RESEARCH ARTICLE

The potential impact of age, gender, body mass index, socioeconomic status and dietary habits on the prevalence of dental caries among Egyptian adults: a cross-sectional study [version 1; peer review: 3 approved]

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Abstract

Background: Dental caries is a major public health problem and the most widespread chronic disease to affect individuals throughout their lifetime. Little information exists about the prevalence of dental caries among Egyptian adults. Therefore, this study investigated the dental caries experience among Egyptian adults in correlation with different risk factors.

Methods: A total of 359 Egyptian adults (age range, 18-74 years) were examined over a period of 3 months, starting on the 15th of November 2017 until the 13th of January 2018. Socio-demographic data, brushing frequency, body mass index (BMI) and eating habits were recorded and collected using a questionnaire. Dental examination was performed using the Decayed, Missing and Filled tooth (DMFT) index.

Results: In total, 86.63% of participants had dental caries experience. Of the participants, 60.45%, 48.47% and 55.43% had at least one decayed, missing and filled tooth, respectively. The mean number of decayed, missing, filled or DMFT for the whole sample were 2.4±3.6, 1.98±3.99, 1.79±2.45, 6.09±5.7, respectively. Decayed teeth were inversely correlated with socio-economic status (SES), education level, brushing frequency and milk consumption and positively correlated with grains, junk food and soda drinks consumption. Missing teeth were inversely correlated with SES, education level and brushing frequency, while positively correlated with age, BMI and caffeinated drink consumption. Conversely, filled teeth were positively correlated with age, BMI, SES and education level, while negatively correlated with grains and sugars in drinks.

Conclusion: The present study clarifies that age, BMI, SES, education level and brushing frequency are risk factors significantly associated with dental caries prevalence amongst Egyptian adults. Egyptian adults' dietary habits

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might lead to obesity, which indirectly causes dental caries rather than directly as in children.

Keywords
Caries, Prevalence, Age, Socioeconomic, Dietary, Education, Egyptian, Adults

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Introduction

Dental caries is the progressive destruction of the tooth structure by bacterial acids[1]. It is considered the most prevalent chronic oral disease and the primary reason for tooth loss in adults. Dental caries has been estimated to affect almost every individual during their adult life, affecting an average of 5 to 10 teeth per each individual[1–3]. The prevalence of caries in a population is affected by numerous risk factors, such as sex, oral hygiene and dietary habits. Moreover, the prevalence of caries tends to increase with age as it is a cumulative process[3–6]. Tooth decay is particularly prevalent in developing countries owing to the dietary habits, socioeconomic conditions and a lack of education[7].

Data on the incidence of dental caries among Egyptian adults are scarce and are mostly grey literature, which makes this data hard to find. The last published report for the prevalence of caries among Egyptian adults was carried out by the World Health Organization (WHO) in collaboration with the Egyptian Ministry of Health in 2014[8].

Therefore, the current study was carried out to investigate the prevalence of caries among Egyptian adults in correlation with different risk factors.

Methods

Subjects and methods

This study was carried out according to the regulations of the Research Ethics Committee of Faculty of Dentistry, Cairo University, Egypt (Approval:171217). Written informed consent was obtained from patients before participating in the study.

The subjects in this study were recruited between November 2017 to January 2018, from the outpatients' clinics of Faculty of Dentistry, Cairo University, which serves patients arriving from different parts of Egypt; in addition to two private dental clinics.

The inclusion criteria for the patients were: age, 18–74 years; either gender; ethnicity, Egyptian. The exclusion criteria were: history of radiotherapy and/or chemotherapy; subjects undergoing orthodontic therapy and patients who might not comply with study procedures (as judged by those who refused to answer all questions in the questionnaire[9]).

Sample size calculation

The sample size for caries in adults was estimated to be 264 individuals according to the following equation:

$$n' = \frac{NZ^2 2P(1-P)}{d^2(N-1)+Z^2P(1-P)}10\cdot$$

n' = sample size with finite population correction, N = Egyptian adults population size (estimated by 45,000,000), Z = Z statistic for a level of confidence which is conventional (1.96). P = Expected prevalence (78.00%) and d = Precision (5% = (0.05)). The prevalence was estimated as 78%, as in India the caries prevalence was estimated to be 82.6–91.6%[11] and in Kosovo was 72.8%[12].

Data collection and grouping

A total of 359 Egyptian adult patients were examined in this study. The collected data included name, age, gender, address, level of education; low (primary school or illiterate); moderate (diploma or high school); high (university), occupation and brushing frequency. A full assessment of the dietary habits was performed using a questionnaire[9].

Subjects were instructed to remove only their shoes while taking their anthropometric measurements. Weight was measured using a Beurer scale (Ulm, Germany) and their stature was measured to the nearest 0.1 cm using a stadiometer. Body mass index (BMI) was calculated using the formula: BMI = weight in kg / (height in m)^2. Patients were categorized according to their BMI as follows: underweight (<18.5 kg/m^2), normal (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2) and obese (≥30.0 kg/m^2)[13].

Adults were classified according to their age as follows: BI (18–34 years old), BII (35–44 years old), BIII (45–64 years old) and BIV (65–75 years old) and were classified according to their socioeconomic status into low, moderate and high depending on their level of education, occupation and address[14].

Oral examination

At the beginning, the authors (M.M.S., S.E., D.R., N.A., I.A.R.) were calibrated to avoid differences in observations and to reach a consensus. Oral examination was carried out according to WHO recommendations[15], as described in our previous study[16]. All present teeth were examined for the presence of carious lesions. Teeth were carefully inspected for the presence of any lesion with a softened floor, undermined enamel, or softened wall, in a pit or fissure or on a smooth tooth surface. Tooth surface containing temporary filling or a permanent restoration but showing an area of decay (either primary or secondary caries) were also considered carious. DMFT index was used to measure the activity of caries, where D denotes decayed teeth, M is for missing teeth and F is for filled teeth[17].

Statistical analysis

The statistical package used in this study is the R statistical package, version 3.3.1 (2016-06-21). For descriptive analyses, variables were described in terms of means ± standard deviations (SD), medians and ranges. For normality, Shapiro-Wilk test was applied to assess the normality of data. All data were not normally distributed. For comparative analysis, the non-parametric Kruskal-Wallis test was performed. Spearman's correlation coefficient was calculated for correlation analysis. The significance level was verified at $P \leq 0.05$.

Results

Raw data from the present study are available on figshare[18].

Population profile

The mean number of decayed, missing, filled and DMFT for the whole sample were 2.4±3.6, 1.98±3.99, 1.79±2.45, 6.09±5.7,

respectively. A total of 60.45%, 48.47% and 55.43% of participants had at least one decayed, missing or filled tooth, respectively. The prevalence of DMFT among participants was 86.63%.

The number and percentage of adults in different categories in each studied parameter as well as comparisons between them are presented in Table 1. The number and percentage of participants that had decayed, missing, filled or DMFT in different categories in each studied parameter are presented in Table 2.

Decayed teeth in correlation to different caries risk factors

As shown in Table 3 and Figure 1, despite the highest means of decayed teeth were recorded in adults aged 65–75 years, in males and in adults of normal weight (3.42±7.39, 2.61±3.68 and 2.83±3.77, respectively), the differences in medians were statistically insignificant (p≥0.05) and there was no correlation between age, gender or BMI and decayed teeth (Spearman's rho=-0.04, 0.08 and -0.07, respectively; p≥0.05).

Adults with low SES, low education level and who do not brush their teeth had the highest mean number of decayed teeth (4.08±4.63, 4.78±5.97 and 4.26±5.76, respectively). The differences in medians were statistically significant (p≤0.0001). SES, education level and brushing frequency were inversely correlated with number of decayed teeth (Spearman's rho= -0.28, -0.24, and -0.26, respectively; p≤0.0001).

Adults who consume bread, eggs, fruits/vegetables, grains, crackers, junk food, chocolate, soft drinks and caffeinated drinks 1–6 times per day had the highest mean number of decayed teeth (2.48±3.70, 3.11±2.54, 2.54±3.98, 2.90±4.16, 2.67±3.2, 3.34±3.87, 2.43±3, 3.22±4.47 and 2.48±3.74, respectively). Milk consumption was significantly inversely correlated with decayed teeth (rho= -0.15, p=0.0037), whereas consumption of grains, junk food and soft drinks were significantly positively correlated (rho=0.13, 0.15 and 0.13; p=0.0143, 0.0058 and 0.0121, respectively). The differences in medians for decayed teeth in all dietary elements were statistically insignificant except for eggs, milk, grains and junk food.

Missing teeth and different caries risk factors

As revealed in Table 4 and Figure 2, the highest mean number of missing teeth were detected in adults aged 65–75 years, besides in obese adults (6.08±6.64 and 3.51±5.56, respectively). The differences in medians were statistically significant (p≤0.0001). Age and BMI were directly correlated with number of missing teeth (Spearman's rho=0.44 and 0.25, respectively; p≤0.0001).

However, males had a higher mean missing teeth than females (2.07±4.38), the difference in medians was statistically insignificant (p≥0.05) and there was no correlation between gender and missing teeth (Spearman's rho= -0.02, p≥0.05).

Adults with low SES, low education level and those who don't brush their teeth had the highest means missing teeth (3.23±4.84, 3.78±5.09 and 3.34±5.57, respectively). The differences in medians were statistically significant (p≤0.0001). SES, education level and brushing frequency were inversely correlated with number of missing teeth (Spearman's rho= -0.25, -0.3 and -0.23, respectively; p≤0.0001).

