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Epidemiology of dental caries among preparatory school children (12–15 years old) in Shebin El-Kom District, Menoufia Governorate

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Objective
Estimating the prevalence of dental caries in preparatory school children as well as identifying the possible risk factors and determining the correlation between dental caries and total antioxidant capacity in saliva in the studied group.

Background
Dental caries is one of the most common chronic diseases affecting millions of people globally, with high prevalence even in adolescents, ranging from 60 to 90%, and it is a major cause of tooth loss, pain, and discomfort worldwide. However, it does not have an inevitable outcome as some of the risk factors can be modified and caries can be prevented.

Patients and methods
A case–control design nested in a cross-sectional study was carried out in Menoufia Governorate. This study was carried out in Shebin El-Kom district. The study sample consisted of 1283 (651 males and 632 females) children. Saliva samples and questionnaire were collected through school visits. Total antioxidant capacity in saliva was assessed in all of the collected samples.

Results
Prevalence of dental caries was 62.8%, with decayed, missed, and filled Teeth index score of 1.3 ± 1.32. There was a significant relationship between children with dental caries and ones without caries regarding dietary habits and habitual optimal teeth brushing ($P < 0.05$).

Conclusion
Prevalence of dental caries is high among preparatory school children. To face this problem, there should be a program carried out by the government, especially Ministry of Education and Ministry of Health, targeted toward both children and their parents through different public media approaches. Programs should focus on the optimal teeth brushing and the healthy nutritional habits needed for better teeth health.

Keywords:
dental caries, decayed, missed, and filled teeth, epidemiology, school children, total antioxidant capacity

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Introduction

Dental caries is an infectious, transmissible bacterial disease. The most predominant bacterial species are *Streptococcus mutans* and *Lactobacilli* spp. as in ordinary pattern of dental caries [1].

Dental caries is a multifactorial disease that starts with microbiological shifts within the complex biofilm (dental plaque). Caries is affected by the consumption of dietary sugars, salivary flow, exposure to fluoride, and preventive behaviors. It is therefore very important to prevent dental caries, but this will not be successful unless the available scientific knowledge about changing the etiological factors of the disease is applied [2].

The WHO 2003 report on oral health provided an overview of global caries epidemiology that confirms its international pandemic distribution. It reported caries prevalence in school-age children as 60–90%. It also mentioned that caries experience in 12-year-old children is decreasing in developed and increasing in developing countries [3].

The WHO report does not include data from Egypt. Published caries epidemiological data are very few and old. On the basis of the available data on caries prevalence among adolescents, the incidence of dental caries is low and skewly distributed, with the large majority of dentinal carious lesions being present in a small percentage of children [4].

There are four main criteria required for caries formation: a tooth surface (enamel or dentin), cariogenic (or potentially caries-causing) bacteria, fermentable carbohydrates (such as sucrose), and time. The caries process does not have an inevitable outcome, and different individuals will be susceptible to different degrees depending on the shape of their teeth, oral hygiene habits, and the buffering capacity of their saliva. Dental caries can occur on any surface of a tooth that is exposed to the oral cavity but not the structures that are retained within the bone [1].

High-risk factors for the development of caries are oral hygiene, carbohydtate nutrition, the viscosity of the saliva, the buffer capacity, the pH of the saliva, the incidence of caries in parents, and social status. Moderate-risk factors are the insufficient fluoride prophylaxis and some parameters of the salivary current, such as the buffer capacity and the viscosity of the saliva. When the intake of carbohydrates is high, the way of intake of carbohydrates and the frequency of meals makes no substantial difference [5].

Antioxidants have many health benefits that made their evaluation in disease process very popular [6]. Salivary antioxidant system was found to reduce the susceptibility to dental caries; the specific role of antioxidants is to neutralize rampaging free radical and thus reducing its capacity to damage. They act as radical scavenger, hydrogen donor, electron donor, peroxide decomposer, singlet oxygen quencher, and synergist [7].

As dental caries in preparatory school age is a serious issue because it affects permanent teeth, which are not replaceable, in addition to the scanty Egyptian research in this field (to our knowledge), both constitute the two factors that trigger the conduction of this study.

