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Association between Body Mass Index and Dental Caries among Preschool and School Children in Upper Egypt and Potential Role of Family and Demographic Variables on the Association

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Dental Caries, family organization, school children, overweight, Body mass index,

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ABSTRACT

Aim: To analyze and report the type of relation present between dental caries and body mass index (BMI)-for-age among schoolchildren in south valley region of Arab Republic of Egypt.. **Subjects and methods:** We conducted a cross-sectional observational study of 262 aged three to 15 years with clinically recorded dental caries. The World Health Organization diagnostic criteria for BMI percentile was used to evaluate and record dental caries clinically. The obtained results were plotted on age- and gender-specific percentile curves by the Centers for Disease Control and Prevention and categorized accordingly. **Results:** Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. The mean dmft and DMFT for the whole sample were (2.5 ± 2.1 and 1.2± 1.4) respectively **Conclusion:** This study showed that unhealthy family functioning was associated with dental caries among young children. Family functioning partly explained the relationship between family SES and childhood dental caries.

INTRODUCTION

Every human being has the fundamental right to access adequate and healthy nutrition. However, the social inequalities, changes in the lifestyle, especially dietary habits as a result of industrialization, and various other factors are influencing this fundamental right. Currently, globally, there are two problems. One associated with nutritional deficiency and the other one is dietary excess. On the other side, the dental caries in children still continues to be a significant public health problem, especially in developing countries.

A factor that may mediate the relationship between social conditions, oral health behaviours and child oral health is the family environment. Family functioning is known to be associated with various components of child development and physical and mental health outcomes, including childhood obesity.[1-4] There are several plausible mechanisms by which family functioning could also affect child oral health. For example, a positive family environment could promote the adoption and maintenance of dentally healthy behaviours through the provision of a supportive, flexible and organized family environment where roles and boundaries are well defined. Indirectly, the emotional quality of family relationships, such as the involvement and affective interaction between family members, could influence parents' behavioural expectations and discipline practices, such as whether they are permissive or demanding towards their child's behaviours.[5]

Childhood dental caries is a very common, largely preventable, chronic condition with substantial adverse impacts on child health and well-being.[6,7]

Dental caries develops from an array of risk factors interplaying at the individual level (e.g., biology and health behaviors), family level (e.g., family functioning, parenting styles, and practices), and a broader societal level (e.g., level of deprivation, provision/access to care and resources).[6-10] Further, evidence has shown that dental caries are socially patterned, whereby children from poorer social backgrounds often show more untreated disease and less treatment experience.[10]

Understanding the mechanisms by which these factors affect the caries process is key to improve child oral health and reduce social inequalities in childhood oral health.[11] The role that families play as a nurturing environment for young children has a pivotal influence on their health and wellbeing outcomes across the life course.[12,13] A family context that is favorable is more conducive to better health and healthier behaviors.[14] One family-level factor that has been studied in relation to child chronic conditions, like obesity and asthma, is family functioning.[15,16]

Dental caries and deviations from normal weight are two conditions constitute important health problems worldwide and have been associated with a great number of negative health outcomes which can affect us at any age. If untreated, it can lead to pain and discomfort and finally loss of teeth and although the World Health Organization (WHO) estimates that oral diseases are the fourth-most expensive diseases to treat in most industrialized countries. While treatment is a costly consequence of oral diseases, reductions in morbidity may also imply other economic benefits. Importantly, there are indirect costs to consider in terms of productivity losses due to absenteeism from school and work.[17,18] Both two condition share several predisposing factors such as diet that is ingestion of carbohydrates,[19] socioeconomic status (SES), fluoride, microbial plaque, bacterial and salivary activity, and social and lifestyle related behavioral factors, and other factors in common.[20] It is important from public health point of view to understand the relationship between the two for their effective management.

In developing countries like Egypt, changing lifestyle and economic growth have contributed to decreased physical activity and altered dietary patterns, especially in children living in urban areas.[21]Thus, sedentary lifestyle along with modern dietary patterns is contributing to the epidemic of overweight in children.[22,23]

Childhood obesity may lead to serious disease, a decrease in life expectancy and numerous other problems. A high body weight is associated with a greater risk for type 2 diabetes and might be at risk factor for cardiovascular disease, asthma, arthritis, and general poor health.[24,25] Obesity in children may also result in emotional unhealthiness.[26]

The most commonly used tool for measuring overweight in children is body mass index (BMI) for age.[27]The link between dietary carbohydrate intake and overweight and the association between refined carbohydrates and dental caries strongly reveal that being overweight might be a predictor for dental caries in children.[27,28]

There are conflicting reports in literature on the association between overweight and dental caries.

Thippeswamy *et al*. reported that dental caries correlates positively with BMI while a systematic review of studies published from 1984 to 2004 showed an inconclusive relationship between overweight and dental caries.[29] A systematic review of the articles published between 2005 and January 2012 by Silva *et al*. in 2013 did not find sufficient evidence relating the association between obesity and dental caries, and it did not clarify the possible role of diet and other possible effect modifiers on this association.[30]

Further, the caries prevalence of Egypt population present a high decayed, missing, and filled teeth score in the adult and young people. The prevalence of caries in the permanent dentition of 12- and 15-year-old school children is 51.4% and the corresponding D2MFT and D3MFT scores were 1.5 and 0.8, respectively while in primary dentition at ages ranged from three years to six years the caries prevalence was 60.4% with the mean dmf value 3.31.[31,32]

However, there have been little studies documented in literature in this part of Egypt assessing the prevalence of dental caries in relation to obesity. Thus, cross sectional study was designed to explore the association between overweight and dental caries in 3-15 year-old school children Upper Egypt, and to analyze the role of age, gender, SES, diet habits, and sugar exposure on the association between body mass index and dental caries.

POPULATION AND METHOD

A cross-sectional observational study was carried out according to the regulations of the Research Ethics Committee of the Faculty of Medicine, South Valley University, Egypt. [Approval: 387] The subjects in this study were recruited from the outpatients' clinics of Faculty of oral and Dental medicine, South Valley University and among school-going children aged three to 15 years in Qena and Luxor governorates, government schools were chosen for the study so that children from different socio demographic levels would be covered, and written informed consent for involvement in the study was obtained from each child's parent or guardian.