Adults who consume eggs, milk, sugar in drinks and caffeinated drinks 1–6 times per day had the highest means missing teeth (3.11±6.01, 2.27±4.78, 2.22±4.35 and 2.10±4.01, respectively); while those who consume bread, other carbohydrates, fruits/vegetables, milk products, grains, sugar, jam, candies, crackers, junk food, chocolate, soft drinks, juices and citric juices less than or equal to two times a week had the highest means of missing teeth (2.31±4.35, 3±4.44, 2.09±3.82, 2.34±4.44, 2.13±4.13, 2.33±4.4, 2.04±4.09, 2.47±4.42, 2.57±4.62, 2.49±4.68, 2.32±4.21, 2.40±4.45, 2.42±4.18 and 2.06±3.92, respectively). The differences in medians for missing teeth in all parameters were statistically insignificant except for other carbohydrates, sugar not in drinks, candies, crackers, junk food, chocolate, soft drinks and juices. Consumption of sugars not included in drinks, candies, crackers, junk food, chocolate, soft drinks, juices and caffeinated drinks were inversely correlated with missing teeth.

Filled teeth and different caries risk factors

As seen in Table 5 and Figure 3, adults aged 65–75 years and obese adults had the highest mean numbers of filled teeth (1.83±1.64 and, 3.51±5.56, respectively). The difference in medians was statistically insignificant for age (p->0.05), while was statistically significant for BMI (p=0.0223). Age and BMI were directly correlated with number of filled teeth (Spearman's rho=0.13 and 0.16, and p=0.0138 and, 0.002, respectively).

Males had a higher mean number of filled teeth than females (1.81±2.4), while adults who don't brush their teeth had the lowest mean number of filled teeth (1.39±1.79). The differences in medians were statistically insignificant (p>0.05) and there was no correlation between gender or brushing frequency and number of filled teeth (Spearman's rho=-0.02 and 0.04, respectively; p>0.05).

Adults with high SES and high education levels had the highest mean number of filled teeth (2.26±2.74 and 2.24±2.72, respectively); the differences in medians were statistically significant (p=0.0016 and 0.0002, respectively). SES and education level were directly correlated with filled teeth (Spearman's rho=0.18 and 0.21; p=0.0004 and <0.0001, respectively).

Adults who consume eggs, fruits/vegetables, milk, milk products, grains, sugar in drinks, sugar not in drinks, jam, candies, junk food, chocolate, soft drinks, citric juices and caffeinated drinks 3–6 times per week had the highest means of filled teeth (2.01±2.8, 2.18±2.52, 2.48±2.56, 2.05±2.1, 3±2.69, 3.67± 2.9, 3.38±2.47, 2.3±2.14, 2.28±2.96, 3.72±3.1, 2.13±2.67, 2.77±2.78, 2.64±3.07 and 2.93±2.97, respectively). Moreover, adults who consume bread, other carbohydrates, crackers and juices less than or equal to two times a week had the highest mean numbers of filled teeth (2.62±3.36, 2.09±2.83, 2.02±2.66 and, 2.03±2.71, respectively).

The differences in medians for filled teeth regarding all dietary elements were statistically insignificant except for grains, sugar

Table 1. Descriptive analysis of categorical variables and comparisons between proportions (N=359).

Parameter and categories		Number (%)	Pearson's Chi-squared test	
			χ^2	p-value
Age	**BI (18-34 years)**	185(51.53)	297.31	<0.0001*
	BII (35-44 years)	81(22.56)		
	BIII (45-64 years	81(22.56)		
	BIV (65-75 years)	12(3.34)		
Gender	**Males**	150(41.78)	9.70	0.0018*
	Females	209(58.22)		
Body mass index	**Underweight**	2(0.56)	134.8	<0.0001*
	Normal	128(35.85)		
	Overweight	143(40.05)		
	Obese	84(23.53)		
SES	**Low**	95(26.46)	7.78	0.02*
	Moderate	128(35.93)		
	High	134(37.6)		
Level of education	**Low**	46(12.81)	115.86	<0.0001*
	Moderate	103(28.69)		
	High	210(58.5)		
Brushing frequency	**No brushing**	83(23.11)	114.57	<0.0001*
	Infrequent	48(13.37)		
	once daily	106(29.52)		
	Twice daily	89(24.79)		
	Three times	32(8.91)		
	Other	1(0.27)		
Reason for no brushing	**Bleeding**	31 (31)	28.9	<0.0001*
	I don't know how to brush	6 (6)		
	I forget	13 (13)		
	I don't have time	34 (34)		
	Other	16(16)		
Dietary Habits				
-Bread	**≤ 2 times/week**	13(3.62)	559.84	<0.0001*
	3-6 times/week	15(4.18)		
	1-6 times/day	331(92.20)		
-Other carbohydrates	**≤ 2 times/week**	65(18.10)	214.77	<0.0001*
	>3-6 times/week	44(12.26)		
	>1-6 times/day	250(69.64)		
-Eggs	**≤ 2 times/week**	236(65.74)	174.19	<0.0001*
	3-6 times/week	78(21.73)		
	1-6 times/day	45(12.53)		

Parameter and categories		Number (%)	Pearson's Chi-squared test	
			χ^2	p-value
-Fruits/Vegetables	≤ 2 times/week	69(19.22)	161.6	<0.0001*
	3-6 times/week	57(15.88)		
	1-6 times/day	233(64.90)		
-Milk	≤ 2 times/week	181(50.42)	107.32	<0.0001*
	3-6 times/week	29(8.08)		
	1-6 times/day	149(41.50)		
-Milk products	≤ 2 times/week	107(29.81)	125.62	<.0.0001*
	3-6 times/week	40(11.14)		
	1-6 times/day	212(59.05)		
-Grains	≤ 2 times/week	153(42.62)	59.12	<0.0001*
	3-6 times/week	51(14.20)		
	1-6 times/day	155(43.18)		
-Jam, Molasses and Honey	≤ 2 times/week	264(73.54)	266.25	<0.0001*
	3-6 times/week	30(8.36)		
	1-6 times/day	65(18.10)		
-Candies	≤ 2 times/week	249(69.36)	218.51	<0.0001*
	3-6 times/week	32(8.91)		
	1-6 times/day	78(21.73)		
-Crackers	≤ 2 times/week	196(54.60)	113.99	<0.0001*
	3-6 times/week	32(8.91)		
	1-6 times/day	131(36.49)		
-Junk food	≤ 2 times/week	240(66.85)	201.4	<0.0001*
	3-6 times/week	25(6.96)		
	1-6 times/day	94(26.18)		
-Chocolate	≤ 2 times/week	261(72.70)	255.8	<0.0001*
	3-6 times/week	31(8.64)		
	1-6 times/day	67(18.66)		
-Soda	≤ 2 times/week	211(58.77)	129.98	<0.0001*
	3-6 times/week	35(9.75)		
	1-6 times/day	113(31.48)		
-Juices	≤ 2 times/week	223(62.11)	157.98	<0.0001*
	3-6 times/week	30(8.36)		
	1-6 times/day	106(29.53)		
-Citric juices	≤ 2 times/week	274(76.32)	303.68	<0.0001*
	3-6 times/week	25(6.96)		
	1-6 times/day	60(16.71)		
-Caffeinated drinks	≤ 2 times/week	47(13.09)	403.19	<0.0001*
	3-6 times/week	14(3.90)		
	1-6 times/day	298(83)		

Statistical significance at p-value ≤ 0.05

Table 2. Descriptive analysis of number and percentage of individuals that had untreated decayed, missing and filled teeth in different categories.

Parameter and categories		Number (%)			
		Decayed	Missing	Filled	DMFT
Age	**BI (18-34 years)**	108 (58.38)	52 (28.11)	94 (50.81)	184 (80)
	BII (35-44 years)	51 (62.96)	74 (58.82)	45 (55.56)	73 (90.12)
	BIII (45-64 years	53 (65.43)	63 (77.78)	51 (62.96)	78 (96.30)
	BIV (65-75 years)	5 (41.67)	11 (91.67)	9 (75)	12 (100)
Gender	**Males**	101 (67.33)	76 (50.67)	84 (56)	134 (89.33)
	Females	116 (55.50)	98 (46.89)	116 (55.50)	174 (83.25)
Body mass index	**Underweight**	1 (50)	0 (0)	1 (50)	2 (100)
	Normal	78 (60.94)	46 (35.94)	61 (47.66)	108 (84.38)
	Overweight	87 (60.48)	69 (48.25)	83 (58.04)	118 (82.52)
	Obese	48 (57.14)	59 (70.24)	54 (64.29)	79 (94.05)
SES	**Low**	77 (81.05)	67 (70.53)	42 (44.21)	89 (93.68)
	Moderate	72 (55.81)	54 (41.86)	72 (55.81)	108 (83.72)
	High	68 (50.75)	53 (39.55)	86 (64.18)	113 (84.33)
Level of education	**Low**	74 (71.84)	32 (31.07)	21 (20.39)	42 (40.78)
	Moderate	52 (50.49)	48 (46.6)	40 (38.83)	75 (72.82)
	High	113 (53.81)	79 (37.62)	133 (63.33)	176 (83.81)
Brushing frequency	**No brushing**	60 (72.29)	51 (61.45)	43 (51.81)	81 (97.59)
	Infrequent	36 (75)	29 (60.42)	28 (58.33)	42 (87.50)
	once daily	61 (57.55)	59 (55.66)	60 (56.60)	92 (86.79)
	Twice daily	48 (53.93)	25 (28.09)	53 (59.55)	73 (82.02)
	Three times	10 (31.25)	8 (25)	14 (43.75)	20 (62.5)
	Other	0 (0)	1 (100)	1 (100)	1(100)
Dietary habits					
-Bread	**≤ 2 times/week**	9 (69.23)	5 (38.46)	8 (61.54)	11 (84.62)
	3-6 times/week	7 (64.67)	3 (20)	8 (53.33)	11 (73.33)
	1-6 times/day	201 (60.73)	165 (49.85)	187 (56.5)	289 (87.31)
-Other carbohydrates	**≤ 2 times/week**	37 (56.92)	35 (53.85)	35 (53.85)	56 (86.15)
	3-6 times/week	24 (54.55)	19 (43.18)	25 (56.82)	39 (88.64)
	1-6 times/day	155 (62)	120 (48)	140 (56)	215 (86)
-Eggs	**≤ 2 times/week**	156 (66.1)	116 (49.15)	130 (55.08)	202 (85.59)
	3-6 times/week	39 (50)	37 (47.44)	43 (55.13)	66 (84.62)
	1-6 times/day	31 (68.89)	20 (44.44)	26 (57.78)	41 (91.11)
-Fruits/Vegetables	**≤ 2 times/week**	43 (62.32)	35 (50.72)	39 (56.52)	62 (89.86)
	3-6 times/week	31 (54.39)	30 (52.63)	38 (66.67)	51 (89.47)
	1-6 times/day	140 (60.34)	107 (46.12)	121 (52.16)	195 (84.05)
-Milk	**≤ 2 times/week**	120 (66.3)	88 (48.62)	100 (55.25)	159 (87.85)
	3-6 times/week	20 (68.97)	16 (55.17)	21 (72.41)	27 (93.1)
	1-6 times/day	78 (51.32)	70 (46.05)	81 (53.29)	127 (83.55)