Patients and methods

This study was conducted during the period from 1 May 2014 to the end of September 2015. It was carried out in Shebin El-Kom district, Menoufia governorate preparatory schools. The Menoufia Faculty of Medicine Committee for Medical Research Ethics reviewed and formally approved the study before it began. Approval from Ministry of Education was obtained, and guardians of all the participants gave written consents.

The number of preparatory schools in Shebin El-Kom district was 66 (44 rural and 22 urban). Three preparatory rural and two urban schools were chosen randomly by simple random sample methodology, and then two classes from each grade were chosen randomly in the selected schools. The total number was 1383 children from the selected schools: 704 from rural (Kafr Tanbdy, AL Batanoon and Melig) and 679 from urban (Shebin El-Kom city).

A pilot study was done on 100 children (50 rural and 50 urban). These children were excluded from analysis in the study. The pilot study was done to test the methodology applied, tools, and the feasibility of the study; to evaluate of the adequacy of the questionnaire sheet; and to reveal any modifications that might be needed according to its results.

All participants were subjected to a predesigned questionnaire, and general and local examination.

General examination included skin colors (pallor, jaundice, and cyanosis), anthropometric measures (weight, height, and BMI), and systemic organ examination (e.g., chest, heart, and abdominal examinations).

Weight was measured on a calibrated digital electronic scale, which was set to zero before placing the student on it and was checked weekly with known calibration weights [8]. Height was measured by a tape measure permanently fixed to a wall or door frame; the head was held firmly at the top of the board [9].

BMI was calculated using the following formula and was interpreted by charts of Center for Disease Control and Prevention according as follows: the children were considered underweight if they fell in a percentile range less than 5%, and normal weight, overweight, and obese if they fell in a range from 5 to less than 85%, 85 to less than 95% and more than 95%, respectively. BMI is a person's weight in kilograms divided by the square of height in meters [weight (kg)/height (m) ^{2}]. For children and teens, BMI is age and sex specific and is often referred to as BMI for age [10].

Local oral examination for all the children was done by the help of a dentist for detection of any abnormalities of the oral cavity and for dental caries using good light source, mirror, and explorer. Dental caries was then assessed using the decayed, missed, and filled teeth (DMFT) scoring system [11].

The DMF index has been used for more than 70 years and is well established as the key measure of caries experience in dental epidemiology [12].

The DMF Index is applied to the permanent dentition and is expressed as the total number of teeth or surfaces that are decayed (D), missing (M), or filled (F) in an individual. When the index is applied to teeth specifically, it is called the DMFT index, and scores

per individual can range from 0 to 28 or 32, depending on whether the third molars are included in the scoring or not [11].

Calculating decayed, missed, and filled teeth

The teeth not counted are unerupted teeth, congenitally missing teeth, or supernumerary teeth, teeth removed for reasons other than dental caries, and primary teeth retained in the permanent dentition. Counting the third molars is optional. When a carious lesion(s) or both carious lesion(s) and a restoration are present, the tooth is listed as decayed. When a tooth has been extracted owing to caries, it is listed as missing. When a permanent or temporary filling is present, or when a filling is defective but not decayed, this is counted as filled. Teeth restored for reasons other than caries are not counted as filled (12).

The new oral health goals were not numerically specific. Instead, each country could specify its own targets based on current disease prevalence and severity, local priorities, and oral health systems. Based on DMFT values, WHO generated a scale to classify caries severity: DMFT values between 0.0 and 1.1 were very low, 1.2–2.6 were low, 2.7–4.4 were moderate, 4.5–6.5 were high, and values exceeding 6.6 were very high [3].

Among the studied children, 300 of them were chosen randomly from all the children: 200 of them had dental caries and 100 were caries free. This number was selected according to the available funding. Saliva samples were collected from them in test tubes, at least 2 ml, when they were asked to expectorate in the tubes. Each sample was coded randomly by a number from one to three hundred. Samples were then refrigerated in a cold box until reaching the private laboratory to be examined.

