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CARIES ASSESSMENT IN EGYPTIAN ADOLESCENTS CONCERNING SOME EPIDEMIOLOGICAL FACTORS

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ABSTRACT

Background: Dental caries is a multifactorial disease, prevention of which requires a comprehensive understanding of these factors and their population impact.

Aim: to assess dental caries prevalence in Egyptian adolescents concerning some epidemiological factors.

Subjects and Methods: A cross-sectional, analytical study was conducted on 1416 Egyptian adolescents (12-19 years old) from Cairo, Delta, and Upper Egypt governments. The personal and sociodemographic variables were obtained through a questionnaire. The clinical assessment of caries prevalence and DMFT indices were calculated, tabulated, and statistically analyzed.

Results: The Upper Egypt adolescents showed the lowest prevalence index (48.87 %) and DMFT scores (1.31) than that of Cairo [86.67% & 4.68] and Delta [77.13 % & 3.28] adolescents respectively. However, the girls showed relative lower prevalence and relative higher DMFT indices [71.34 % & 3.17] than boys [71.84 % & 2.95]. The prevalence and DMFT indices of Egyptian adolescents were 71.61 % and 3.05 respectively. Also, it was found that Dental caries in adolescents was directly proportional to age, systemic disease affection, frequency of carbohydrate intake, and the increase in family income and increase of education level at this stage of life. While it was inversely proportional to the improvement of personal career, self-satisfaction, and teeth brushing practice.

Conclusion: Egyptian adolescents have a relatively high-caries prevalence and DMFT indices scores especially in civilized areas so they need more efforts and intensive dental health programs to care for their oral health.

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INTRODUCTION

Dental caries risk factors have been expanded to emphasize biology, dietary and oral habits, and broader social determinants such as socioeconomic factors and health services utilization [1]. Although preventive strategies have been improved in the last years, dental caries remains a major public health problem, especially in developing countries [2]. The World Health Organization (WHO) has reported that caries experience decreases in developed countries while it increases in developing countries [3].

Adolescence remains a period of high risk for dental caries [4]. It is a vital life stage in which children begin to develop self-performed oral health habits instead of relying solely on parental supervision [5]. The global caries prevalence was approximately 50% among 12–15-year-old adolescents and over 70% among 17-year-old adolescents [6]. A review article in 2020 showed that the prevalence of dental caries in permanent teeth in children and adolescents all over the world with a sample size of 1,454,871 was 53.8% [7]. These numbers have raised concerns about caries experience among adolescents. Dental caries may lead to pain, and swelling and may affect the dental apparatus development in adolescents and dramatically reduce their life quality [8]. Therefore, it is important to adopt some intervention measures for the early prevention of caries among teenagers [9].

Caries risk assessment is an essential element in planning preventive oral health programs and therapeutic strategies [10]. The prevalence (the percent of individuals exhibiting the disease at a specific point in time) and **DMFT** (**D**ecayed, **M**issing, **F**illed permanent **T**ooth) indices are the most commonly used indices for caries assessment worldwide [11,12]. Dental caries is the most common chronic and infectious disease affecting children and teenagers [13]. It has a complicated etiology model consisting of biological factors, socioeconomic factors, demographic factors, and oral health-related behaviors. [14].

However, few epidemiological studies of dental caries among Egyptians have been published despite of the high prevalence of dental caries in the Egyptian population. Moreover, most of the available data is grey literature which is not available on common search engines [15-19]. Moreover, most of the epidemiological studies focused on children more than adolescents [20,21].

In Egypt, a study in 2019 showed that the mean DMFT for adolescents aged between 12 to 17y was 1.68 ±1.92 [12]. Another study demonstrated that the prevalence of dental caries and mean DMFT amongst 967 students were 51.4% and 1.5 respectively. Also, it showed that Female students had statistically significantly higher caries scores than males [21]. Moreover, a study in 2014 had been reported that the dental caries prevalence and DMFT indices in Egyptian adolescents were 73.93% and 3.32 respectively. However, this study showed that females showed a lower prevalence index score (72.83%) and higher DMFT scores (3.52) than males (74.83% & 3.16 respectively) [22].