Parameter and categories		Number (%)			
		Decayed	Missing	Filled	DMFT
-Milk products	≤ 2 times/week	66 (61.88)	56 (52.34)	52 (48.6)	92 (85.98)
	3-6 times/week	24 (60)	20 (50)	29 (72.5)	37 (92.5)
	1-6 times/day	126 (59.43)	98 (46.23)	119 (56.13)	182 (85.85)
-Grains	≤ 2 times/week	82 (53.59)	76 (49.67)	86 (56.21)	125 (81.7)
	3-6 times/week	30 (58.82)	28 (54.9)	39 (76.47)	48 (94.12)
	1-6 times/day	105 (67.74)	70 (45.16)	75 (48.39)	137 (88.39)
-Sugar in drinks	≤ 2 times/week	42 (64.62)	29 (44.62)	36 (55.38)	59 (90.77)
	3-6 times/week	6 (50)	5 (41.76)	10 (83.33)	12 (100)
	1-6 times/day	168 (59.57)	139 (49.29)	150 (53.19)	200 (70.92)
-Sugar not in drinks	≤ 2 times/week	149 (60.32)	131 (53.04)	137 (55.47)	216 (87.45)
	3-6 times/week	9 (56.25)	6 (37.5)	13 (81.25)	16 (100)
	1-6 times/day	59 (61.46)	36 (37.5)	50 (52.08)	79 (82.29)
-Jam, Molasses and Honey	≤ 2 times/week	164 (62.36)	134 (50.95)	135 (51.33)	227 (86.31)
	3-6 times/week	17 (56.67)	16 (53.33)	23 (76.67)	28 (93.33)
	1-6 times/day	37 (56.92)	24 (36.92)	42 (64.62)	56 (86.15)
-Candies	≤ 2 times/week	152 (61.04)	140 (56.22)	144 (57.83)	220 (88.35)
	3-6 times/week	20 (62.5)	9 (28.13)	18 (56.25)	27 (84.38)
	1-6 times/day	59 (61.46)	36 (37.5)	50 (52.08)	79 (82.29)
-Crackers	≤ 2 times/week	118 (59.6)	109 (55.05)	117 (59.09)	178 (89.9)
	3-6 times/week	17 (53.13)	16 (50)	20 (62.5)	27 (84.38)
	1-6 times/day	83 (63.85	49 (37.69)	64 (49.23)	107 (82.31)
-Junk food	≤ 2 times/week	138 (57.5)	122 (50.83)	137 (57.08)	217 (90.42)
	3-6 times/week	13 (52)	15 (60)	19 (76)	23 (92)
	1-6 times/day	65 (69.15)	37 (39.36)	44 (46.81)	81 (86.17)
-Chocolate	≤ 2 times/week	158 (60.54)	143 (54.79)	134 (54.79)	239 (91.57)
	3-6 times/week	18 (58.06)	12 (38.71)	18 (58.06)	26 (83.87)
	1-6 times/day	36 (53.73)	19 (28.36)	39 (58.21)	65 (97.01)
-Soda	≤ 2 times/week	119 (56.4)	112 (53.08)	112 (53.08)	184 (87.2)
	3-6 times/week	26 (74.29)	20 (57.14)	27 (77.14)	32 (91.43)
	1-6 times/day	71 (62.83)	42 (37.17)	61 (53.98)	84.07)
-Juices	≤ 2 times/week	135 (60.54)	125 (56.05)	126 (56.5)	199 (89.24)
	3-6 times/week	14 (46.67)	12 (40)	19 (63.33)	24 (80)
	1-6 times/day	67 (63.21)	37 (34.91)	53 (50)	87 (82.08)
-Citric juices	≤ 2 times/week	163 (59.49)	138 (50.36)	150 (54.74)	237 (86.5)
	3-6 times/week	15 (60)	11 (44)	16 (64)	22 (88)
	1-6 times/day	39 (65)	25 (41.67)	34 (56.67)	52 (86.67)
-Caffeinated drinks	≤ 2 times/week	25 (53.19)	16 (34.04)	22 (46.81)	37 (78.72)
	3-6 times/week	10 (71.43)	8 (57.14)	9 (64.29)	14 (100)
	1-6 times/day	181 (60.74)	150 (50.34)	169 (56.71)	260 (87.25)

Table 3. **Decayed teeth and different risk factors (N= 359).**

Parameter and categories		Mean (SD)	Median (Range)	Correlation		K-W test
				rho	p-value*	p-value
Age	**BI (18-34 years)**	2.54(3.27)	2(0–16)	-0.04	0.498	0.8434
	BII (35-44 years)	2.12(3.13)	1(0–17)			
	BIII (45-64 years	2.25(3.99)	1(0–32)			
	BIV(65-75 years)	3.42(7.39)	0(0–26)			
Gender	**Males**	2.61(3.68)	2(0–26)	-0.08	0.1201	0.12
	Females	2.26(3.55)	1(0–32)			
Body mass index	**Underweight**	1(1.41)	1(0–2)	-0.07	0.177	0.502
	Normal	2.83(3.77)	1(0–17)			
	Overweight	2.42(4.11)	2(0–32)			
	Obese	1.7(2.03)	1(0–10)			
SES	**Low**	4.08(4.63)	3(0–32)	-0.28	<0.0001*	<0.0001*
	Moderate	1.87(2.79)	1(0–15)			
	High	1.73(3.10)	0.5(0–26)			
Level of education	**Low**	4.78(5.97)	3(0–32)	-0.24	<0.0001*	<0.0001*
	Moderate	2.34(2.51)	2(0–10)			
	High	1.91(3.16)	1(0–26)			
Brushing frequency	**No brushing**	4.26(5.76)	3(0–32)	-0.26	<0.0001*	0.0001*
	Infrequent	2.47(2.47)	2.5(0–10)			
	once daily	2.17(2.90)	1(0–15)			
	Twice daily	1.76(2.44)	1(0–10)			
	Three times	0.96(1.40)	0(0–5)			
Dietary Habits						
-Bread	**≤ 2 times/week**	1.85(2.38)	2(0–9)	0.06	0.2491	0.348
	3-6 times/week	1.13(1.51)	0(0–5)			
	1-6 times/day	2.48(3.70)	1(0–32)			
-Other carbohydrates	**≤ 2 times/week**	1.98(2.68)	1(0–12)	0.07	0.1575	0.3128
	3-6 times/week	2.59(5.58)	1(0–32)			
	1-6 times/day	2.48(3.38)	2(0–26)			
-Eggs	**≤ 2 times/week**	2.57(3.76)	1(0–32)	-0.03	0.5291	0.0266*
	3-6 times/week	1.49(2.04)	1(0–8)			
	1-6 times/day	3.11(2.54)	2(0–26)			
-Fruits/Vegetables	**≤ 2 times/week**	2.42(2.74)	2(0–12)	-0.01	0.8853	0.3137
	3-6 times/week	1.84(2.80)	1(0–16)			
	1-6 times/day	2.54(3.98)	1(0–32)			
-Milk	**≤ 2 times/week**	2.94(4.33)	2(0–32)	-0.15	0.0037*	0.0095*
	3-6 times/week	2.45(2.76)	2(0–12)			
	1-6 times/day	1.79(2.59)	1(0–13)			