Data management

Data were collected, tabulated, and statistically analyzed using an IBM personal computer with statistical package for the social sciences (SPSS) version 20 (Washington, Chicago, USA) and Epi Info 2000 (Centers for Disease Control and Prevention, Atlanta, USA) programs, where the following statistics were applied: Student's *t*-test for quantitative variables; χ^2-test for qualitative variables; Mann–Whitney for nonparametric data; and Spearman's correlation, and for correlation, with a significance level of *P* Equal to or less than 0.05.

Results

Sociodemographic data of the studied children were as follows: 651 males and 632 females; 629 urban and 654 rural ones; mean age was 13.05 ± 0.84 years; 60% of children were considered of middle socioeconomic standard; prevalence of dental caries was 62.8%, with DMFT score of 1.3 ± 1.32 (as mean and SD) (Table 1); and the percentages of children with decayed teeth only, treated teeth only, and decayed and treated were 37.4, 7.8, and 17.8%, respectively (Table 1). There was no significant difference in dental caries prevalence between males and females ($P > 0.05$) and also between rural and urban children ($P > 0.05$, Table 2). Dental caries was statistically significantly higher with higher birth order than lower birth order ($P < 0.05$, Table 2) and also higher prevalence in family with large size than with small size ($P < 0.001$, Table 3). Dental caries was significantly higher in children whose fathers worked as manual workers and professionals than employees ($P < 0.001$) and in children whose fathers are lower educated and highly educated in relation to middle (secondary) educated ones ($P < 0.05$, Table 3).

There was significantly higher caries in children with high socioeconomic standard and low socioeconomic standard in relation to with middle one ($P < 0.05$), and there is no significant difference regarding mother's job or education ($P > 0.05$, Table 3). There was no statistically significant difference between caries occurrence in children who do not brush their teeth as a habit and those who habitually brush their teeth ($P > 0.05$, Table 4). Dental caries was less significantly common in children who brush their teeth more than once per day ($P < 0.001$, Table 4) and those who consume dairy products daily and red meat regularly (weekly) ($P < 0.001$), and it was significantly higher in children who consume soda and soft sugary drink on daily regular basis ($P < 0.05$, Table 5). Pain experience was a highly significantly present feature occurring with caries at 92.9% ($P < 0.001$, Table 5).

Prevalence of dental caries varied significantly ($P < 0.05$) with BMI, as it was higher with overweight and obese children (Table 5).

Total antioxidant capacity (TAC) in the saliva was significantly higher in children with caries (Table 6) than those without caries ($P < 0.001$). There was a positive correlation (Table 7) between

Table 1 Prevalence of dental caries among studied children (*n*=1283)

Sociodemographic data	*N* (%)
Prevalence of dental caries	
Absent	477 (37.2)
Present	806 (62.8)
Decayed, missed, and filled teeth score	1.3±1.32
Status of teeth	
Decayed only (untreated)	480 (37.4)
Treated only (missed or filled)	101 (7.8)
Decayed and treated	225 (17.8)

Table 2 Sociodemographic characteristics in relation to dental caries among studied children (*n*=1283)

Sociodemographic data	Studied children [*n* (%)]		Total [*n* (%)]	χ^2	Odds ratio (95% confidence interval)	*P*
	With caries (*N*=806)	Without caries (*N*=477)				
Age (mean±SD) (years)	13.02±0.86	13.08±0.86		[a]*t*-Test=1.268 *P*>0.05		
Sex						
Male	397 (61)	254 (39)	651 (100)	1.912	1.73 (0.96–1.48)	>0.05
Female	409 (64.7)	223 (35.3)	623 (100)			
Educational year						
First	257 (64.2)	143 (35.8)	400 (100)	1.66	0.93 (0.83–1.03)	>0.05
Second	318 (64.5)	175 (35.5)	493 (100)	2.35	0.92 (0.83–1.02)	>0.05
Third[a]	231 (59.2)	159 (40.8)	390 (100)			
Residence						
Urban	390 (62)	239 (38)	629 (100)	0.35	1.07 (0.85–1.34)	>0.05
Rural	416 (63.6)	238 (36.4)	654 (100)			
Birth order						
>3rd	97 (70.8)	40 (29.2)	137 (100)	4.18	1.49 (1.01–2.20)	<0.05
1st to 3rd	709 (61.9)	437 (38.1)	1146 (100)			

[a]Reference group.

