1(4.2%)	28(24.3%)
	Sausages and cheese	**n (%)**	6(27.3%)	13(18.8%)	5(20.8%)	24(20.9%)
Test of significance				$\chi2$= 9.615		
P value				**0.047***		
Do you eat at least 2 portions (200 g) of fruit every day?	**Never**	**n (%)**	12(54.5%)	33(47.8%)	18(75.0%)	63(54.8%)
	Often	**n (%)**	10(45.5%)	36(52.2%)	6(25.0%)	52(45.2%)
Test of significance				$\chi2$= 5.309		
P value				0.070		
Do you eat at least 2 portions (200 g) of vegetables every day?	**Never**	**n (%)**	12(54.5%)	33(47.8%)	18(75.0%)	63(54.8%)
	Often	**n (%)**	10(45.5%)	36(52.2%)	6(25.0%)	52(45.2%)
Test of significance				$\chi2$= 5.309		
P value				0.070		
Do you usually eat a cake or a dessert at meals?	**Always**	**n (%)**	10(45.5%)	23(33.3%)	3(12.5%)	36(31.3%)
	Often	**n (%)**	3(13.6%)	20(29.0%)	18(75.0%)	41(35.7%)
	Sometimes	**n (%)**	9(40.9%)	26(37.7%)	3(12.5%)	38(33.0%)
Test of significance				$\chi2$= 22.409		
P value				**0.000***		
Do you usually eat breakfast, lunch and dinner every day?	**Never**	**n (%)**	8(36.4%)	34(49.3%)	14(58.3%)	56(48.7%)
	Sometimes	**n (%)**	0(0.0%)	9(13.0%)	7(29.2%)	16(13.9%)
	Often	**n (%)**	14(63.6%)	26(37.7%)	3(12.5%)	43(37.4%)
Test of significance				$\chi2$= 16.293		
P value				**0.003***		
Your diet is based mainly on:	**High fat foods**	**n (%)**	5(22.7%)	21(30.4%)	1(4.2%)	27(23.5%)
	High carb foods	**n (%)**	11(50.0%)	37(53.6%)	22(91.7%)	70(60.9%)
	Different foods every day	**n (%)**	6(27.3%)	11(15.9%)	1(4.2%)	18(15.7%)
Test of significance				$\chi2$= 13.926		
P value				**0.008***		
Your snacks are based mainly on:	**Sweets/Chocolate/Ice creams/Cakes**	**n (%)**	13(59.1%)	29(42.0%)	16(66.7%)	58(50.4%)
	Fried potatoes/Popcorn/ Peanuts/ Soft drinks	**n (%)**	6(27.3%)	34(49.3%)	6(25.0%)	46(40.0%)
	Biscuits/Crackers/Bread	**n (%)**	3(13.6%)	6(8.7%)	2(8.3%)	11(9.6%)

Test of significance				$\chi 2$= 6.746		
P value				0.150		
Which beverages do you usually drink between meals?	**Soft drinks**	**n (%)**	1(4.5%)	14(20.3%)	17(70.8%)	32(27.8%)
	Mineral water	**n (%)**	12(54.5%)	27(39.1%)	4(16.7%)	43(37.4%)
	Fruit/Fruit juice/fruit milk shakes	**n (%)**	9(40.9%)	28(40.6%)	3(12.5%)	40(34.8%)
Test of significance				$\chi 2$=30.520		
P value				**0.000***		
Do you drink at least one glass of milk, or do you eat at least One cup of yogurt every day?	**Never**	**n (%)**	17(77.3%)	57(82.6%)	11(45.8%)	85(73.9%)
	Sometimes	**n (%)**	0(0.0%)	6(8.7%)	11(45.8%)	17(14.8%)
	Always	**n (%)**	5(22.7%)	6(8.7%)	2(8.3%)	13(11.3%)
Test of significance				MCET		
P value				**0.000***		

Similarly, a statistically significant difference (p=0.000) was noticed among subjects belonged to different categories of caries, as most of subjects with high / very high caries level (45.8%) did not use to drink at least one glass of milk or eat at least one cup of yogurt daily, compared to 8.3% of them were found to do that continuously. Regardless of the caries level, 73.9, 14.8 and 11.3% of all study subjects never, sometimes and always drink at least one glass of milk or eat at least one cup of yogurt daily, respectively.

In general, a high significant negative correlation (p=0.024) between the level of dental caries and eating habits score of all study subjects was found (Table 6).