Sample size calculation

Using PASS 2021 Power Analysis & Sample Size, A sample size of 209 from a population of 2,200,000 children produces a two-sided 90% confidence interval with a precision (half-width) of 0.05 when the actual proportion is near 0.74.[33]

Questionnaire

The data and the medical history of children were obtained from the parents or guardians with a list-type questionnaire. Information about oral hygiene and dietary habits was obtained with questions on daily oral hygiene practices, intake and frequency of different types of foods (i.e., carbohydrates, dairy products, sweets).[34]

A written approval from respective school authorities was obtained and the children were informed about the study before proceeding with the examination.

Children with long-standing systemic illness, physical or mental disability or those under any medication within the past two months were excluded from the study.

To avoid subjective errors, all the measurements were performed by two examiners who had previously undergone calibration to standardise their procedures before the clinical examination phase in the Department of Pediatric Dentistry and Dental Public Health with the assistance of one recorder, examining the children for the presence of dental caries. For every child, a complete set of disposable diagnostic instruments were used and then discarded, and a new one was used for the next child.

The children were then divided into Three groups based on their age: Group I Primary Dentition (ages three to five years), Group II Mixed Dentition (ages six to11years) and Group III Permanent Dentition (12 to 15years).

The dental caries was recorded according to WHO dentition status and treatment needs (1997) criteria.[35]

The findings were recorded as decayed, missing, or filled using the (decayed-missing-filled teeth [DMFT]/decayed- missed-filled teeth [dmft]) index. Since children were in different stages of the mixed dentition, naturally exfoliated primary teeth were not taken into consideration.

The tooth is considered carious if there is a lesion with a detectably softened floor, undermined enamel or softened wall, caries presented around existing filling, and tooth containing temporary filling. For every child, dmf and DMF indices were calculated separately.

Body weight was recorded by using digital electronic scale Medzana to the nearest 100-gram with the Children were instructed to stand straight, and their height and weight were recorded while barefoot and wearing light dresses. The balance was calibrated at the beginning of each working day and at frequent intervals throughout the day. Height was measured using a standard height chart, to the nearest 0.1cm, according to the following protocol: no shoes, heels together and head touching the ruler with line of sight aligned horizontally. All findings were entered in a data sheet for further analysis.

BMI was calculated using the height and weight recorded, and the formula used to calculate BMI was weight in kg/[height (m)]2 wherein weight is in kilograms and height in meters..

Moreover, in the pediatric population, BMI allows comparison between children of the same sex and age. For children, a BMI that is less than the fifth percentile is underweight and above the 95th percentile is considered obese._Underweight - BMI under 18.5 kg/m2, Normal weight - BMI greater than or equal to 18.5 to 24.9 kg/m2, Overweight – BMI greater than or equal to 25 to 29.9 kg/m2,Obesity – BMI greater than or equal to 30 kg/m2.[36]

Table (1) *Distribution of different parameters (n=262)*

		No. (%)
Age (years)	3–<6 years	117 (44.7%)
	6 – <12 years	119 (45.4%)
	12 – 15 years	26 (9.9%)
Sex	Male	149 (56.9%)
	Female	113 (43.1%)
BMI (kg/m²)	Underweight	151 (57.6%)
	Normal	95 (36.3%)
	Over weight	16 (6.1%)
SES	Low	70 (26.7%)
	Moderate	163 (62.2%)
	High	29 (11.1%)
Parental education	Low	70 (26.7%)
	Moderate	70 (26.7%)
	High	122 (46.6%)
Biological risk factor	No brushing	109 (41.6%)
	Infrequent	95 (36.3%)
	Once daily	49 (18.7%)
	Twice daily	9 (3.4%)
Bread	<2times/week	13 (5.0%)
	1–6 time/day	147 (56.1%)
	3–6 times/week	102 (38.9%)
Other carbo	<2times/week	22 (8.4%)
	1–6 time/day	47 (17.9%)
	3–6 times/week	193 (73.7%)
Eggs	<2times/week	62 (23.7%)
	1–6 time/day	24 (9.2%)
	3–6 times/week	176 (67.2%)
Fruit/ vegetables	<2times/week	46 (17.6%)
	1–6 time/day	36 (13.7%)
	3–6 times/week	180 (68.7%)
Milk	<2times/week	74 (28.2%)
	1–6 time/day	34 (13.0%)
	3–6 times/week	154 (58.8%)
Milk products	<2times/week	127 (48.5%)
	1–6 time/day	22 (8.4%)
	3–6 times/week	113 (43.1%)
Beans	1–6 time/day	101 (38.5%)
	3–6 times/week	161 (61.5%)
Jam molasses & honey	<2times/week	123 (46.9%)
	1–6 time/day	30 (11.5%)
	3–6 times/week	109 (41.6%)
Candies	<2times/week	77 (29.4%)
	1–6 time/day	45 (17.2%)
	3–6 times/week	140 (17.2%)
Crackers	<2times/week	92 (35.1%)
	1–6 time/day	61 (23.3%)
	3–6 times/week	109 (41.6%)
Junk f	<2times/week	112 (42.7%)
	1–6 time/day	66 (25.2%)
	3–6 times/week	84 (32.1%)
Chocolate	<2times/week	88 (33.6%)
	1–6 time/day	61 (23.3%)
	3–6 times/week	113 (43.1%)

Soda	<2times/week 1–6 time/day 3–6 times/week	125 (47.7%) 58 (22.1%) 79 (30.2%)
Juices	<2times/week 1–6 time/day 3–6 times/week	52 (19.8%) 42 (16%) 168 (64.1%)
Citric juices	<2times/week 1–6 time/day 3–6 times/week	161 (61.5%) 24 (9.2%) 77 (29.4%)
Caffeinated drinks	<2times/week 1–6 time/day 3–6 times/week	215 (82.1%) 10 (3.8%) 37 (14.1%)
Deft (n = 236)	Mean ± SD. Median (Min. – Max.)	2.5 ± 2.1 2 (0 – 10)
DMFT (n = 145)	Mean ± SD. Median (Min. – Max.)	1.2 ± 1.4 1 (0 – 8)

SD: **Standard deviation**

The mean dmft and DMFT for the whole sample were (2.5 ± 2.1 and 1.2± 1.4) respectively.