Table 3 Socioeconomic data in relation to dental caries among studied children (*n*=1283)

Socioeconomic data	Studied children [*n* (%)]		Total [*n* (%)]	χ^2	Odds ratio (95% confidence interval)	*P*
	With caries (*N*=806)	With caries (*N*=477)				
Family size						
>5	285 (70)	122 (30)	407 (100)	13.24	1.59 (1.24–2.04)	<0.001
≤5	521 (59.5)	355 (40.5)	876 (100)			
Family income						
Low[a]	86 (61)	55 (39)	141 (100)	0.84	0.96 (0.67–1.13)	>0.05
Middle	628 (61.9)	387 (38.1)	1015 (100)	3.34	0.59 (0.36–1.00)	>0.05
High	92 (72.4)	35 (27.6)	127 (100)			
Mother's education						
Illiterates and basic[a]	193 (63.1)	113 (36.9)	306 (100)	0.90	0.86 (0.64–1.05)	>0.05
Secondary	299 (59.4)	204 (40.6)	503 (100)	0.69	1.15 (0.85–1.55)	>0.05
High	314 (66.2)	160 (33.8)	474 (100)			
Mother's occupation						
Not working	541 (63.9)	305 (36.1)	846 (100)	1.35	1.05 (0.96–1.16)	>0.05
Working	265 (60.6)	172 (39.4)	437 (100)			
Father's education						
Illiterates and basic[a]	155 (56.2)	121 (43.8)	276 (100)	0.3	1.04 (0.76–1.41)	<0.05
Secondary	237 (47.1)	178 (42.9)	415 (100)	15.81	1.82 (1.35–1.40)	<0.001
High	414 (69.9)	178 (30.1)	592 (100)			
Father's occupation						
Worker[a]	265 (55.4)	213 (44.6)	478 (100)	18.06	1.81 (1.38–2.38)	<0.001
Employee	307 (69.3)	136 (30.7)	433 (100)	6.83	1.47 (1.04–1.30)	<0.001
Professional	234 (64.6)	128 (35.4)	372 (100)			
Socioeconomic standard						
Low	36 (73.5)	13 (26.5)	49 (100)	3.35	1.91 (1.00–3.6)	<0.05
Middle[a]	455 (59.2)	314 (40.8)	769 (100)	8.72	1.45 (1.14–1.85)	<0.05
High	315 (67.7)	150 (32.3)	465 (100)			

[a]Reference group.

TAC and DMFT ($P < 0.05$) and no significant correlation between TAC and both age and BMI ($P > 0.05$, Table 7). There was no correlation between DMFT score and age ($P < 0.05$, Table 7).

Discussion

In this study, prevalence of dental caries was 62.8% in the studied children with DMFT of 1.3 ± 1.32. This result is similar to those reported by WHO report, 2003, in Eastern Mediterranean Region in which average DMFT index found in the region was 2 ± 1.3. Half of the countries had an index of 1.6 and the values ranged from 0.4 to 5.9, and the prevalence of dental caries was 60–90%. This is against the study by Al Agili [13] who found that prevalence of dental caries was ~70% for children's permanent dentition, with a mean DMFT score of 3.5, which is higher than our result but falls in the range of prevalence stated by WHO.