Some studies have been performed to investigate the risk indicators of dental caries among Egyptian adolescents [12,21,22], but there is a lack of evidence of such studies that locate these risk factors. These may be attributed to unique social and psychological needs, high increasing caries rate, lack of funds, and critical stage of self-behavior formation [23], so the primary objective of this study was to assess the effect of some caries risk factors on the prevalence of dental caries among the Egyptian adolescents.

SUBJECTS AND METHODS

Study setting and population Sample size:

The present study was a cross-sectional survey, where data were collected through a household survey conducted between 2019 and 2021. It was conducted on 1416 Egyptian adolescents (12-19 years old) from many governorates. The subjects

were classified according to their residential location into 3 main groups; Cairo and surrounding civilized areas (390), Delta (586), and Upper Egypt (440 governorates). The sample size in each group has an 80% power to detect an increase of 0.38 with a significance level (alpha) of 0.05 (two-tailed). In 80% (the power) of those examinations, the P-value was less than 0.05 (two-tailed) so the results were deemed "statistically significant". In the remaining 20% of the examinations, the increase was deemed "not statistically significant" [24].

The adolescents were selected according to WHO guidelines for pathfinder surveys. The subjects were investigated by a survey team consisting of the investigator, teaching staff assistants, and well-trained fourth grade students of the faculty of dental medicine, Al-Azhar University as a part of their study qualification requirements. Each student examined only 5 adolescents of his family, relatives, and neighbors. Dental caries among adolescents was assessed using the prevalence and DMFT indices. The relation and effect of some Socio-demographic factors on dental caries were investigated. Univariate and multivariate regression analyses were performed to identify the effects of some socio-demographic parameters [21-24].

The survey was conducted as follows:

(A) Data collecting:

A parental questionnaire survey was performed including the adolescent's data and some habits. The data were collected first before clinical examination and recorded in a detailed questionnaire chart. The chart included personal history (name, age, sex, address, telephone No, …etc.), medical status, family income level, adolescent education level, carbohydrates consumption, and teeth brushing habits. The collected data were recorded in each child chart according to the criteria of WHO [1,7,22,25.] and then revised by teaching assistants and tabulated before presentation to the investigator for discussion and documentation. The adolescents were classified according to the previous variables into the following groups [22-26]:

1. ***Medical status:*** adolescents were classified into normal subjects and diseased subjects.

2. ***Family income level:*** adolescents were classified according to their family income /month into high (≥ 20000 L.E.), medium (from 10000 to 20000 L.E), and low (≤ 10000)

3. ***Individual education levels:*** adolescents were classified according to their education levels into three groups:

Group 1: High educational levels (college students).

Group 2: Moderate educational levels. (Secondary school students)

Group 3: Low educational levels (Preparatory school students or school dropout).

4-Job: The adolescents were classified according to the nature of their work into three groups:

1- Mental: This group include adolescents who worked in mental profession as students, employees, clerks etc..

2- Combined This group include adolescents who worked in mental and manual works like students who worked part time in manual profession to improve or raise their financial income

3- Manual. This group include adolescents who drop out of school worked in manual occupations.

5. ***Frequency of carbohydrates intake:*** subjects were classified into high consumption (eat sweets ≥ 3 times/day), moderate consumption (eat sweets twice/day), and low consumption (eat sweets ≤ 1 time/day).

6. ***Adolescents Satisfaction:*** adolescents were classified according to their Satisfaction with their lives into three groups:

Group 1: High satisfaction.

Group 2: Moderate satisfaction.

Group 3: Low satisfaction.

7. ***Teeth brushing habit:*** adolescents were classified according to the frequency of teeth brushing into 4 groups:

Group 1: High brushing rate 2-3 times/day.

Group 2: Moderate brushing rate (1/day or 1/2days).

Group 3: Low brushing rate (1/3d or 1/week).

Group 4: adolescents didn't brush their teeth at all.

(B) Subjects examination:

Each subject was examined using simple diagnostic tools (simple source of light, disposable mirrors, dental explorers. gloves, and masks). The prevalence and DMFT indices scores were recorded according to the criteria of WHO in each subject chart. A photograph of each subject upper and lower teeth was taken by the examiner as proof of examination and for discussions [22, 25].