Parameter and categories		Mean (SD)	Median (Range)	Correlation		K-W test
				rho	p-value*	p-value
-Milk products	≤ 2 times/week	2.80(4.50)	2(0–32)	-0.03	0.5113	0.5401
	3-6 times/week	2.15(3.53)	1(0–16)			
	1-6 times/day	2.25(3.07)	1(0–17)			
-Grains	≤ 2 times/week	2.19(3.28)	1(0–17)	0.13	0.0143*	0.0131*
	3-6 times/week	1.55(2.31)	1(0–12)			
	1-6 times/day	2.90(4.16)	2(0–32)			
-Sugar in drinks	≤ 2 times/week	2.74(4.12)	2(0–26)	-0.03	0.5519	0.5306
	3-6 times/week	1.67(2.35)	0.5(0–6)			
	1-6 times/day	2.36(3.52)	1(0–32)			
-Sugar not in drinks	≤ 2 times/week	2.48(3.93)	1(0–32)	0.01	0.8317	0.6475
	3-6 times/week	1.44(1.75)	1(0–6)			
	1-6 times/day	2.38(2.87)	1.5(0–12)			
-Jam, Molasses and Honey	≤ 2 times/week	2.49(3.69)	1.5(0–32)	-0.06	0.2471	0.3784
	3-6 times/week	1.70(2.68)	1(0–12)			
	1-6 times/day	2.37(3.62)	1(0–16)			
-Candies	≤ 2 times/week	2.51(3.87)	1(0–32)	-0.02	0.6968	0.6133
	3-6 times/week	1.38(1.36)	1(0–4)			
	1-6 times/day	2.50(2.32)	1(0–16)			
-Crackers	≤ 2 times/week	2.35(4.02)	1(0–32)	0.08	0.1286	0.1388
	3-6 times/week	1.63(2.11)	1(0–8)			
	1-6 times/day	2.67(3.20)	2(0–16)			
-Junk food	≤ 2 times/week	2.14(3.57)	1(0–32)	0.15	0.0058*	0.0035*
	3-6 times/week	1.44(1.87)	1(0–6)			
	1-6 times/day	3.34(3.87)	2(0–17)			
-Chocolate	≤ 2 times/week	2.41(3.79)	1(0–32)	0.01	0.7924	0.9448
	3-6 times/week	2.29(3.30)	1(0–16)			
	1-6 times/day	2.43(3)	1(0–10)			
-Soda drinks	≤ 2 times/week	2.01(3.16)	1(0–26)	0.13	0.0121*	0.0434*
	3-6 times/week	2.11(2.39)	2(0–12)			
	1-6 times/day	3.22(4.47)	2(0–32)			
-Juices	≤ 2 times/week	2.40(3.39)	1(0–26)	-0.01	0.8482	0.2614
	3-6 times/week	2.57(6.23)	0(0–32)			
	1-6 times/day	2.36(3.03)	1.5(0–15)			
-Citric juices	≤ 2 times/week	2.51(3.87)	1(0–32)	-0.002	0.9672	0.4813
	3-6 times/week	1.40(1.80)	1(0–8)			
	1-6 times/day	2.35(2.78)	1(0–10)			
-Caffeinated drinks	≤ 2 times/week	1.83(2.98)	1(0–15)	0.04	0.4389	0.1366
	3-6 times/week	2.79(2.19)	3(0–6)			
	1-6 times/day	2.48(3.74)	1(0–32)			

*The correlation coefficient, rho, ranges from -1 to +1. Where 1= perfect positive correlation, 0=no correlation, -1 = perfect negative (inverse) correlation. *Statistical significance at p-value ≤ 0.05*

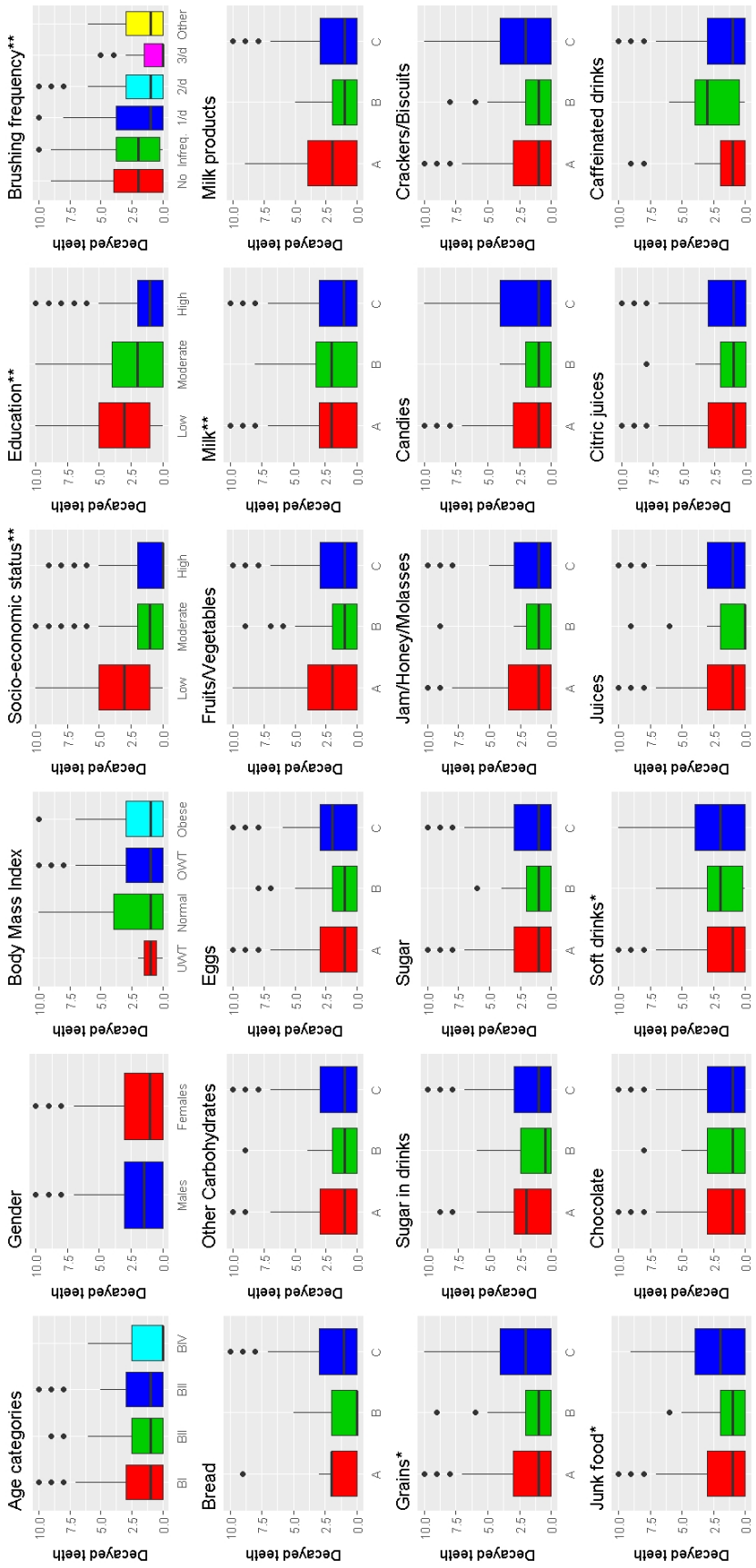

Figure 1. Decayed permanent teeth and different risk factors. N= 359. *positive correlations; **inverse correlations. A: ≤2 times/week, B: 3–6 times/week, C: 1–6 times/day.

Table 4. Missed teeth and different risk factors (N=359).

Parameter and categories		Mean (SD)	Median (Range)	Correlation		K-W test
				rho	p-value*	p-value
Age	**BI (18-34 years)**	0.85 (1.98)	0 (0–11)	0.44	<0.0001*	<0.0001*
	BII (35-44 years)	1.91 (3.54)	1 (0–27)			
	BIII (45-64 years	4.05 (5.82)	2(0–26)			
	BIV (65-75 years)	6.08 (6.64)	3.5 (0–22)			
Gender	**Males**	2.07 (4.38)	1 (0–27)	-0.02	0.7748	0.7744
	Females	1.92 (3.69)	0 (0–26)			
Body mass index	**Underweight**	0 (0)	0(0)	0.25	<0.0001*	<0.0001*
	Normal	1.5 (3.60)	0 (0–22)			
	Overweight	1.57 (2.94)	0 (0–21)			
	Obese	3.51 (5.56)	2 (0–27)			
SES	**Low**	3.23 (4.84)	2 (0–27)	-0.25	<0.0001*	<0.0001*
	Moderate	1.62 (3.92)	0 (0–26)			
	High	1.48 (3.18)	0 (0–22)			
Level of education	**Low**	3.78 (5.09)	2 (0–21)	-0.30	<0.0001*	<0.0001*
	Moderate	2.72 (4.94)	1 (0–27)			
	High	1.23 (2.87)	0 (0–22)			
Brushing frequency	**No brushing**	3.34 (5.57)	1 (0–27)	-0.23	<0.0001*	0.0003*
	Infrequent	1.61 (2.02)	1 (0–7)			
	once daily	2.01 (3.70)	1 (0–22)			
	Twice daily	1.46 (3.97)	0 (0–26)			
	Three times	0.96 (1.71)	0 (0–6)			
Dietary Habits						
-Bread	**≤ 2 times/week**	2.31 (4.35)	0 (0–14)	0.10	0.0523	0.0687
	3-6 times/week	0.40 (0.91)	0 (0–3)			
	1-6 times/day	2.04 (4.05)	1 (0–27)			
-Other carbohydrates	**≤ 2 times/week**	3 (4.44)	1 (0–22)	-0.05	0.3909	0.0319
	3-6 times/week	0.68 (1.03)	0 (0–5)			
	1-6 times/day	1.95 (4.13)	0 (0–27)			
-Eggs	**≤ 2 times/week**	1.94 (3.90)	0 (0–26)	-0.01	0.9242	0.8232
	3-6 times/week	1.45 (2.44)	0 (0–11)			
	1-6 times/day	3.11 (6.01)	0 (0–27)			
-Fruits/Vegetables	**≤ 2 times/week**	2.09 (3.82)	1 (0–21)	-0.03	0.6172	0.8806
	3-6 times/week	1.58 (3.11)	1 (0–21)			
	1-6 times/day	2.05 (4.23)	0 (0–27)			
-Milk	**≤ 2 times/week**	1.79 (3.43)	0 (0–21)	0.01	0.9229	0.8256
	3-6 times/week	1.72 (2.52)	1 (0–11)			
	1-6 times/day	2.27 (4.78)	0 (0–27)			