Table 4 Oral hygiene differences in relation to dental caries among studied children (*n*=1283)

Oral hygiene	Studied children [*n* (%)]		Total [*n* (%)]	χ^2	Odds ratio (95% confidence interval)	*P*
	With caries (*N*=606)	Without caries (*N*=377)				
Teeth brushing						
No	79 (65.8)	41 (34.2)	120 (100)	0.51	1.05 (0.92–1.20)	>0.05
Yes	727 (62.5)	436 (37.5)	1163 (100)			
Frequency of teeth brushing						
Not a habit	541 (61.2)	343 (38.8)	884 (100)	2.65	0.81 (0.63–1.03)	>0.05
Always (habit)	260 (66.2)	133 (33.8)	393 (100)			
Number of times of brushing						
Once/day	489 (67.6)	234 (32.4)	723 (100)	21.99	1.77 (1.39–2.26)	<0.001
More than once/day	238 (54.1)	202 (45.9)	440 (100)			

Table 5 Food item difference and BMI in relation to dental caries among studied children (*n*=1283)

Number of eating some food stuffs/week	Studied children [*n* (%)]		Total [*n* (%)]	χ^2	Odds ratio (95% confidence interval)	*P*
	With caries (*N*=806)	Without caries (*N*=477)				
Diary product						
Not daily	435 (68.8)	197 (31.2)	632 (100)	19.25	1.67 (1.33–2.10)	<0.001
Daily	371 (57)	280 (43)	651 (100)			
Meat						
Monthly and never	112 (75.2)	37 (24.8)	149 (100)	11	1.92 (1.23–2.87)	<0.001
Daily and weekly	694 (61.2)	440 (38.8)	1134 (100)			
Fish						
Monthly and never	495 (62.9)	292 (37.1)	787 (100)	0.5	1.01 (0.80–1.27)	>0.05
Daily and weekly	311 (62.7)	185 (37.3)	496 (100)			
Vegetables and fruits						
Daily as a habit	610 (63.5)	350 (36.5)	960 (100)	0.84	1.05 (0.95–1.016)	>0.05
Not daily	196 (60.7)	127 (39.3)	323 (100)			
Snacks						
Daily	610 (63.5)	350 (36.5)	960 (100)	0.85	1.05 (0.95–1.15)	>0.05
Not daily	196 (60.7)	127 (39.3)	323 (100)			
Soda						
Daily	319 (68)	150 (32)	469 (100)	8.54	1.14 (1.05–1.24)	<0.05
Not daily	487 (59.8)	327 (40.2)	814 (100)			
BMI						
Under weight (<18.5)	190 (62.9)	112 (37.1)	302 (100)	0.41	1.11 (0.84–1.47	>0.05
Normal weight[a] (18.5–24.99)	406 (60.5)	265 (39.5)	671 (100)	4.45	1.37 (1.02–1.84)	<0.05
Over weight and obese (≥25–29.99)	210 (67.7)	100 (32.3)	310 (100)			

[a]Reference group.

Table 6 Total antioxidant capacity in saliva difference in relation to dental caries among studied children (*n*=300)

Total antioxidant capacity in saliva (mmol/l)	Studied children (*N*=300)		*t*-Test	*P*
	Without caries (*N*=100)	With caries (*N*=200)		
TAC (mean±SD)	0.63±0.05	0.81±0.05	17.8	<0.001

TAC, total antioxidant capacity.

Table 7 Correlation between different parameters in the studied children (*n*=1283)

	r	*P* value
TAC and DMFT score	0.87	<0.001
TAC and BMI	0.098	>0.05
TAC and age	0.27	>0.05
DMFT and age	0.005	>0.05

DMFT, decayed, missed, and filled teeth; TAC, total antioxidant capacity.

It was found that many factors were associated with increasing risk of dental caries. It occurred in both sex, with female predominance (50.7%), though no significant difference was found ($P > 0.05$). This is in agreement with Cortés *et al.* [14], where females had higher caries experience than males, but with similar prevalence and severity ($P > 0.05$). There was no statistically significant difference between females and males for the missing teeth and filled teeth, which can be owing to the fact that these children have not reached puberty yet, so there is no evident hormonal difference and effect. This is in disagreement with the study by Al-Darwish *et al.* [15], which found that female children showed a significantly higher incidence of dental caries than male children ($P < 0.05$), and the difference was marginally significant.

This study showed dental caries was significantly higher with higher birth order than 3 than lower one ($P < 0.05$) and in children in families with larger size than lower ones, which may be because of lack of care on part of the parents toward their children's oral hygiene or diet or lower per capita income.