Calculating prevalence index: The prevalence index was calculated by dividing the number of the affected subjects by the total number of subjects.

Calculating DMFT: for the individual, it is equal to the total number of **D**ecayed, **M**issed, and **F**illed Permanent **T**eeth while the DMFT score of the group was equal to the sum of individuals' DMFT scores divided by their numbers. The unerupted or congenitally missed teeth, missed teeth due to trauma, filled teeth due to trauma, and supernumerary teeth were not counted in the DMFT score [22].

(C) Data revision and tabulation:

The collected data were received, reviewed, and hardly discussed; any obscure or incorrect data were excluded. The collected data were revised, recorded, tabulated, and prepared for statistical analysis.

Statistical Analysis

The significant differences between any two groups were assessed by Student's *t*-test. The differences between multiple groups were assessed by one-way analysis of variance (ANOVA) followed by Fisher's exact test. Values of $P \leq 0.05$ were considered significant. These analyses were done using SPSS 22.0 statistical software.

Ethical consideration

This study was approved by the Ethical Committee (EC Ref NO.811/176) of the Faculty of Dental Medicine, Boys, Cairo, Al-Azhar University. Written individual informed consent and parental informed consent with or without assent were obtained as prescribed by national guidelines before they were included in the study.

RESULTS

This study was conducted on 1416 Egyptian adolescents. The adolescents were selected from many governorates mainly from Cairo, Delta, and Upper Egypt. The adolescents' ages ranged from 12-19y old and the mean age was 16.43y. The total enrolled females were 656 (46.33%), their ages ranged from 12-19y and the average age was 16.31y. while the males were 760 (53.67%) their ages ranged from 12-19y and the average age was 16.54y. The study showed no significant statistical difference ($P > 0.05$) between males' and females' ages (Tab. 1 & 2).

The prevalence index of dental caries among Egyptian adolescents was 71.61% since only 402 (28.39) out of them were caries-free. While the numbers of caries-free females and males were 188 (28.66%) & 214 (28.16), respectively. In the same context, the prevalence indices among the females and males were 71.34% & 71.84% respectively. Also, the study showed that the DMFT score of Egyptian adolescents was 3.05. Moreover, it

showed the females' DMFT scores were higher than the males' DMFT scores in all study areas with an insignificant statistical difference (Tab. 3).

The adolescents were classified according to their place of residence into three areas:

1-Cairo

The ages of the Cairo adolescents (390) were from 12-19-6y old. The average age was 16.13y. The enrolled females were 140 (35.9%), their ages ranged from 12-19y and the average age was 16.08y. while the males were 250 (64.01%) their ages ranged from 12-19y and the average age was 16.6y. The results showed there is no significant difference between males' and females' ages (Tab. 1 & 2).

The results demonstrated that only 52 (13.33%) of Cairo adolescents were caries-free thus the prevalence of dental caries was 86.67%. While the numbers of caries-free females' and males' were 24 (17.14%) & 28 (11.2%) respectively. Thus the prevalence index scores of females and males were 82.86% & 88.8% respectively. The mean DMFT scores of females, males, and the total of males & females were 5.43, 4.26, and 4.68 respectively with a highly significant ($P \leq 0.01$) difference in favor of males' adolescents (Tab. 3 & 4).

2-Delta

The age of examined adolescents (414) in Delta governorates ranged from 12-19y and the mean age was 16.86 y old. The females (284) constitute 48.46% of the Delta enrolled adolescents, their average age was 16.65y. While the males' adolescents [302 (51.54%)] average age was 17.05y. in comparison, there is an insignificant difference between the males' and females' ages (Tab.1&2).

However, 134 (22.87%) adolescents out of delta adolescents were caries-free hence the prevalence index of dental caries was 77.13%. while caries-free females and males were 68 (23.94%) & 66 (21.85%) respectively. Hence the prevalence index scores of females and males were 76.06 % &78.15 %. The mean DMFT scores of females, males, and total adolescents were 3.46, 3.11, and 3.28 respectively. However, the females showed higher DMFT score than males DMFT score without an insignificant difference (Tab. 3 & 4).