Parameter and categories		Mean (SD)	Median (Range)	Correlation		K-W test
				rho	p-value*	p-value
-Milk products	≤ 2 times/week	2.34 (4.44)	1 (0–27)	-0.07	0.2099	0.4373
	3-6 times/week	1.60 (2.69)	0.5 (0–11)			
	1-6 times/day	1.88 (3.96)	0 (0–26)			
-Grains	≤ 2 times/week	2.13 (4.13)	0 (0–26)	-0.05	0.3611	0.6173
	3-6 times/week	2.06 (4.06)	1 (0–22)			
	1-6 times/day	1.81 (3.85)	0 (0–27)			
-Sugar in drinks	≤ 2 times/week	1.15 (2.07)	0 (0–11)	0.09	0.1068	0.2488
	3-6 times/week	1 (2)	0 (0–7)			
	1-6 times/day	2.22 (4.35)	0 (0–27)			
-Sugar not in drinks	≤ 2 times/week	2.33 (4.40)	1 (0–27)	-0.16	0.0026*	0.0105*
	3-6 times/week	1.06 (1.95)	0 (0–7)			
	1-6 times/day	1.24 (2.87)	0 (0–22)			
-Jam, Molasses and Honey	≤ 2 times/week	2.04 (4.09)	1 (0–27)	-0.07	0.2067	0.2771
	3-6 times/week	1.97 (3.23)	1 (0–13)			
	1-6 times/day	1.77 (3.94)	0 (0–22)			
-Candies	≤ 2 times/week	2.47 (4.42)	1 (0–27)	-0.25	<0.0001*	<0.0001*
	3-6 times/week	0.63 (1.41)	0 (0–7)			
	1-6 times/day	1 (2.80)	0 (0–22)			
-Crackers	≤ 2 times/week	2.57 (4.62)	1 (0–26)	-0.18	0.0007*	0.0034*
	3-6 times/week	1.47 (2.69)	0.5 (0–14)			
	1-6 times/day	1.24 (2.99)	0 (0–27)			
-Junk food	≤ 2 times/week	2.49 (4.68)	1 (0–27)	-0.13	0.0122*	0.03611*
	3-6 times/week	0.96 (0.98)	1 (0–3)			
	1-6 times/day	0.97 (1.65)	0 (0–8)			
-Chocolate	≤ 2 times/week	2.32 (4.21)	1 (0–27)	-0.22	<0.0001*	0.0002*
	3-6 times/week	0.68 (1.01)	0 (0–3)			
	1-6 times/day	1.27 (3.80)	0 (0–26)			
-Soda drinks	≤ 2 times/week	2.40 (4.45)	1 (0–26)	-0.16	0.0029*	0.006*
	3-6 times/week	1.97 (3.27)	1 (0–14)			
	1-6 times/day	1.21 (3.11)	0 (0–27)			
-Juices	≤ 2 times/week	2.42 (4.18)	1 (0–26)	-0.21	<0.0001*	0.0003*
	3-6 times/week	1.10 (2.22)	0 (0–11)			
	1-6 times/day	1.32 (3.87)	0 (0–27)			
-Citric juices	≤ 2 times/week	2.06 (3.92)	1 (0–26)	-0.08	0.1302	0.3176
	3-6 times/week	1.80 (4.47)	0 (0–22)			
	1-6 times/day	1.70 (4.18)	0 (0–27)			
-Caffeinated drinks	≤ 2 times/week	1.49 (4.35)	0 (0–26)	0.11	0.0441*	0.0814
	3-6 times/week	1.21 (1.48)	1 (0–4)			
	1-6 times/day	2.10 (4.01)	1 (0–27)			

The correlation coefficient, rho, ranges from -1 to +1. Where 1= perfect positive correlation, 0=no correlation, -1 = perfect negative (inverse) correlation. *Statistical significance at p-value ≤ 0.05

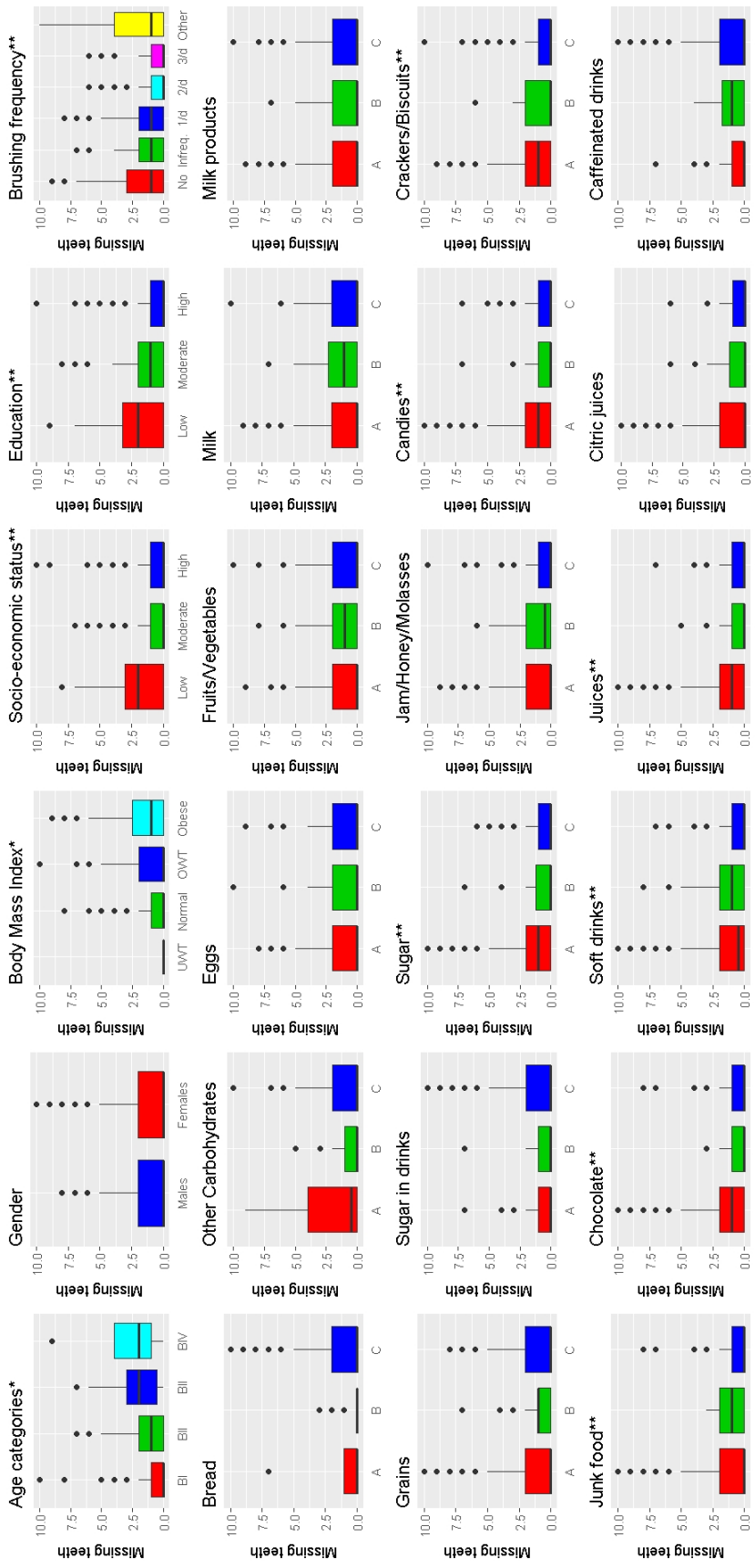

Figure 2. Missing permanent teeth and different risk factors. N= 359: *positive correlations; **inverse correlations. A: ≤2 times/week, B: 3–6 times/week, C: 1–6 times/day.