Statistical analysis of the data

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). Categorical data were represented as numbers and percentages. For continuous data, they were tested for normality by the Kolmogorov-Smirnov test. Quantitative data were expressed as range (minimum and maximum), mean, standard deviation and median. Mann Whitney test was used to compare two groups for not normally distributed quantitative variables. Kruskal Wallis test was used to compare between more than two studied groups for not normally distributed quantitative variables. Significance of the obtained results was judged at the Results.

Table (2) *Relation between deft and different parameters in 3–<6 age group (n=117)*

		N	deft Mean ± SD.	Median (Min. – Max.)	Test of sig.	p
Sex	Male	**69**	2.5 ± 2.0	2 (0 – 10)	U= 1537.0	0.503
	Female	**48**	2.6 ± 1.8	2.5 (0 – 6)		
BMI (kg/m²)	Underweight	**59**	3.4 ± 1.8	3 (0 – 10)	H= 30.124*	<0.001*
	Normal	**48**	2 ± 1.8	2 (0 – 6)		
	Over weight	**10**	0.6 ± 0.7	0.5 (0 – 2)		
SES	Low	**31**	3.4 ± 1.9	3 (0 – 8)	H= 8.956*	0.011*
	Moderate	**66**	2.4 ± 1.9	2 (0 – 10)		
	High	**20**	1.9 ± 1.7	2 (0 – 6)		
Parental education	Low	**31**	3.7 ± 2.1	3 (0 – 10)	H= 28.965*	<0.001*
	Moderate	**28**	3.3 ± 1.7	3 (0 – 7)		
	High	**58**	1.6 ± 1.4	2 (0 – 5)		
Biological risk factor	No brushing	**59**	2.7 ± 2.2	2 (0 – 10)	H= 8.649*	0.034*
	Infrequent	**30**	3.1 ± 1.4	3 (0 – 6)		
	Once daily	**22**	1.9 ± 1.7	2 (0 – 7)		
	Twice daily	**6**	1.8 ± 1.7	1.5 (0 – 5)		
Bread	<2times/week	**6**	2.7 ± 1.8	2.5 (0 – 5)	H= 5.514	0.063
	1–6 time/day	**60**	2.2 ± 1.8	2 (0 – 7)		
	3–6 times/week	**51**	3 ± 2.1	3 (0 – 10)		
Other carbo	<2times/week	**10**	2.8 ± 2	2.5 (0 – 6)	H= 5.262	0.072
	1–6 time/day	**16**	3.4 ± 1.7	4 (0 – 6)		
	3–6 times/week	**91**	2.4 ± 2	2 (0 – 10)		
Eggs	<2times/week	**26**	2.9 ± 1.5	3 (0 – 6)	H= 3.898	0.142
	1–6 time/day	**7**	3 ± 1.4	3 (1 – 5)		
	3–6 times/week	**84**	2.4 ± 2.1	2 (0 – 10)		
Fruit/ vegetables	<2times/week	**21**	3 ± 1.7	3 (0 – 6)	H= 4.632	0.099
	1–6 time/day	**19**	2.8 ± 1.6	3 (0 – 7)		
	3–6 times/week	**17**	2.4 ± 2	2 (0 – 10)		
Milk	<2times/week	**37**	3.4 ± 2.1	3 (0 – 10)	H= 9.223*	0.010*
	1–6 time/day	**7**	1.9 ± 1.9	1 (0 – 5)		
	3–6 times/week	**73**	2.2 ± 1.8	2 (0 – 7)		

		N	Mean ± SD.	deft Median (Min. – Max.)	Test of sig.	p
Milk products	<2times/week	**66**	2.2 ± 1.8	2 (0 – 8)	H= 5.285	0.071
	1–6 time/day	**6**	2.7 ± 1.2	2.5 (1 – 4)		
	3–6 times/week	**45**	3.1 ± 2.1	3 (0 – 10)		
Beans	1–6 time/day	**48**	2.4 ± 1.8	2 (0 – 6)	U= 1517.0	0.434
	3–6 times/week	**69**	2.7 ± 2	2 (0 – 10)		
jam molasses & honey	<2times/week	**52**	2.1 ± 1.6	2 (0 – 7)	H= 9.386*	0.009*
	1–6 time/day	**16**	3.9 ± 2.2	3.5 (1 – 10)		
	3–6 times/week	**49**	2.7 ± 2	3 (0 – 8)		
Candies	<2times/week	**33**	1.8 ± 1.4	2 (0 – 6)	H= 11.939*	0.003*
	1–6 time/day	**22**	3.5 ± 1.6	3 (1 – 7)		
	3–6 times/week	**62**	2.6 ± 2.1	2 (0 – 10)		
Crackers	<2times/week	**46**	1.9 ± 1.4	2 (0 – 6)	H= 11.767*	0.003*
	1–6 time/day	**22**	3.4 ± 1.7	3 (0 – 7)		
	3–6 times/week	**49**	2.9 ± 2.2	3 (0 – 10)		
Junk f	<2times/week	**52**	2.1 ± 1.6	2 (0 – 8)	H= 7.214*	0.027*
	1–6 time/day	**24**	3.2 ± 1.8	3 (0 – 7)		
	3–6 times/week	**41**	2.8 ± 2.3	3 (0 – 10)		
Chocolate	<2times/week	**48**	2 ± 1.6	2 (0 – 6)	H= 11.158*	0.004*
	1–6 time/day	**24**	3.6 ± 1.9	3.5 (0 – 8)		
	3–6 times/week	**45**	2.6 ± 2.1	2 (0 – 10)		
Soda	<2times/week	**64**	1.8 ± 1.6	2 (0 – 6)	H= 22.383*	<0.001*
	1–6 time/day	**23**	3.7 ± 1.9	3 (0 – 8)		
	3–6 times/week	**30**	3.3 ± 2.1	3 (0 – 10)		
Juices	<2times/week	**21**	2.9 ± 1.5	3 (0 – 6)	H= 13.479*	0.001*
	1–6 time/day	**16**	3.8 ± 1.4	4 (2 – 7)		
	3–6 times/week	**80**	2.3 ± 2	2 (0 – 10)		
Citric juices	<2times/week	**75**	2.1 ± 1.7	2 (0 – 8)	H= 16.917*	<0.001*
	1–6 time/day	**9**	3.8 ± 1.6	4 (2 – 7)		
	3–6 times/week	**33**	3.4 ± 2	3 (0 – 10)		
Caffeinated drinks	<2times/week	**93**	2.2 ± 1.7	2 (0 – 8)	H= 15.587*	<0.001*
	1–6 time/day	**7**	3.3 ± 1.3	4 (2 – 5)		
	3–6 times/week	**17**	4.4 ± 2.3	4 (1 – 10)		