3-Upper Egypt

The age of enrolled adolescents (440) in Upper Egypt was 12-19y and the mean age was 16.15y old (Tab.1). The females (47.27%) mean age was 16.03y. While the males (52.73%) average age was 16.27. Also, there is no significant difference between the males' and females' ages in this group (Tab. 2).

Since the caries-free individuals among females, males and total adolescents were 96 (41.38%), 120 (57.69 %) & 216 free (48.87 %); the prevalence index scores for them were 58.62 %, 42.31 % & 51.13% respectively. The mean DMFT scores of females, males, and total adolescents were 1.45, 1.15, and 1.31 respectively. However, although females showed higher DMFT score than males DMFT score without an insignificant difference (Tab. 3 & 4).

Effect of some epidemiological factors

Age

This study found that the age is directly proportional to dental caries since dental caries irregularly increases with the increase of adolescents' age. Moreover, it showed that the DMFT score (2.36) of the adolescents in preparatory school (12-15y) stage had highly significant differences with the adolescents' DMFT score (3.33) in secondary school stage (16-18y) and adolescents' DMFT score (3.56) in the first year of university stage (19Y). While it showed no significant difference between individuals in the secondary school stage

& individuals in the first year in the university stage (Tab. 5).

Gender

The present study demonstrated that girls had a higher DMFT score than boys in all areas with insignificant differences except in the Cairo governorate which showed a highly significant difference. This was reflected in the Egyptian females' total DMFT score which showed a higher DMFT score than Egyptian adolescent males with an insignificant difference (Tab. 3).

Residential location

Table 4 showed that the females and males adolescents who lived in Upper Egypt showed the lowest DMFT score (1.45 & 1.15) than Delta (3.46 & 3.11) and Cairo (5.43 & 4.68) females & males. This was reflected in the DMFT score of the total number of adolescents who lived in these areas since Upper Egypt adolescents had the lowest DMFT (1.31) than Delta (3.28) and Cairo (4.68) adolescents respectively. On comparison between groups, it was found that there are highly significant differences between all groups.

Individual Education level

It was found that the high educational level adolescents had the highest DMFT (3.8) with highly significant statistical differences with moderate (2.97) and low (2.64) educational level adolescents. Moreover, the moderate educational level adolescents showed a higher DMFT score (2.97) in comparison to low educational level (2.64) adolescents but without statistically significant differences (Tab. 6).

General Health

Considering the effect of systemic disease on caries rate, it was found that, the medically compromised adolescents had a higher DMFT score (5.47) than normal healthy adolescents' DMFT score (2.99) with a highly significant difference (Tab. 6).

Family income level

However, this study showed a direct relationship between family income levels and adolescents' tooth decay. It showed that the highly family income adolescent had the highest DMFT scores (3.75) followed by moderate family income (3.36) and low family income (2.71). Also, it showed highly significant and significant differences between DMFT scores of low family income adolescents and both high & moderate family income adolescents. Furthermore, it demonstrated that there is no significant difference between the high family income adolescents and moderate family income adolescents' DMFT scores (Tab. 6).

Job

On analysis of the DMFT scores related to the career of the adolescents, the study showed that individuals who work in mental jobs had the lowest DMFT score (2.82) than individuals who work in the manual (3.04) and combined (4.04) jobs. In comparing these three groups, there were significant differences between the adolescents groups who work in a manual profession and the two other groups. Moreover, there is no significant difference between the adolescents who work in mental and mixed jobs groups.

Carbohydrates Consumption.

Comparing the adolescents' DMFT scores based on their carbohydrate consuming habits, this study showed that the adolescents who highly consume sweets have the highest DMFT score (4.14). Moreover, it was found that the adolescents who moderately consume sweets had fewer caries (2.64) than adolescents with low sweets consumption (2.41). However, all differences between these three groups were statistically highly significant (Tab. 6).

Satisfaction

The results of this study showed that psychological status plays an important role in caries

experiences. It showed an inverse relation between psychological satisfaction and DMFT score. Since the highly satisfied adolescents reported the lowest DMFT score (2.52) then the moderately satisfied group (3.04) and low satisfaction group (3.18). However, there were no significant differences between all groups except that difference between the high and low satisfied individuals which was a highly significant difference (tab. 6).