Table 6: Correlation between DMFT scale and total eating habits score of study subjects (n=115)

Variables	**DMFT Scale**	
	Spearman rho	**P value**
Eating habits score	-.210	**0.024***

3.5 Oral hygiene practices of study subjects:

Table (7) is pointing to the relation between the level of dental caries and oral hygiene practices of study subjects. It was found that most of study subjects with different levels of dental caries (80%) brush their teeth once daily and only (20%) brush their teeth twice/day. Most of study subjects with different levels of dental caries (92.1%) also were found to use local toothpaste (not branded or coal), while a higher percentage (97.3%) did not use interdental cleaning aids. Regarding brushing time, it was found that 77.4% of all study subjects used to brush their teeth in the morning before meal versus 22.6% brushes their teeth at night after meal. About two thirds of study subjects (66.1%) did not use to rinse their mouths after meals. Nearly similar percentage (67%) of study subjects was not found to visit dentist for checkup. In the same time, 40% of study subjects with different levels of dental caries used to change their tooth brushes when broken and another 40% did not know about the necessity of this change. Moreover and regardless of dental caries level, nearly half (52.2%) of study subjects were not found to be aware of tongue cleaning and 24.3% did not clean their tongues absolutely.

On the other hand, 73% of study subjects with different levels of dental caries were found to follow the mixed method in brushing their teeth, while only 27% followed the horizontal method. In general, no statistically significant differences among different categories were found regarding any of the studied practices.

Table 7: The relation between the level of dental caries and oral hygiene practices of study subjects (n=115)

Oral hygiene practices		DMF Scale								Test of significance	P value
		Very low/ low (n=22)		Moderate (n=69)		High/very high (n=24)		Total (n=115)			
		n	%	n	%	n	%	n	%		
Brushing frequency	**Once daily**	20	90.9	55	79.7	17	70.8	92	80.0	MCET	.222
	Twice daily	2	9.1	14	20.3	7	29.2	23	20.0		
Using toothbrush-paste	**Toothpaste + Toothbrush**	22	100	69	100	24	100	115	100	NA	
Type of toothpaste	**Branded toothpaste**	0	0.0	1	1.4	0	0.0	1	0.9	MCET	.231
	Local toothpaste	22	100	64	92.8	20	83.3	106	92.1		
	Coal	0	0.0	4	5.8	4	16.7	8	7.0		
Brushing time	**Morning before meal**	20	90.9	50	72.5	19	79.2	89	77.4	$\chi2$=3.298	0.192
	Night after meal	2	9.1	19	27.5	5	20.8	26	22.6		
Brushing technique	**Horizontal stroke**	5	22.7	22	31.9	4	16.7	31	27.0	$\chi2$=2.341	0.310
	Mixed	17	77.3	47	68.1	20	83.3	84	73.0		
Mouth rinse after meal	**Yes**	3	13.6	27	39.1	9	37.5	39	33.9	$\chi2$=5.012	0.082
	No	19	86.4	42	60.9	15	62.5	76	66.1		
Type of toothbrush	**Don't know**	22	100	69	100	24	100	115	100	NA	
Interdental cleaning	**Don't use**	21	95.5	66	97.1	23	100	110	97.3	MCET	.629
	dental floss/dental thread	1	4.5	2	2.9	0	0.0	3	2.7		
How often change toothbrush	**Every 3 months**	2	9.1	16	23.2	5	20.8	23	20.0	$\chi2$=6.067	0.194
	Change when broken	7	31.8	31	44.9	8	33.3	46	40.0		
	Don't know about changing	13	59.1	22	31.9	11	45.8	46	40.0		
Tongue cleaning	**Yes**	3	13.6	19	27.5	5	20.8	27	23.5	$\chi2$=3.305	0.508
	No	8	36.4	15	21.7	5	20.8	28	24.3		
	Don't know	11	50.0	35	50.7	14	58.3	60	52.2		
Visit dentist for checkup	**Yes**	4	18.2	25	36.2	9	37.5	38	33.0	$\chi2$=2.728	0 .255
	No	18	81.8	44	63.8	15	62.5	77	67.0		
If yes, How often you visit (n=38)	**Every 6 months**	2	50.0	16	64.0	5	55.6	23	60.5	$\chi2$=1.526	0.821
	yearly	1	25.0	5	20.0	1	11.1	7	18.4		
	If pain/problem	1	25.0	4	16.0	3	33.3	8	21.1		

4. Discussion

Oral disease is one of the most prevalent chronic diseases and an alarming public health problem worldwide (Peres *et al.,* 2019). A WHO analysis reported that oral disease has become a determining factor for quality of life and a global burden on social and economic health, affecting 2.4 billion people, 621 million adolescents worldwide (Martins *et al.,* 2017). The global average decayed–missing–filled teeth (DMFT) in 12-year-old adolescent is 1.86. Puberty is an important stage of adolescents' growth and development because their physical and mental status gradually mature.

Permanent dentition begins to function in the subsequent decades of life. A high prevalence of dental caries may impact adolescents' quality of life, their reports of pain and absences from school and hence weak academic achievement (Kassebaum *et al.,* 2015; Ruff *et al.,* 2018).