SD: Standard deviation U: Mann Whitney test H: H for Kruskal Wallis test
*p: p value for comparing between the studied groups *: Statistically significant at p ≤ 0.05*

Gender showed a non- statistically significant relation with dmft (p-value =0.503).

BMI showed a significant relation with dmft (p-value<0.001*) and the highest mean dmft was for underweight children (3.4±1.8) followed by Normal (2±1.8), followed by Over weight (0.60±0.70).

SES showed a significant relation with dmft (p-value=0.011*) and the highest mean dmft was for Low (3.4±1.9) followed by normal (2.4±1.9), followed by High (1.9 ± 1.7).

Parental education showed a significant relation with dmft (p-value<0.001*) and the highest mean dmft was for Low (3.7±2.1) followed by Moderate (3.3±1.7), followed by High (1.6±1.4).

Biological risk factor showed a significant relation with dmft (p-value 0.034*) and the highest mean dmft was for Infrequent (3.1±1.4) followed by No brushing (2.7 ± 2.2), followed by Once daily (1.9±1.7), Twice daily (1.8±1.7).

Table (3) *Relation between deft and different parameters in 6–<12 age group (n=119)*

		N	deft Mean ± SD.	Median (Min. – Max.)	Test of sig.	p
Sex	Male	**62**	2 ± 1.9	2 (0 – 8)	U= 1337.50*	0.020*
	Female	**57**	2.9 ± 2.4	2 (0 – 10)		
BMI (kg/m²)	Underweight	**80**	2.7 ± 2.3	2 (0 – 10)	H= 2.379	0.304
	Normal	**35**	1.9 ± 1.9	2 (0 – 8)		
	Over weight	**4**	2 ± 0.8	2 (1 – 3)		
SES	Low	**35**	2.5 ± 1.7	2 (0 – 6)	H= 1.744	0.418
	Moderate	**79**	2.4 ± 2.4	2 (0 –10)		
	High	**5**	2.8 ± 1.8	2 (2 – 6)		
Parental education	Low	**29**	2.8 ± 1.5	3 (0 – 6)	H= 11.691*	0.003*
	Moderate	**36**	3.2 ± 2.6	2.5 (0 – 9)		
	High	**54**	1.8 ± 2	2 (0 – 10)		
Biological risk factor	No brushing	**44**	3 ± 2	2.5 (0 – 9)	H= 6.931	0.074
	Infrequent	**52**	2.1 ± 2.3	2 (0 – 10)		
	Once daily	**22**	2.3 ± 2.2	2 (0 – 8)		
	Twice daily	**1**	2			
Bread	<2times/week	**6**	2.5 ± 1.5	2.5 (0 – 4)	H= 2.779	0.249
	1–6 time/day	**68**	2.2 ± 2.2	2 (0 – 9)		
	3–6 times/week	**45**	2.8 ± 2.3	2 (0 – 10)		
Other carbo	<2times/week	**11**	3.1 ± 1.6	3 (0 – 6)	H= 3.352	0.187
	1–6 time/day	**26**	2.8 ± 2.6	2 (0 – 10)		
	3–6 times/week	**82**	2.2 ± 2.1	2 (0 – 9)		
Eggs	<2times/week	**33**	2.2 ± 1.7	2 (0 – 6)	H= 0.450	0.799
	1–6 time/day	**13**	3 ± 2.5	2 (1 – 8)		
	3–6 times/week	**73**	2.4 ± 2.3	2 (0 – 10)		
Fruit/ vegetables	<2times/week	**15**	3 ± 1.9	2 (0 – 6)	H= 4.746	0.093
	1–6 time/day	**14**	3.2 ± 2.4	2 (1 – 9)		
	3–6 times/week	**90**	2.2 ± 2.2	2 (0 – 10)		
Milk	<2times/week	**29**	3 ± 1.8	3 (0 – 6)	H= 8.335*	0.015*
	1–6 time/day	**18**	3.1 ± 2.5	2 (0 – 9)		
	3–6 times/week	**72**	2.1 ± 2.2	2 (0 – 10)		
Milk products	<2times/week	**45**	2.3 ± 1.8	2 (0 – 7)	H= 0.258	0.879
	1–6 time/day	**11**	2.5 ± 2.8	1 (0–9)		
	3–6 times/week	**63**	2.5 ± 2.3	2 (0 – 10)		
Beans	<2times/week	**37**	2.8 ± 2.3	2 (0 – 10)	U= 1256.50	0.128
	3–6 times/week	**82**	2.3 ± 2.1	2 (0 – 9)		
jam molasses & honey	<2times/week	**56**	1.8 ± 1.6	2 (0 – 6)	H= 11.325*	0.003*
	1–6 time/day	**14**	4.4 ± 2.7	4.5 (0 – 8)		
	3–6 times/week	**49**	2.6 ± 2.3	2 (0 – 10)		