Teeth brushing

Regarding this habit, the study showed that there is an inverse relationship between teeth decay and the frequency of teeth brushing. Since it showed a gradual irregular increase in DMFT scores with the decrease in teeth brushing numbers where group 1 showed the lowest DMFT score (1.82) than groups 2, 3 & 4 (3.04, 3.38 & 3.53 respectively). On comparing between groups' DMFT scores; it was found that there are highly significant differences between all groups (tab. 6).

TABLE (1): Comparisons between ages of different areas of subjects

Area	N	Age Mean (years)	Std. Dev. ±	Std. Err. ±	Min.	Max.	Mean diff. ±	Sig.
1- Cairo	390	16.1333	2.06393	.10451	12.00	19.00	1:2=72332*	.000
2- Delta	586	16.8567	2.18619	.09031	12.00	19.00	1:3=.01212	.938
3- Upper Egypt	440	16.1455	2.47018	.11776	12.00	19.00	2:3=.71120*	.000
Total	1416	16.4364	2.27263	.06039	12.00	19.00		

TABLE (2): Comparisons between females and males ages in the three areas.

Area	Gender	N	Age Mean (years)	Std. Dev. ±	Std. Err. ±	Min.	Max.	Mean diff. ±	Sig.
Cairo	1- Females	140	16.0857	2.17072	.18346	12.00	19.00	.07429	0.754
	2- Males	250	16.1600	2.00561	.12685	12.00	19.00		
Delta	3- Females	284	16.6549	2.24960	.13349	12.00	19.00	.39143*	.035
	4- Males	302	17.0464	2.11100	.12147	12.00	19.00		
Upper Egypt	5- Females	232	16.0345	2.48260	.16299	12.00	19.00	.23475	.274
	6- Males	208	16.2692	2.45631	.17031	12.00	19.00		
Total	Females	656	16.3140	2.33438	.09114	12.00	19.00	-.22808	.059
	Males	760	16.5421	2.21406	.08031	12.00	19.00		

TABLE (3): Effect of gender on dental caries incidence.

Area	Gender	N	Mean (DMFT)	Std. Dev. ±	Std. Err. ±	Min.	Max.	Mean diff. ±	Sig.
Cairo	1-Females	140	5.4286	4.03428	.34096	.00	15.00	1.17257*	.000
	2-Males	250	4.2560	3.58915	.22700	.00	17.00		
Delta	3-Females	284	3.4648	2.96901	.17618	.00	13.00	.35221	.143
	4-Males	302	3.1126	2.94477	.16945	.00	17.00		
Upper Egypt	5-Females	232	1.4483	1.68695	.11075	.00	7.00	.29443	.289
	6-Males	208	1.1538	1.78436	.12372	.00	7.00		
Egypt	Females	656	3.1707	3.23173	.12618	.00	15.00	.21810	.199
	Males	760	2.9526	3.16067	.11465	.00	17.00		
Total males & females		1416	3.0537	3.19451	.08489	.00	17.00		

TABLE (4): Effect of residential location on DMFT score of dental caries.

Gender	Area	N	Mean (DMFT)	Std. Dev. ±	Std. Err. ±	Min.	Max.	Mean diff. ±	Sig.
Females	1- Cairo	140	5.4286	4.03428	.34096	.00	15.00	1:2=1.96378*	.000
	2- Delta	284	3.4648	2.96901	.17618	.00	13.00	1:3=3.98030*	.000
	3-Upper Egypt	232	1.4483	1.68695	.11075	.00	7.00	2:3=2.01651*	.000
Males	1- Cairo	250	4.2560	3.58915	.22700	.00	17.00	1:2=1.14342*	.000
	2- Delta	302	3.1126	2.94477	.16945	.00	17.00	1:3=3.10215*	.000
	3- Upper Egypt	208	1.1538	1.78436	.12372	.00	7.00	2:3=1.95874*	.000
Males & Females	1- Cairo	390	4.6769	3.79192	.19201	.00	17.00	1:2=1.39365*	.000
	2- Delta	586	3.2833	2.95926	.12225	.00	17.00	1:3=3.36783*	.000
	3- Upper Egypt	440	1.3091	1.73794	.08285	.00	7.00	2:3=1.97419*	.000
Total	Egypt	1416	3.0537	3.19451	.08489	.00	17.00		