In the current study, the majority of participants (60%) were found to suffer from moderate level of dental caries which disagree with the results of Oulis *et al.,* 2011) who found that the majority of Greek children (12-15 years) had a higher level of caries prevalence and higher DMFT score.

It was showed that most study subjects with high level of dental caries were females (83.3%) with a statistically significant difference (P=0.001). This result was in agreement with Li *et al.,* (2021) who found that 12–15-year-old girls had more caries than boys. This result may be because girls' permanent teeth erupt earlier than boys' teeth. Therefore, the girls' teeth were exposed to cariogenic foods earlier and had a greater chance of decaying (Baume, 1968; Xiaolan *et al.,* 2019). Hiremath, 2016) added that females take care of their teeth more than males and go to the dentist for treatment. The more filled teeth, the more risk of dental caries as it becomes more susceptible for caries than sound one.

No statistically significant differences were found among different categories of caries regarding both age and socio-economic status. The age average of study subjects was small (12 - 15.9 years with a mean of 13.3 ± 1.03 years), and most of subjects of different categories were of middle socio-economic status. Our result can be explained that the age group covered is the same and that they are rural dwellers.

On the other hand, a highly significant negative correlation between the level of dental caries and calcium level in serum of study subjects was found. This result was in harmony with Lacruz *et al.,* (2017) who stated that calcium plays a critical role in the ordered crystalline and mineralized structure of enamel by combining with inorganic phosphate to form hydroxyapatite and participating in ion transport during amelogenesis.

A high significant negative correlation between the level of dental caries and eating habits score of study subjects was noticed. These results were in line with Puy and Forner (2010) and Selvaraju *et al.,* (2022) who reported that children and adolescents with tooth decay have bad eating habits and tend to eat unhealthy food from consuming large amounts of sugar, sweets, processed foods and soft drinks. The omission of breakfast and irregular main meals were significantly associated with caries increment (Bruno-Ambrosius *et al.,* 2005), and this may be due to increased snacking depending on unhealthy foods such as sweets and soft drinks as a result. On the other hand, low consumption of dairy products at breakfast or all over the day in general was more obvious among those with high/very high caries level. Besides high nutritional value, many anti-caries agents are found in milk and its products (Woodward and Rugg-Gunn, 2020; Khan *et al.,* 2022; Veeresha *et al.,* 2012; Sandhu *et al.,* 2014).

In view of our results, the consumption of chocolate, sweets and soft drinks was higher by subjects with high /very high caries level. These results were consistent with the results of previous studies (Mobley *et al.,* 2009; Mafuvadze *et al.,* 2013; Sohn *et al.,* 2006; Chandrasekha *et al.,* 2019). Also, large percentage of subjects with high /very high caries level used to eat pizza, focaccia, toast, desserts, and cakes either in breakfast or snacks. These foods contain large amounts of starch and sugars. High carb foods affect teeth by getting lodged in between the teeth surfaces. The starchy foods are not sweet or sugary, but as they enter the mouth, they get converted into sugars affecting the enamel of teeth. These sugars and salts get adhere to the tooth surface and produce acid which erodes the enamel surface of the tooth (Chandrasekha *et al.,* 2019). A direct linkage between sugar intake and caries has been reported previously, as cariogenic bacteria grow with the presence of fermentable carbohydrates (Sheiham and James, 2014).

Despite of no significant differences, 75% of subjects with high/ very high caries did not use to consume 200 g of either fruits or vegetables every day and only 25% of them had this healthy habit. These results agreed with previous studies which recorded that dental caries prevalence was higher in non-vegetarians in comparison with vegetarians. This relation could be attributed to a lesser tendency for sweets between meals in vegetarians compared with non-vegetarians, as well as the high contents of anti-caries, antioxidants, antimicrobial and anti-inflammatory agents in fruits and vegetables (Prabakar *et al.,* 2016; Abbass *et al.,* 2019; Chandrasekha *et al.,* 2019).

Similarly, most of study subjects with different levels of dental caries were found to brush their teeth less than twice daily, use local toothpaste (not branded or coal), do not use interdental cleaning

aids, do not rinse their mouths, do not visit dentist for checkup, change their tooth brushes only when broken or do not know about the necessity of this change at all, were not aware of tongue cleaning or do not clean their tongues absolutely. Despite of no significance, it is no doubt that avoiding these bad practices will improve the oral health of the study subjects in their later life and prevent dental caries (Sistani *et al.,* 2013; Abbass *et al.,* 2019; He *et al.,* 2022).

5. Conclusion

Female sex, unhealthy eating habits and bad oral hygiene practices threaten the dental health of young teens. Accordingly, oral health care and dietary behavior modification are recommended in order to improve the oral health status of young adolescents.

Conflict of interest

The authors reported no conflict of interest.

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