		N	deft		Test of sig.	p
			Mean ± SD.	Median (Min. – Max.)		
Candies	<2times/week	**33**	2.3 ± 1.8	2 (0 – 6)	H= 4.350	0.114
	1–6 time/day	**22**	3.4 ± 2.6	2.5 (0 – 9)		
	3–6 times/week	**64**	2.2 ± 2.2	2 (0 – 10)		
Crackers	<2times/week	**35**	2.3 ± 2.1	2 (0 – 7)	H= 1.103	0.576
	1–6 time/day	**36**	3 ± 2.8	2 (0 – 10)		
	3–6 times/week	**48**	2.1 ± 1.7	2 (0 – 8)		
Junk f	<2times/week	**41**	2.5 ± 1.9	2 (0 – 7)	H= 1.597	0.450
	1–6 time/day	**40**	2.7 ± 2.7	2 (0 – 10)		
	3–6 times/week	**38**	2.1 ± 2	2 (0 –8)		
Chocolate	<2times/week	**31**	2.5 ± 2	2 (0 – 7)	H= 7.165*	0.028*
	1–6 time/day	**32**	3.4 ± 2.8	2 (0 – 10)		
	3–6 times/week	**56**	1.8 ± 1.7	2 (0 – 8)		
Soda	<2times/week	**48**	2 ± 1.8	2 (0 – 7)	H= 3.456	0.178
	1–6 time/day	**30**	3.1 ± 2.6	2 (0 – 9)		
	3–6 times/week	**41**	2.4 ± 2.2	2 (0 – 10)		
Juices	<2times/week	**21**	2.4 ± 1.9	2 (0 – 7)	H= 1.520	0.468
	1–6 time/day	**21**	3.1 ± 2.7	2 (0 – 9)		
	3–6 times/week	**77**	2.3 ± 2.1	2 (0 – 10)		
Citric juices	<2times/week	**71**	1.9 ± 1.9	2 (0 – 10)	H= 9.216*	0.010*
	1–6 time/day	**15**	3.4 ± 2.9	2 (0 – 9)		
	3–6 times/week	**33**	3.1 ± 2.1	3 (0 – 8)		
Caffeinated drinks	<2times/week	**99**	2.4 ± 2.2	2 (0 – 10)	H= 2.238	0.327
	1–6 time/day	**3**	1 ± 1.7	0 (0 – 3)		
	3–6 times/week	**17**	2.8 ± 2	2 (0 – 8)		

SD: Standard deviation *U: Mann Whitney test* *H: H for Kruskal Wallis test*
p: p value for comparing between the studied groups **: Statistically significant at p ≤ 0.05*

Gender showed a statistically significant relation with dmft (p-value =0.020*).

BMI showed a non-significant relation with dmft (p-value<0.304) and the highest mean dmft was for underweight children (2.7 ± 2.3) followed by over weight (2 ± 0.8), followed by normal(1.9 ± 1.9).

SES showed a non-significant relation with dmft (p-value=0.418) and the highest mean dmft was for high (2.8 ± 1.8) followed by low (2.5 ± 1.7), followed by normal (2.4 ± 2.4).

Parental education showed a significant relation with dmft (p-value<0.003*) and the highest mean dmft was for moderate (3.2 ± 2.6) followed by low (2.8 ± 1.5), followed by High (1.8 ± 2).

Biological risk factor showed a non-significant relation with dmft (p-value =0.074) and the highest mean dmft was for no brushing (3 ± 2) followed by once daily (2.3 ± 2.2), followed by infrequent (2.1 ± 2.3), Twice daily .

Table (4) *Relation between DMFT and different parameters in 12–15 age group (n=26)*

		N	DMFT		Test of sig.	p
			Mean ± SD.	Median (Min. – Max.)		
Sex	Male	**18**	2.4 ± 2	2 (0 – 8)	U= 56.500	0.397
	Female	**8**	1.6 ± 1.7	1.5 (0 – 4)		
BMI (kg/m²)	Underweight	**12**	2.83 ± 1.34	3 (0 – 4)	H= 9.816	0.007*
	Normal	**12**	1 ± 1.13	0.5 (0 – 3)		
	Over weight	**2**	5 ± 4.2	5 (2 – 8)		
SES	Low	**4**	2.3 ± 0.5	2 (2 – 3)	H= 0.429	0.807
	Moderate	**18**	1.9 ± 1.7	2 (0 – 4)		
	High	**4**	3.3 ± 3.4	2.5 (0 – 8)		
Parental education	Low	**10**	3.2 ± 0.9	3.5 (2 – 4)	H= 12.036*	0.002*
	Moderate	**6**	2.2 ± 0.8	2 (1 – 3)		
	High	**10**	1.1 ± 2.5	0 (0 – 8)		
Biological risk factor	No brushing	**6**	2.2 ± 0.8	2 (1 – 3)	H= 8.877*	0.031*
	Infrequent	**13**	3 ± 2.1	3 (0 – 8)		
	Once daily	**5**	0.8 ± 1.3	0 (0– 3)		
	Twice daily	**2**	0 ± 0	0 (0 – 0)		
Bread	<2times/week	**1**	3		H= 0.508	0.776
	1–6 time/day	**19**	1.9 ± 1.6	2 (0 – 4)		
	3–6 times/week	**6**	2.7 ± 2.8	2 (0 – 8)		
Other carbo	<2times/week	**1**	3		H= 0.580	0.748
	1–6 time/day	**5**	2.2 ± 0.8	2 (1 – 3)		
	3–6 times/week	**20**	2.1 ± 2.1	2 (0 – 8)		
Eggs	<2times/week	**3**	1.7 ± 1.5	2 (0 – 3)	H= 0.194	0.908
	1–6 time/day	**4**	3 ± 3.6	2 (0 – 8)		
	3–6 times/week	**19**	2.1 ± 1.5	2 (0 – 4)		
Fruit/ vegetables	<2times/week	**10**	2.7 ± 1.7	3.5 (0 – 4)	H= 3.354	0.187
	1–6 time/day	**3**	1.3 ± 1.5	1 (0 – 3)		
	3–6 times/week	**13**	1.9 ± 2.1	2 (0 – 8)		
Milk	<2times/week	**8**	2.6 ± 1.5	3 (0 – 4)	H= 2.603	0.272
	1–6 time/day	**9**	2.4 ± 2.7	2 (0 – 8)		
	3–6 times/week	**9**	1.4 ± 1.1	2 (0 – 3)		
Milk products	<2times/week	**16**	2.1 ± 1.7	2 (0 – 4)	H= 0.198	0.906
	1–6 time/day	**5**	2.4 ± 3.4	1 (0 – 8)		
	3–6 times/week	**5**	2.2 ± 0.4	2 (2 – 3)		
Beans	1–6 time/day	**16**	2.5 ± 1.4	2.5 (0 – 4)	U= 44.0	0.060
	3–6 times/week	**10**	1.6 ± 2.5	0.5 (0 – 8)		
Jam molasses & honey	<2times/week	**15**	2.2 ± 1.7	2 (0 – 4)	U= 69.50	0.507
	3–6 times/week	**11**	2.1 ± 2.3	2 (0 – 8)		
Candies	<2times/week	**11**	1.3 ± 1.7	0 (0 – 4)	H= 6.098*	0.047*
	1–6 time/day	**1**	**8**			
	3–6 times/week	**14**	2.4 ± 1.2	2 (0 – 4)		
Crackers	<2times/week	**11**	1 ± 1.3	0 (0 – 3)	H= 8.262*	0.016*
	1–6 time/day	**3**	4.3 ± 3.2	3 (2 – 8)		
	3–6 times/week	**12**	2.7 ± 1.4	2.5 (0 – 4)		