TABLE (5): Effect of age on dental caries

Age	N	DMFT Mean	Std. Dev. ±	Std. Err. ±	Min.	Max.	Mean diff. ±	Sig.
12-15Y	484	2.3554	2.93578	.13344	.00	15.00	1:2=.97796	.000
16-18Y	588	3.3333	3.32321	.13705	.00	17.00	1:3=1.20277	.000
19Y	344	3.5581	3.15990	.17037	.00	17.00	2:3=.22481	.294

TABLE (6): Effect of some epidemiological factors on dental caries.

Items	Character	N	Mean (DMFT)	Std. Dev. ±	Std. Err. ±	Min.	Max.	Mean diff. ±	Sig.
Educational Level	1-High	314	3.8025	3.29282	.18582	.00	17	1:2=.82982*	.000
	2-Moderate	660	2.9727	3.06567	.11933	.00	14	1:3=1.16001*	.000
	3-Low	442	2.6425	3.22881	.15358	.00	17	2:3=.33019	.090
General Health	Normal	1382	2.9942	3.16525	.08514	.00	17	2.47638*	.000
	Diseased	34	5.4706	3.48360	.59743	.00	12		
Income level	1-High	106	3.7547	3.45808	.33588	.00	12	1:2=.39140	.244
	2-Moderate	578	3.3633	3.13357	.13034	.00	17	1:3=1.04707*	.002
	3-Low	732	2.7077	3.16518	.11699	.00	17	2:3=.65567*	.000
Job	1-mental	132	2.8182	3.09103	.26904	.00	13	1:2=.22072	.450
	2-combined	1234	3.0389	3.24183	.09229	.00	17	1:3=1.22182	.021
	3- Manual	50	4.0400	1.88398	.26644	.00	8	2:3=1.00110	.030
Carbohydrates Consumption.	1-High	420	4.1429	3.51180	.17136	.00	17	1:2=1.50672*	.000
	2-Moderate	808	2.6361	2.86651	.10084	.00	15	1:3=1.72796*	.000
	3-Low	188	2.4149	3.20898	.23404	.00	17	2:3=.22124	.381
Satisfaction	1-High	200	2.5200	3.02246	.21372	.00	13	1:2=.51509	.070
	2-Moderate	342	3.0351	3.45545	.18685	.00	17	1:3=.66307*	.008
	3-Low	874	3.1831	3.11643	.10541	.00	17	2:3=.14798	.467
Teeth brushing	1-High	274	1.8248	.53061	.03206	.00	9	1:2=1.21161*	.000
	2-Moderate	357	3.0364	.04218	.00223	.00	17	1:3=1.55617*	.000
	3-Low	210	3.3810	.10979	.00758	.00	17	1:4=1.70562*	.000
	4- not use bush	575	3.5304	.00000	.00000	.00	17	2:3=.34456*	.000
								2:4=.49401*	.000
								3:4= .14945*	.000

DISCUSSION

Dental caries is the most ubiquitous infectious disease of mankind. It is the most prevalent chronic disease worldwide with the resulting destruction of the teeth recognized as a global health crisis [27]. Dental caries affects mastication, speaking, growth and development, and school attendance. Moreover, it has a long-term psychological effect on affected individuals [28,29].

Adolescence is characterized by accelerated biological growth, changes, and social role transitions that bridge the gap from childhood to adulthood. It marks a period of significant caries activity for many individuals. Researchers suggest that the overall caries rate is declining, yet remains highest during adolescence. This potential high caries may be due to; Immature permanent tooth enamel, hormonal changes, a tendency to poor oral hygiene, nutritional habits & disorders, increased

risk for periodontal disease and traumatic injury; dental phobia; potential use of tobacco, nicotine, alcohol, and other recreational drugs; desire for oral piercings; increased risk of pregnancy or sexually transmitted infections; and unique social and psychological needs [23,30-36].