Table 5. **Filled teeth and different risk factors (N=359).**

Parameter and categories		Mean (SD)	Median (Range)	Correlation		K-W test
				rho	p-value*	p-value
1- Age	**BI (18-34 years)**	1.51(2.15)	1(0–10)	0.13	0.0138*	0.0888
	BII (35-44 years)	1.76(2.48)	1 (0–13)			
	BIII (45-64 years	2.44(3)	2(0–11)			
	BIV (65-75 years)	1.83(1.64)	1.5(0–5)			
2- Gender	**Males**	1.81(2.4)	1(0–13)	-0.02	0.7371	0.7366
	Females	1.78(2.49)	1(0–11)			
3- Body Mass Index	**Underweight**	0.5(0.71)	0.5(0–1)	0.16	0.002*	0.0223*
	Normal	1.38(2.1)	0(0–10)			
	Overweight	1.89(2.62)	1(0–13)			
	Obese	2.31(2.59)	2(0–11)			
4- SES	**Low**	1.04(1.64)	**0(0–10)**	0.18	0.0004*	0.0016*
	Moderate	1.86(2.51)	1(0–11)			
	High	2.26(2.74)	1 (0–13)			
5- Level of education	**Low**	0.96(1.3)	0(0–5)	0.21	<0.0001*	0.0002*
	Moderate	1.25(2.03)	0(0–10)			
	High	2.24(2.72)	1 (0–13)			
6- Brushing frequency	**No brushing**	1.39(1.79)	1(0–6)	0.04	0.4322	0.7093
	Infrequent	1.82(2.48)	1(0–9)			
	once daily	2.01(2.69)	1(0–11)			
	Twice daily	1.84(2.63)	1(0–13)			
	Three times	1.72(2.36)	0(0-9)			
	Other	3.5(3.42)	3(0–8)			
7-Dietary Habits						
-Bread	**≤ 2 times/week**	2.62(3.36)	1(0–9)	-0.02	0.6597	0.7676
	3-6 times/week	1.93(2.91)	1(0–10)			
	1-6 times/day	1.76(2.39)	1(0–13)			
-Other carbohydrates	**≤ 2 times/week**	2.09(2.83)	1(0–13)	-0.04	0.4946	0.7739
	3-6 times/week	2.07(2.87)	1(0–11)			
	1-6 times/day	1.66(2.26)	1(0–11)			
-Eggs	**≤ 2 times/week**	1.75(2.37)	1(0–13)	0.01	0.8744	0.9069
	3-6 times/week	2.01(2.8)	1(0–11)			
	1-6 times/day	1.64(2.22)	1(0–9)			
-Fruits/Vegetables	**≤ 2 times/week**	1.94(2.72)	1(0–10)	-0.07	0.2015	0.1702
	3-6 times/week	2.18(2.52)	1(0–11)			
	1-6 times/day	1.66(2.35)	1(0–13)			
-Milk	**≤ 2 times/week**	1.79(2.45)	1(0–11)	-0.02	0.6665	0.1161
	3-6 times/week	2.48(2.56)	2(0–10)			
	1-6 times/day	1.66(2.42)	1(0–13)			

Parameter and categories		Mean (SD)	Median (Range)	Correlation		K-W test
				rho	p-value*	p-value
-Milk products	≤ 2 times/week	1.7(2.42)	0(0–10)	0.02	0.7511	0.1836
	3-6 times/week	2.05(2.1)	1(0–7)			
	1-6 times/day	1.79(2.53)	1(0–13)			
-Grains	≤ 2 times/week	2.11(2.91)	1(0–13)	-0.14	0.0102*	<0.0001*
	3-6 times/week	3(2.69)	3(0–9)			
	1-6 times/day	1.08(1.47)	0(0–7)			
-Sugar in drinks	≤ 2 times/week	2.45(3.18)	1(0–11)	-0.11	0.0414*	0.0125*
	3-6 times/week	3.67(2.9)	3.5(0–8)			
	1-6 times/day	1.56(2.17)	1(0–13)			
-Sugar not in drinks	≤ 2 times/week	1.76(2.46)	1(0–13)	-0.004	0.9938	0.009
	3-6 times/week	3.38(2.47)	3(0–8)			
	1-6 times/day	1.61(2.36)	1(0–11)			
-Jam, Molasses and Honey	≤ 2 times/week	1.68(2.39)	1(0–11)	0.1	0.051	0.0453*
	3-6 times/week	2.3(2.14)	2(0–7)			
	1-6 times/day	2.02(2.8)	1(0–13)			
-Candies	≤ 2 times/week	1.85(2.33)	1(0–11)	-0.01	0.0821	0.0861
	3-6 times/week	2.28(2.96)	1.5(0–11)			
	1-6 times/day	1.42(2.57)	0(0–13)			
-Crackers	≤ 2 times/week	2.02(2.66)	1(0–13)	-0.11	0.0435*	0.0731
	3-6 times/week	2(2.31)	1(0–8)			
	1-6 times/day	1.4(2.32)	0(0–10)			
-Junk food	≤ 2 times/week	1.87(2.53)	1(0–13)	-0.08	0.134	0.0001*
	3-6 times/week	3.72(3.1)	4(0–10)			
	1-6 times/day	1.1(1.63)	0(0–7)			
-Chocolate	≤ 2 times/week	1.86(2.57)	1(0–13)	-0.01	0.8298	0.7281
	3-6 times/week	2.13(2.67)	1(0–10)			
	1-6 times/day	1.39(1.74)	1(0–8)			
-Soda drinks	≤ 2 times/week	1.79(2.58)	1(0–13)	0.01	0.8692	0.0162*
	3-6 times/week	2.77(2.78)	2(0–10)			
	1-6 times/day	1.5(1.98)	1(0–8)			
-Juices	≤ 2 times/week	2.03(2.71)	1(0–13)	-0.09	0.081	0.1201
	3-6 times/week	1.25(1.7)	1(0–8)			
	1-6 times/day	1.97(2.39)	1(0–7)			
-Citric juices	≤ 2 times/week	1.79(2.45)	1(0–13)	-0.003	0.9551	0.303
	3-6 times/week	2.64(3.07)	1(0–10)			
	1-6 times/day	1.45(2.1)	1(0–9)			
-Caffeinated drinks	≤ 2 times/week	1.74(2.84)	0(0–13)	0.01	0.8177	0.2232
	3-6 times/week	2.93(2.97)	2(0–8)			
	1-6 times/day	1.75(2.35)	1(0–11)			

The correlation coefficient, rho, ranges from -1 to +1. Where 1= perfect positive correlation, 0=no correlation, -1 = perfect negative (inverse) correlation. *Statistical significance at p-value ≤ 0.05

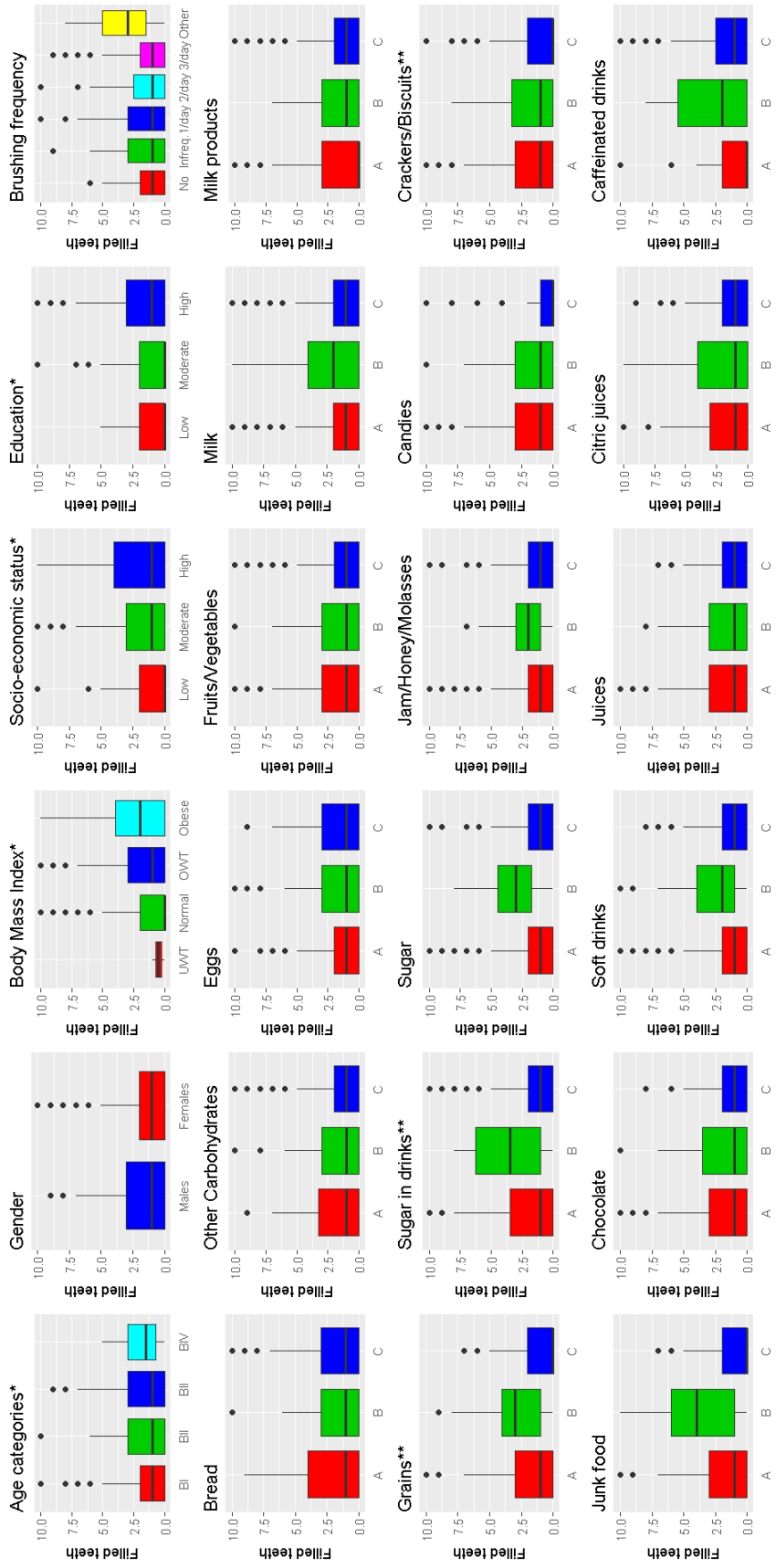

Figure 3. Filled permanent teeth and different risk factors. N= 359: *positive correlations; **inverse correlations. A: ≤2 times/week, B: 3–6 times/week, C: 1–6 times/day.

in drinks, sugar not in drinks, jam, junk food and soft drinks. Grains, sugar in drinks and crackers were inversely correlated with filled teeth, while jams were borderline positively correlated.