		N	DMFT		Test of sig.	p
			Mean ± SD.	Median (Min. – Max.)		
Junk f	<2times/week	**19**	1.9 ± 1.6	2 (0 – 4)	H= 1.457	0.483
	1–6 time/day	**2**	5 ± 4.2	5 (2 –8)		
	3–6 times/week	**5**	1.8 ± 1.1	2 (0 – 3)		
Chocolate	<2times/week	**9**	1.9 ± 1.7	2 (0 – 4)	H= 0.589	0.745
	1–6 time/day	**5**	3.2 ± 2.8	2 (1 – 8)		
	3–6 times/week	**12**	1.9 ± 1.6	2 (0 – 4)		
Soda	<2times/week	**13**	2.2 ± 1.8	3 (0 – 4)	H= 2.207	0.332
	1–6 time/day	**5**	3.2 ± 2.8	2 (1 – 8)		
	3–6 times/week	**8**	1.4 ± 1.2	2 (0 – 3)		
Juices	<2times/week	**10**	3 ± 1.3	3.5 (0 – 4)	H= 7.996*	0.018*
	1–6 time/day	**5**	2.8 ± 3.1	2 (0 – 8)		
	3–6 times/week	**11**	1.1 ± 1.1	1 (0 – 3)		
Citric juices	<2times/week	**15**	2.1 ± 1.8	2 (0 – 4)	U= 78.50	0.838
	3–6 times/week	**11**	2.3 ± 2.1	2 (0 – 8)		
Caffeinated drinks	<2times/week	**23**	1.9 ± 1.6	2 (0 – 4)	U= 23.0	0.395
	3–6 times/week	**3**	4 ± 3.5	2 (2 – 8)		

SD: Standard deviation *U: Mann Whitney test* *H: H for Kruskal Wallis test*
p: p value for comparing between the studied groups **: Statistically significant at p ≤ 0.05*

Gender showed a statistically non-significant relation with dmft (p-value =0.397).

BMI showed a statistically significant relation with dmft (p-value=0.007*) and the highest mean dmft was for overweight children (5 ± 4.2) followed by underweight (2.83 ± 1.34), followed by normal (1 ± 1.13).

SES showed a non-significant relation with dmft (p-value=0.299) and the highest mean dmft was for high (3.3 ± 3.4) followed by low (2.3 ± 0.5), followed by normal (3.8 ± 3.9).

Parental education showed a significant relation with dmft (p-value=0.002*) and the highest mean dmft was for low (3.2 ± 0.9) followed by moderate (2.2 ± 0.8), followed by High (1.1 ± 2.5).

Biological risk factor showed a significant relation with dmft (p-value =0.031*) and the highest mean dmft was for infrequent (3 ± 2.1) followed by no brushing (2.2 ± 0.8), followed by once daily (0.8 ± 1.3), Twice daily.

DISCUSSION

There many numbers of literatures available demonstrating the relationship between dental caries and BMI among schoolchildren. However, this is the first such study to be performed among preschool (nurseries) and schoolchildren residing in Qena and Luxor Governorates. The vision of this study is to determine the prevalence of dental caries in relation to obesity of 3-15 year-old school children of Upper Egypt area, Egypt, and to facilitate the health promotion and program planning of two of the most prevalent diseases among the school going children in Egypt.

The multifactorial and chronic nature of overweight and dental caries leads to economic impacts for individuals and nations. Most evident are the direct healthcare costs associated with treating obesity-attributable diseases. Individuals living with obesity are significantly more likely to use home healthcare services, have more outpatient visits, be prescribed more medications, be admitted to a hospital and undergo surgery than individuals with lower weight.[37,38]Finally, individuals with obesity experience higher costs of care and longer hospital stays.[39]

Tooth decay could adversely affect children's health quality of life psychosocial well-being, and education.[40]

Dietary deficiency occurring early in the life of a child, when the primary teeth are being formed, will enhance the occurrence of caries three to four years later[41]. Moreover, Macro and micro tooth morphology, chemical composition and eruption pattern could be affected by nutrients like vitamin A, vitamin D, calcium and phosphorus36.[42]and oral clearance rate of dietary elements and its erosive effects on children teeth.[43] The ability of a tooth to withstand caries attack is reduced if the teeth experienced nutritional harm during the essential stages of their growth[44]. Acs et al. reported that children with early childhood caries weighed significantly less than age- and sex-matched caries-free children.[45]

It is thought that the increase in children's overweight status has occurred because of an increase in caloric intake and also because of lack of physical activity among children and adolescents.[46] The amount of carbohydrates in children's diet has been increasing over the last 10 years as a consequence of recommendations to decrease dietary fat. Overweight in children has been associated with increased carbohydrate intake and may be related to prolong exposure to carbohydrates.[47] Given the causative relation between refined carbohydrates and dental caries, it is appropriate to hypothesize that overweight might also be a marker for dental caries in children and teenagers .[48]The methodologies varied for determination of caries and overweight. Body weight of a population can be viewed as a continuum from underweight to obesity.