In many developing countries such as Egypt, the prevalence and severity of dental caries have been low until recent years when the trend and lifestyle are changing [12,37,38]. Epidemiological surveys provide insight into disease patterns, trends, and possible prevention and treatment plans. In this study, 1416 Egyptian adolescents were selected from different governorates aiming to represent the majority of Egyptian adolescents living in different environments. They were aged 12-19y (age of adolescence) and examined with simple disposable diagnostic tools. The caries prevalence and DMFT indices of the Egyptian adolescents were 71.61% & 3.05 respectively. These results are in line with the international rates (60-90%) [39] and are nearly identical to the results of Alaa and Mousa 2014 [22] who reported 73.93% & 3.32 respectively for caries prevalence and DMFT indices of Egyptian adolescents (12-19y). Moreover, it came compatible with many other studies that demonstrated similar values [12,21,40].

Concerning the effect of age, this study showed a direct relationship between age and dental caries. Also, it showed a highly significant difference in the caries experiences between the preparatory school-age adolescents and adolescents in both secondary school and first year of university ages in favor of the younger age group. However, although the adolescents in secondary school age showed a lower DMFT score than adolescents in the first year of university age but with insignificant differences. Since dental caries is a cumulative disease these results may refer to differences between the preparatory school ages adolescents and the two other groups' ages were 3 & 4 years bigger than the difference between the two older groups. These results were in agreement with Pierce et al., 2019 [41] who proved that dental caries increases with age. Also, this study was in agreement with many other studies [22,26] that showed a direct relationship between age and dental caries.

Regarding the effect of gender; this study demonstrated that boys had lower DMFT scores than girls in all areas with insignificant differences except in the Cairo governorate which showed a highly significant difference. This was reflected in the Egyptian males' total DMFT score which was lower than Egyptian females with an insignificant difference. This relatively higher caries incidence in adolescent females may have been attributed to the earlier growing up of girls at this stage of life than boys. This can have reflected in earlier teeth eruption, and earlier entrance in hormonal disturbances accompanying adolescence. Also, it can be referred to as the drawbacks of the menstrual cycle beginning in girls at this age. These results were in agreement with many studies [21,22,40,41] that stated that the females had higher caries experiences than males at this stage of life. In addition, it is in agreement with the American Academy of Pediatric Dentistry Guidelines on adolescents' oral health that suggested that hormonal changes affect the composition of oral flora and alter capillary permeability [42,43]. Also, the current study results were in harmony with the review article of Amare et al., 2021 [28] who estimated that females were 1.33 times more likely to develop dental caries as compared with males. Furthermore, Nag et al., 2016 [44] suggest that at the age of 6 to 18 years, caries rates were higher in girls than in boys, as girls are more neglected by parents than boys.

It is noteworthy that the Upper Egypt females and males showed the lowest caries experiences than Delta and Cairo females & males respectively. This was reflected in the DMFT score of the total number of adolescents who lived in these areas since

the Upper Egypt adolescents suffer less than Delta and Cairo adolescents respectively with highly significant differences between all groups in favor of rural governorates adolescents. These results were nearly identical to the results of Alaa and Mousa 2014 [22]. Also, these results were in agreement with Amal et al., 2021 [1] and Tsang et al, 2019 [45] who stated that despite greater health knowledge and resources among urban mothers, urban children's increased access to junk food and frequency of consumption was associated with higher prevalence and severity of caries compared to rural children. Moreover, results were compatible with the results of Alaa 2022[26] who stated that the individuals who live in the countryside eat more dairy products and are more exposed to sunlight, and live in a less contaminated area (especially in Upper Egypt) than individuals who lived in a civilized area.

Considering the effects of education level on dental decay, it is logical to find that both prevalence and DMFT indices were higher in 19y age adolescents than in secondary school and preparatory schools ages respectively. Since dental decay is a cumulative disease and directly proportional to age. In the same context, the adolescents at moderate educational level had higher caries experiences than the adolescents at the low education level. These findings are in harmony with many published studies [1,21-24].