DMFT and different caries risk factors

Table 6, Figure 4 show that the highest means DMFT was in adults aged 65–75 years and obese adults (11.42±7.63 and 7.4±5.89, respectively). The differences in medians were statistically significant (p≤0.0001). Age and BMI were directly correlated with DMFT (Spearman's rho=0.33 and 0.15; p≤0.0001 and 0.0053, respectively).

Males had a higher mean DMFT teeth than females (6.5±5.47). The difference in medians was statistically insignificant (p≥0.05)

Table 6. DMFT and different risk factors (N= 359).

Parameter and categories		Mean (SD)	Median (Range)	Correlation		K-W test
				Rho	p-value*	p-value
Age	BI (18-34 years)	4.71(4.78)	4(0–30)	0.33	<0.0001*	<0.0001*
	BII (35-44 years)	5.8(4.95)	5(0–27)			
	BIII (45-64 years	8.74(6.67)	7(0–32)			
	BIV (65-75 years)	11.42(7.63)	10(0–26)			
Gender	Males	6.5 (5.47)	5(0–27)	-0.09	0.0773	0.207
	Females	5.79(5.85)	4(0–32)			
Body mass index	Underweight	1.5(0.71)	1.5(1–2)	0.15	0.0053*	0.0118*
	Normal	5.62(5.64)	4(0–29)			
	Overweight	5.8(5.61)	4(0–32)			
	Obese	7.4(5.89)	6(0–27)			
SES	Low	8.2(6.24)	7(0–32)	-0.19	0.0002*	<0.0001*
	Moderate	5.23(5.34)	4(0–30)			
	High	5.42(5.28)	4(0–28)			
Level of education	Low	9.48(6.93)	9(0–32)	-0.21	<0.0001*	<0.0001*
	Moderate	6.18(5.44)	5(0–29)			
	High	5.3(5.26)	4(0–30)			
Brushing frequency	No brushing	8.95(6.71)	8(0–32)	-0.3	<0.0001*	<0.0001*
	Infrequent	5.84(4.18)	6(0–19)			
	once daily	6.06(5.31)	5(0–30)			
	Twice daily	5.04(5.76)	4(0–29)			
	Three times	3.64(3.69)	2(0–16)			
	Other	6.5(5.97)	6(0–14)			
Dietary Habits						
-Bread	≤ 2 times/week	6.69(5.23)	6(0–16)	0.08	0.1414	0.9858
	3-6 times/week	2.73(2.87)	2(0–9)			
	1-6 times/day	6.22(5.78)	5(0–32)			
-Other carbohydrates	≤ 2 times/week	7.05(6.42)	6(0–30)	-0.03	0.5668	0.2368
	3-6 times/week	5.36(5.84)	4(0–32)			
	1-6 times/day	5.97(5.47)	5(0–28)			
-Eggs	≤ 2 times/week	6.17(5.5)	5(0–32)	-0.04	0.4302	0.2004
	3-6 times/week	4.92(4.35)	4(0–17)			
	1-6 times/day	7.69(8.06)	4(0–29)			
-Fruits/Vegetables	≤ 2 times/week	6.29(5.25)	5(0–29)	-0.04	0.4687	0.6645
	3-6 times/week	5.56(4.54)	5(0–2 1)			
	1-6 times/day	6.16(6.08)	5(0–32)			

Parameter and categories		Mean (SD)	Median (Range)	Correlation		K-W test
				Rho	p-value*	p-value
-Milk	≤ 2 times/week	6.43(5.75)	5(0–32)	-0.08	0.1498	0.287
	3-6 times/week	6.28(5.68)	6(0–30)			
	1-6 times/day	5.63(5.65)	5(0–28)			
-Milk products	≤ 2 times/week	6.66(5.95)	5(0–32)	-0.06	0.2221	0.3557
	3-6 times/week	5.78(5.85)	4(0–30)			
	1-6 times/day	5.86(5.55)	5(0–29)			
-Grains	≤ 2 times/week	6.33(5.9)	5(0–29)	-0.04	0.3965	0.5547
	3-6 times/week	6.41(5.8)	5(0–30)			
	1-6 times/day	5.74(5.48)	4(0–32)			
-Sugar in drinks	≤ 2 times/week	6.34(4.76)	6(0–26)	-0.07	0.1756	0.3963
	3-6 times/week	5.67(3.77)	5.5(1–14)			
	1-6 times/day	6.05(5.97)	5(0–32)			
-Sugar not in drinks	≤ 2 times/week	6.51(6.06)	5(0–32)	-0.09	0.0928	0.2055
	3-6 times/week	5.38(2.78)	4.5(1–9)			
	1-6 times/day	5.13(4.95)	4(0–30)			
-Jam, Molasses and Honey	≤ 2 times/week	6.09(5.62)	5(0–32)	-0.02	0.7405	0.9328
	3-6 times/week	5.97(5.85)	5(0–30)			
	1-6 times/day	6.14(6.04)	4(0–29)			
-Candies	≤ 2 times/week	6.8(6.17)	5(0–32)	-0.18	0.0008*	0.0036*
	3-6 times/week	4.28(3.25)	4(0–13)			
	1-6 times/day	4.58(4.36)	3(0–22)			
-Crackers	≤ 2 times/week	6.85(6.4)	5(0–32)	-0.11	0.0374	0.0839
	3-6 times/week	4.78(4.01)	4.5(0–16)			
	1-6 times/day	5.26(4.69)	4(0–27)			
-Junk food	≤ 2 times/week	6.42(6.2)	5(0–32)	-0.05	0.3459	0.4277
	3-6 times/week	5.84(3.67)	6(0–12)			
	1-6 times/day	5.31(4.67)	4(0–20)			
-Chocolate	≤ 2 times/week	6.51(5.98)	5(0–32)	-0.12	0.0227*	0.075
	3-6 times/week	5.06(4.27)	4(0–16)			
	1-6 times/day	4.94(4.94)	4(0–26)			
-Soda drinks	≤ 2 times/week	6.14(5.9)	5(0–32)	-0.02	0.733	0.2116
	3-6 times/week	6.8(4.59)	6(0–18)			
	1-6 times/day	5.77(5.65)	4(0–32)			
-Juices	≤ 2 times/week	6.78(5.54)	5(0–28)	-0.21	<0.0001*	0.0002*
	3-6 times/week	5.3(7.63)	4(0–32)			
	1-6 times/day	4.85(5.21)	4(0–29)			
-Citric juices	≤ 2 times/week	6.25(5.84)	5(0–32)	-0.05	0.3574	0.6451
	3-6 times/week	5.84(5.49)	4(0–25)			
	1-6 times/day	5.47(5.13)	4(0–27)			
-Caffeinated drinks	≤ 2 times/week	5.02(5.4)	4(0–26)	0.06	0.2382	0.1643
	3-6 times/week	6.21(3.09)	5.5(2–14)			
	1-6 times/day	6.25(5.83)	5(0–32)			

The correlation coefficient, rho, ranges from -1 to +1. Where 1= perfect positive correlation, 0=no correlation, -1 = perfect negative (inverse) correlation.* Statistical significance at p-value ≤ 0.05