The difference in the caries prevalence and mean dmft may be due to different levels of preventive measures practiced in these places and due to different environmental, social and cultural differences prevalent in different places. Also this high prevalence can be attributed to lack of awareness among parents due to low socioeconomic status as the children were taken from public schools, as father's educational status and mother's occupation had a significant effect on children's dmft. Mother's occupation significantly altered caries status and children of mothers with better occupations experienced less caries; affects oral status of a child[49]

Recent evidence suggests that the nutrition transition is accelerating and the outcome of this trend is a rapid increase in obesity and chronic diseases[50] Lifestyle transition and socio-economic improvement have contributed enormously to the escalating problem in developing countries.[51] Especially, lifestyle[52] and food variety[53] may have an influence on obesity. Thus, the eating pattern among overweight or obese children my be a common risk factor in overweight children and dental caries. Lack of oral health education and less physical training to primary school children may also be linked to high obesity and dental caries prevalence

This study investigated the prevalence of dental caries in a wide age range of children because as individuals grow, their dietary needs and habits constantly change. The prevalence of dental caries among Egyptian children was higher in primary dentition (dmft) when compared to permanent dentition (DMFT), this is similar to what has been reported in India.[54] Deciduous teeth have a higher susceptibility to dental caries due to the lower calcium content and structural differences.[55]

In the current study, there was a significant positive correlation between dmft and age, which is in agreement with previous studies conducted in Brazil and Colombia among children aged between 3 to 5 years.[56] On the other hand, age was inversely correlated with deft in Egyptian children as in mixed dentition period, the maintenance of oral hygiene is difficult due to shedding of primary teeth and pubertal changes.

Investigating the effect of gender on dental caries in the present study revealed that the mean dmft and DMFT of males were comparable those of females and there was no statically a significant correlation between both sexes at the primary dentition stage. In accordance to age group (3–<6) and in age group (6–<12) there is statistically significant relation between females and males with a mean (2.9 and 2) respectively, and reverse result in older age group (12–15) where non-significant relation with a mean (1.6, 2.4) for female and male respectively.

This is similar to a study carried out in Kerala on children aged 12–15 years old, where boys and girls were almost equally affected by caries,[(57)] while differs from another cross-sectional study carried on 10-11 years old Italians, where a significant difference was found between DFT of boys (3.20) and DFT of girls (1.96).[(58)] It has been demonstrated that dental caries prevalence switches from male to females with age, where in the 5-year-old age group 47.4% of children with caries were male, while 41.1% were female. On the other hand, in the 12-year- old age group the percentage was inversed (24.1% female versus 20.6% male).[(59)]

Up to date there is a limited evidence clarifying the association between nutritional status and oral health. According to our results, there was statistically significant correlation between BMI and any of the caries indices in both primary and permanent groups, This is in disagreement with the findings from previous studies in Taiwan and in Sweden42.[(61)] Oliveira *et al*. in Brazil,[(60)] concluded that under- weight children were more likely to have caries which is in accordance with our findings where the highest mean dmft was recorded in underweight children (3.4±1.8) in primary age group.

The recorded non-significant correlation between DMFT and BMI is consistent with the findings of a previous study among adolescents aged12 years in public and private schools in São Paulo State,[(61)] meanwhile, it is opposite to a study in a German elementary school[(62)] which reported an increase in the DMF with increased BMI. However, in the present investigation a positive association between BMI and deft was recorded, but this was at a statistically significant level (p=0.010) which is similarly reported by Elangovan *et al*..[(63)]

Parents play a significant role in the development of their children's oral hygiene habits.[(64)] Parental education level, which is directly associated with socioeconomic status,[(65)] greatly affects the child's oral health.[(66)]

In the current study, there was statistically significant relation between parental educational level, socioeconomic status and dmft in children which is in accordance with previous studies that reported this correlation in early years.[(61,67)] Low socioeconomic status is usually accompanied by poor dietary habits and unhealthy lifestyles that contribute to the development of dental caries.[(68)] Meanwhile, parents with high socioeconomic and education levels start taking care of their children's dental health before their second year of life and help them brush their teeth, as reported in a German cross-sectional study.[(69)]

Since, parents' attitude is the principal social force influencing the child's development in the early childhood years, therefore parental oral health beliefs and practices may be helpful in the prevention of oral health diseases such as caries.[(70)]

This is concomitant with our findings where dmft and deft in Egyptian children were related to parental awareness with education level and communication and organization. Children who received oral health education from their parents started to brush their teeth at an earlier age which revealed better dental health.[(71)]

Studies that aim to establish the relationship between eating habits and the development of caries preferentially use frequency of food consumption questionnaires such as that employed in our study.[72]

The prevalence of dental caries in view of our results was significantly related with chocolate, candies and crackers consumption especially during early years of life (3-6year age group). A direct linkage between sugar intake and caries has been reported previously as cariogenic bacteria grow with the presence of fermentable carbohydrates.[73] Higher chocolate consumption led to increased caries indices which is consistent with the results from other studies67.[74] Consumption of candies more than once per week, besides insufficient oral hygiene measures have been claimed to be risk factors for caries development in primary and permanent dentition.[75] Candies remain on the tooth surface for hours and don't have any nutritional value.[76]

Citric juices were also found to be positively related with dental caries in both three children groups. Enamel start to dissolve when the pH reaches 5.5 and enamel begins to be at risk of decalcification. Subsequently, acidic drinks have been reported to play a significant role in the pathogenesis of dental erosion.[77]

There is non-statistically significant relation between fruits/vegetables consumption and caries. And vice versa in relation of milk, Egyptian children who consumed milk more frequently had lower caries experience, especially during the stage of teeth formation. Milk has low cariogenic potential and contains cariostatic factors against dental caries.[78] Studies showed that milk contains potential caries protective factors as calcium, phosphorus and casein79.[79] The variability of milk consumption manner and other factors may result in a positive association between milk and dental caries occurrence.[80] This was proven when the frequency of milk consumption did not show a significant association with caries (DMFT).