Understanding associations between dental caries and systemic diseases play a crucial role in the treatment planning and education of dental patients. Concerning the presence of systemic diseases, it was found that medically compromised adolescents experience dental caries more than healthy normal adolescents with a highly significant difference. These results were in agreement with many studies [22,26,46, 47] results that stated that the medically compromised individuals may have low immunity and frequent drug intakes that may lead to xerostomia, thus increasing the caries experiences.

However, this study showed that the adolescents that lived in poor families suffered fewer teeth decay than middle and rich families with highly significant differences. While there is no significant difference between the middle and rich groups. These results may be referred to as most rich adolescent families living in Cairo (a civilized area) while most of the poor adolescents lived in the countryside, especially in Upper Egypt. These results came compatible with several studies [1,22,26,45] that demonstrated that individuals who lived in rural areas suffer fewer caries than individuals who lived in urban areas.

Amazing, looking at the profession of adolescents, it was found that adolescents who work in the mental profession had lower teeth decay experiences than manual and mixed professions. Moreover, the adolescents who work in manual labor suffer more teeth decay than the other two groups with significant differences. These results may be attributed to adolescents who work in mental labor being more educated and more concerned with their oral health. While the adolescents who work in manual labor were school dropouts, busier (usually work about 12h/day), and less interested in their oral health. However, these results came compatible with many studies [1,26,48] that prove an inverse relationship between the education levels and dental caries.

Considering the rate of carbohydrate consumption among the adolescents, this study revealed high significant differences in caries experiences between the adolescents who had high sweets consumption and adolescents who had moderate and low sweets consumption. Furthermore, the current study results were in agreement with the study of Amare et al., 2021 [28] who estimate the association between sugary food intake and dental caries. Furthermore, these results were compatible with many studies that demonstrated that there is a direct relationship between carbohydrate consumption and the rate of dental caries [22,24, 26].

Looking at the psychological state of adolescents, it was found that although there is an inverse relation between caries incidence and satisfaction. Strangely, there was a highly significant difference between the highly satisfied group and the low satisfied group only. The two other groups' comparisons showed no significant difference. Generally, these results were in harmony with many studies [22,26] that prove an inverse relationship between caries incidence and psychological satisfaction. Moreover, it came compatible with the study of Cademartori et al., 2021 [49] who observed that the presence of moderate/severe depressive signals and symptoms was higher in subjects with dental caries experience.

The value of the teeth brushing habit clearly appeared in this study. Since this study showed highly significant differences between all groups in favor of groups who brush their teeth more than that groups who fewer practice teeth brushing. These results were consistent with many studies [22,26,50] that demonstrated that there is an inverse relationship between the rate of caries and the number of teeth brushing. Furthermore, these results were in line with the study of Amare et al., 2021 [28] who estimated that results revealed that persons who had no tooth brushing practice were 1.97 times at risk of developing dental caries.

Although, dental caries costs US $298 billion in direct treatment costs to the global economy, 4.6% of the global health budget, and 144 billion losses due to loss of productivity [51]. Regrettably, there are few efforts and data about dental health care programs for Egyptian adolescents. Therefore, this study shed light on this problem and provides comparative and valuable data to improve adolescents' oral health. Furthermore, it provides support for government institutions to build up specific regional strategies to control and prevent dental caries among Egyptian adolescents.

Limitation of the study

1- Lack of resources and poor fund since there were no sponsors nor financial support for this study, only self-financing.

2- The study need manpower so the data collection was carried out by undergraduates' students.

3- This study required intense revision and scrutiny by the researcher to exclude any ambiguous or false data.

So Based on the results and the limitation of this study it could be concluded that

1. Dental caries of adolescents was directly proportional to age, systemic disease affection, frequency of carbohydrate intake, and the increase in family income and increase of education level at this stage of life. While it is inversely proportional to the improvement of personal career, self-satisfaction, and frequency of teeth brushing.
2. The dental caries rate is still high among Egyptian adolescents especially in the civilized areas and among adolescent females. So great efforts and support are required for governmental institutions and non-governmental organizations to formulate specific regional strategies for the prevention and control of dental caries among Egyptian adolescents.

Conflict of interest

The author declares that they have no conflict of interest.

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