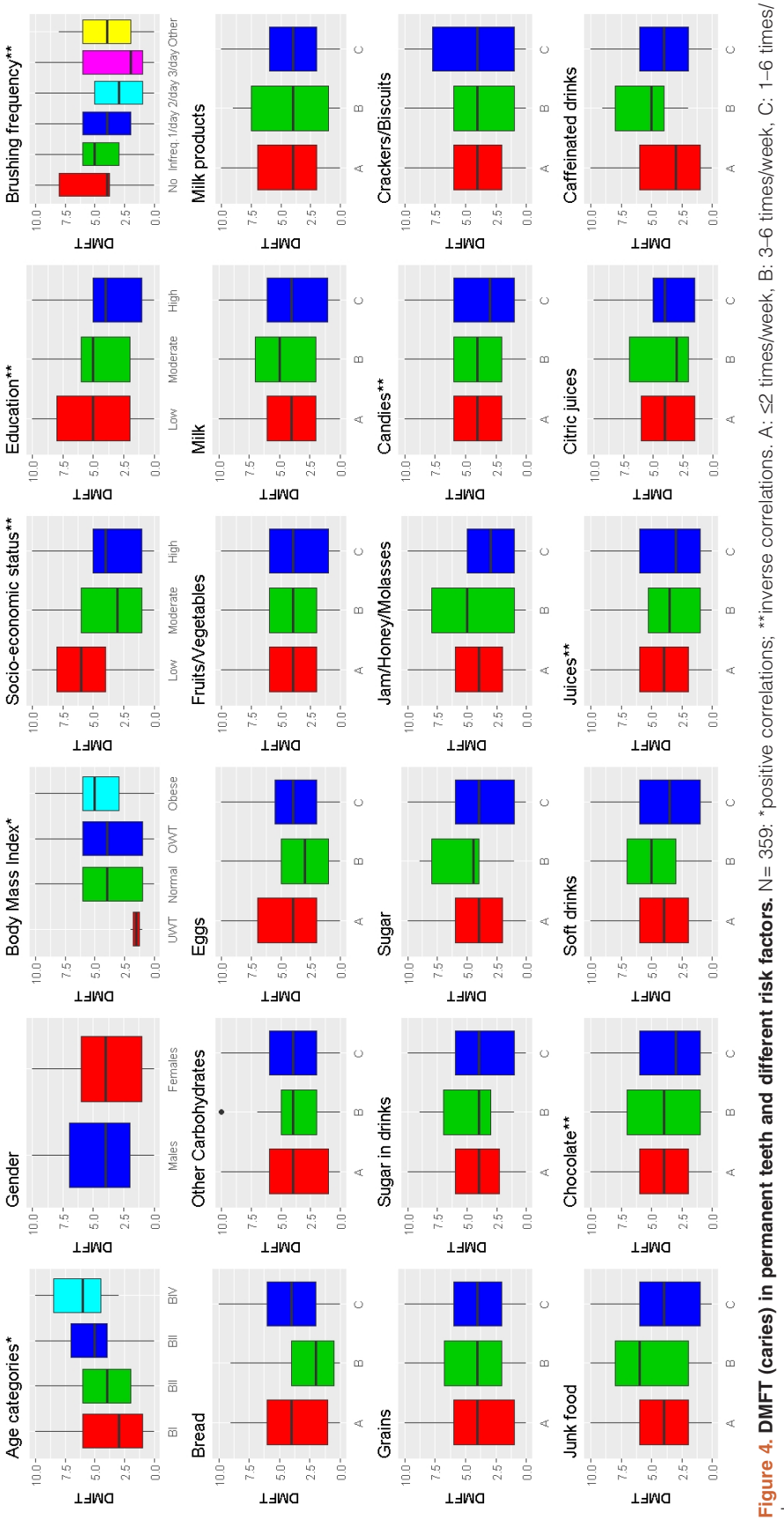

Figure 4. DMFT (caries) in permanent teeth and different risk factors. N= 359: *positive correlations; **inverse correlations. A: ≤2 times/week, B: 3–6 times/week, C: 1–6 times/day.

and there was no correlation between gender and DMFT (Spearman's rho= -0.09, p≥0.05).

Adults with low SES, low education level and those who don't brush their teeth had the highest mean DMFT numbers (8.2±6.24, 9.48±6.93 and 8.95±6.71, respectively). The differences in medians were statistically significant (p<0.0001). SES, education level and brushing frequency were inversely correlated with DMFT (Spearman's rho=-0.19, -0.21 and -0.3; p=0.0002, <0.0001 and <0.0001, respectively).

The highest means of DMFT, were recorded in adults who consume eggs, jam and caffeinated drinks 1–6 times per day (7.69±8.06, 6.14±6.04 and 6.25±5.83, respectively) and those who consume grains and soft drinks 3–6 times per week (6.41±5.8 and 6.8±4.59, respectively), as well as those who consume bread, other carbohydrates, fruits/vegetables, milk, milk products, sugar in drinks, sugar not in drinks, candies, crackers, junk food, chocolate, juices and citric juices two or fewer times a week (6.69±5.23, 7.05±6.42, 6.29±5.25, 6.43±5.75, 6.66±5.95, 6.34±4.76, 6.51±6.06, 6.8±6.17, 6.85±6.4, 6.42±6.2, 6.51±5.98, 6.78±5.54 and 6.25±5.84, respectively). The differences in medians for DMFT in all dietary elements were statistically insignificant except for candies and juices. Consumption of candies, chocolate and juices were inversely correlated with DMFT.

Discussion

To our knowledge, the present study is the first to clarify the prevalence of dental caries and treatment needs among Egyptian adults and their correlation with different risk factors. Egyptian adults proved to be at greater risk of developing caries, with a total prevalence of 86.63%; as compared to children and adolescence, for whom a value of 74% was recorded[16]. The recorded DMFT in the present investigation is lower than that recorded in North-West Russia (96%)[19], higher than that recorded in Turkey (62%)[20] and much higher than the prevalence of caries in England (31%)[21].

In the current work, DMFT with its components M and F showed a significant increase with age (P<0.0001), this is in agreement with previous studies carried out in Australia and China[22,23], but contrary to a study performed in Turkey, which reported a decrease in dental caries with age[20].

No significant correlation between gender and caries has been reported in the current investigation. This is in contrast with other studies, which reported higher caries indices in females[23,24], while another study reported a significant increase in decayed teeth in males[25].

Both dental caries and BMI are diet-related health measures. The incidence of caries and obesity has raised in the last two decades due to changes in lifestyle and diet[26,27]. The reported significant positive correlation between BMI, DMFT and missing teeth in the current study is in accordance with findings by Sheiham *et al.*, who showed that British people that had less than 20 teeth were more likely to be obese[28]; however, a study performed on Korean adults revealed an inverse correlation[29].

SES and education level are thought to be strongly associated with dental caries rate. In the present work, there were inverse correlations between socioeconomic, education levels and number of decayed, missing teeth and DMFT, while a positive correlation with filled teeth. These findings reinforce those of previous studies[30–33] and are partially in agreement with those of Ceylan *et al.*[34], who found that the mean number of filled teeth was strongly correlated with income level, while DMFT was not correlated with income and education level.

Regarding oral hygiene, DMFT and the mean number of missing and decayed teeth were significantly higher in adults who don't brush their teeth (8.95±6.71, 3.34±5.57, 4.26±5.76, respectively). These results are similar to studies conducted by Fukuda *et al.*[35] and Levin *et al.*[36], who reported that regular tooth brushing improved the oral health.

Dietary habits are important contributors to the heath or disease of a population. Alteration in dietary habits, like increased consumption of refined sugars, soft drinks and fast food, cause caries as well as obesity[37]. In the present study, it was found that adults who consumed bread, grains, crackers, junk food, chocolate, soft drinks and caffeinated drinks 1–6 times per day had the highest mean number of decayed teeth, with a significant positive correlation observed with grain, junk food and soft drink consumption. This is in accordance with results obtained by Jones *et al.*, who reported a significant correlation between soft drink consumption and DMFT index[38].

Despite evidence from previous studies, which revealed a correlation between caries incidence and sugar intake in children[39,40] and in adults[34], the present investigation reported weak correlations or even negative correlations between cariogenic food and the number of missing, filled teeth and DMFT, which are in accordance with other studies[41–43]. Consumption of sweetened foods and drinks between meals usually leads to the development of caries in children, while is associated with obesity in adults[44]. An indication of an answer to the controversial question "how obesity causes dental caries?" could be found in a recent cross-sectional study carried out on adolescences. The authors investigated the relationship between obesity and bite force. They inferred that the decreased bite force reported in obese males and females might result in a preference for soft food stuffs and a reduction in chewing, which in turn might cause caries. In contrast, individuals with normal body weight, have increased bite force and choose harder foodstuffs[45].

On the contrary, some diets may favour remineralization when their content is high in calcium, phosphate and protein[46]. This is confirmed by the significant negative correlation between milk consumption and the number of decayed teeth reported in the current study.

A limitation of this cross-sectional study is that the collected dietary information covered only a few short periods in time, which may not be an accurate representation of an individual's

actual lifetime dietary habits. This could explain the lack of significant differences between some caries indices and cariogenic dietary elements. The DMFT index is the most widely used index worldwide, but it has some limitations. The F or M component might not only display teeth that were previously decayed and could include other conditions not related to dental caries[47].

From this study, it could be concluded that age, BMI, SES, education level and brushing frequency are risk factors significantly associated with caries prevalence amongst Egyptian adults.

Data availability

Underlying data

Raw data, including all answers to the questionnaire and data on caries incidence amongst the sampled population, are available on figshare. DOI: https://doi.org/10.6084/m9.figshare.7609832.v1[18].

Extended data

A copy of the study questionnaire is available on figshare. DOI: https://doi.org/10.6084/m9.figshare.7609733.v1[9].

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The subject of the research is new for the area and it will be of value to the profession. The study is well designed, the manuscript is well written and edited however from the research point of view the study is lacking objectives and hypotheses. The methods are clear and well explained. In the result section: the number of tables is excessive which makes it slightly complicated for the reader to follow. Conclusion are clear and well written.

Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Dental Materials and restorative

I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Referee Report 15 March 2019

https://doi.org/10.5256/f1000research.19568.r45143

Tahra Elobeid
Human Nutrition Department, College of Health Sciences, Qatar University, Doha, Qatar

With the high prevalence of obesity and Non communicable diseases (NCDs), it is important to investigate how it affects the other underlying problems associated with it. This study provides very important findings as research in this area is still virgin in the region. The change in the food habits and nutrition transition further complicates this problem. Oral health and NCDs risk factors is established in several studies however the correlations were not significant. The association between dental health and obesity has not been studied in the region although there has been a significant change in the food habits and socioeconomic levels of the different populations. This will further increase the burden on public health system.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Nutrition, food safety, food policy and planning

I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Referee Report 12 March 2019

https://doi.org/10.5256/f1000research.19568.r45145

Mohammed E. Grawish
Department of Oral Biology, Faculty of Dentistry, Mansoura University, Mansoura, Egypt

The paper by Abbass et al., evaluated clearly and accurately the potential impact of age, gender, body mass index, socioeconomic status and dietary habits on the prevalence of dental caries among Egyptian

adults. The title and abstract are appropriate for the content of the text. The cross-sectional study design is appropriate and the work is technically sound. Sufficient details of methods and analyses were provided and it has an external validity as well as internal one and thus it can be reproduced. Non parametric statistical tests were performed as the data are categorical in type. The data obtained are interpreted appropriately and the results are valid. All the source data underlying the results are available and thus full reproducibility can be attained. The conclusions drawn are adequately supported by the results. In addition, the paper is well written and precisely formatted.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Professor of Oral Biology, my research interest biomaterials, stem cells and integrative medicine

I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.