Dental caries was higher in rural children than urban ones but not statistically significant ($P > 0.05$), which may be owing to the semi-urban characteristics of the city of our study and that rural areas recruited are close to the city and not very low in standard.

This study showed that dental caries prevalence is significantly higher in children with low socioeconomic standard ($P < 0.05$), which is in agreement with a meta-analysis by Costa *et al.* [16] which stated that worse socioeconomic indicators, such as subject's schooling, income, and occupation are associated with a greater severity of dental caries in adults, and it also showed higher prevalence of caries in higher socioeconomic standard ($P < 0.05$), which may be owing to faulty dietary habits with excessive snacks or sugary food, which is in disagreement with Al-Darwish *et al.* [17] who stated that private school children had caries lower than public school children, and also with Rashkova *et al.* [18], who found that low SES students had a much greater incidence of caries.

It was found that there was no statistically significant difference between caries occurrence in children who do not brush their teeth as a habit and those who habitually brush their teeth ($P > 0.05$), but there was a statistically significant difference in caries prevalence in children who habitually brush more than one time per day than those who brush once per day ($P < 0.001$), which illustrates the importance not only of teeth brushing but also the number of teeth brushing per day. This result comes in concordance with Veiga *et al.* [19], who stated that deficient oral health behaviors such as irregular brushing and lack of using dental floss daily are great risks for dental caries development; with Peneva [20], who stated that factors such as oral hygiene and social status, which can have both a risk and protective effect, usually evince as having a risk effect; and also with Rashkova *et al.* [18], who stated that children with bad oral hygiene have a noticeably higher number of caries.

This study showed that there is lower prevalence of dental caries in children consuming dairy products daily ($P < 0.001$) and habitually eating meat ($P < 0.05$), which comes in agreement with Petridou *et al.* [21] who reported that milk and dairy products were negatively associated with dental caries in 380 Greek adolescents aged 12–17 years and with Petti *et al.* [22] who reported an inverse relation between milk and caries.

It was found that dental caries prevalence was statistically significantly higher ($P < 0.05$) in children with higher BMI (overweight and obese) than those with normal weight, which may be owing to faulty dietary habits, especially sugary snacks eating. This comes in disagreement with Hooley *et al.* [17], who stated there is still significant disagreement as to the existence and nature of an association between dental caries and BMI, and also with Silva *et al.* [23] who found that there is no sufficient evidence regarding the association between obesity and dental caries.

Total antioxidant capacity in saliva was significantly higher in children with dental caries ($P < 0.001$), which comes in agreement with Tulunoglu *et al.* [6] who found that increase in the antioxidant activity of the saliva has been related to an increase in the suspension of proteins and of cariogenic activity, and also Uberos *et al.* [24], who stated that the TAC of saliva is greater among children who have caries.

There was highly significant positive correlation between total antioxidant capacity in saliva and DMFT index ($P < 0.001$), which is in agreement with Kumar *et al.* [25] who stated that with increasing dental caries experience, the TAC of saliva was found to increase, and with Hegde *et al.* [26], who found that total antioxidant capacity of saliva has a linear relation with caries.

Summary and recommendations

On the basis of the findings of this study, we can conclude that prevalence of dental caries was 62.8% with DMFT of 1.3 ± 1.32 among children. Dental caries prevalence varies in relation to habitually daily brushing of teeth more than once per day and to family size, birth order, socioeconomic standard, dietary habits such as regularly consuming meat and daily consuming dairy product and soda, and BMI. The total antioxidant capacity in saliva is higher in dental caries active children than caries-free children, and it increases with increasing DMFT index.

On the basis of the findings of this study, we can recommend making a health education program involving health authorities and media directed toward children and their families focusing on the importance of regular ideal teeth brushing, the importance of consuming dairy products and meat, and the importance of balanced diet with limiting of excess unhealthy snacks and sugars, for example, potato chips and soda.

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Conflicts of interest
There are no conflicts of interest.

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