In relation to dental caries indices and bread, other carbohydrates, junk food consumption, our study showed none statistically significant relation between these factors and prevalence of caries in all studied groups except the effect of junk food on incidence of primary teeth caries.

Consumption of jam, molasses and honey during primary and mixed dentition years showed statistically significant relation with dental caries. These finding in agree with the conclusions of the study performed in Taiwan on school children and adolescents.[81]

Soda consumption frequency recorded a non-statistically significant relation with dental caries in both mixed and permanent age groups. This disagrees with a study which has reported positive correlation between soft drinks and dental caries.[82] Although sugars in soft drinks lead to drop in the pH of dental plaque and saliva, salivary components can neutralize the acids within 20–30 minutes raising the pH of plaque to its resting level[83] Despite the fact that no correlation was found between caffeinated drinks consumption and caries, it was reported that polyphenols in coffee and tea can reduce the cariogenic potential of foods.[84] Coffee is active against *Streptococcus Mutans*, the organism causing dental caries. Roasted coffee also has anti-adhesive properties. In this manner, it prevents adhesion of *Streptococcus Mutans* to the teeth8.[85]

Our study had several limitations. Because overweight children are not very common in south valley region, as compared to North of Country, it is difficult to collect a sufficient number of children who are overweight in a particular sample population. Moreover, the BMI values that were used were not put forth based on the Egyptian population. This could have resulted in a variation in the distribution of samples, as many of the normal-weight children would fall within the overweight category if the BMI values were given specific of the Egyptian population. Another limitation of the study, which may have underestimated caries experience, is that bitewing radiographs were not used to identify proximal caries. Initial proximal caries detected by bitewing radiographs would have altered the mean caries experience in all groups.

Different geographical areas in one country can have variable potential risk factors for a disease.[86] thus, the health promoters and policymakers should plan their interventions accordingly. This study marks apath for further investigation to be done to understand the increased prevalence of dental caries among the schoolchildren in the south valley region of Egypt.

The adoption of good oral health habits in childhood often leads to positive results in the quality of the health and life of the children.[87] Previous studies have proved that children live in poverty had infrequent dental visit, therefore, had higher prevalence of dental caries. However, in this study, a clear association between family income and dental caries was not observed. This was comparable with a study done in Sri Lanka.[88]

The dimensions responsiveness, communication and social network did not remain significantly associated with dental caries after adjustment for organization and for each other. Still, they were moderately correlated with organization, which indicates that poorly organized families were also more likely to function poorly on the other dimensions. For example, in some families with poor organization, it may have been that other factors, such as high levels of conflict and discord, poor affective and unresponsive relationships, low levels of behavioural control and weak social networks, simultaneously impacted on children's oral health. The importance of good social networks and support for adolescents' and adults' oral health has already been demonstrated by several studies. In contrast to the findings by Marcenes et al.[89] this study could not find an association between the quality of the partner-relation and children's caries experience.

Early childhood caries remains a highly prevalent worldwide disease that has high costs to society and has a major impact of parents' and children's quality of life. Approaches to reduce its prevalence include:

Management of the disease process that start in the first year of a child's life, and depending on the needs of the child includes primary, secondary, and tertiary prevention.

Evidence-based education and risk-based reimbursement systems that foster a shift from surgical to preventive care.

Preventive approaches for all pre-school children should include: (a) avoiding sugar intake for children under age two; (b) limiting sugar intake in children over age two; and (c) brushing their teeth twice daily with fluoridated toothpaste (at least 1000 ppm), using an age-appropriate amount of paste.

Further research on ECC preventive management, oral health-related quality of life, and health economics to support the benefits of worldwide benefits of reducing its prevalence

CONCLUSIONS

1. The early identification of poor oral hygiene and improper feeding habits should be considered in preventive health promotion in low and modest socioeconomic communities of Upper Egypt.

2. This study provides evidence of a positive relationship between family functioning and dental caries among young children. Family functioning partly explained the association between family socioeconomic position and childhood dental caries, emphasizing the role of the family in improving child oral health and reducing socioeconomic inequalities in child oral health

Clinical significance:

High and alarming percentage of untreated dental caries demonstrates the oral health needs among the school going children in Upper Egypt region. Public health dentists should develop and implement prevention programs so that the oral health issues among schoolchildren are addressed.

RECOMMENDATIONS

Oral health education for mothers and their children at health centers and schools is recommended. Encourage physical training and promote healthy eating pattern among primary school children. Encourage mothers to attend regularly with their children to dentists for early detection of dental caries and to be advised for proper dental hygiene. BMI should be estimated and included in the standard case history of children, as it can help in detection of potential health problems in children. Carry out further research including in depth investigation of eating pattern and oral hygiene practice.

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العلاقه بين معامل كتلة الجسم و تسوس الاسنان بين الاطفال فى سن ماقبل المدرسه وأطفال المدارس في منطقة جنوب الوادي بجمهورية مصر العربية و العلاقه القوية بين دور الاسره والمعاملات الجغرافية على هذه العلاقه

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الملخص :

الهدف: تحليل نوع العلاقة الموجودة بين تسوس الأسنان ومؤشر كتلة الجسم (BMI) للعمر بين أطفال المدارس في منطقة جنوب الوادي بجمهورية مصر العربية

المواد والأساليب: أجرينا دراسة رصدية مقطعية ل 262 تتراوح أعمارهم بين ثلاث سنوات و 15 عاما مع تسوس الأسنان المسجل سريريا تم استخدام معايير منظمة الصحة العالمية التشخيصية للنسبة المئوية لمؤشر كتلة الجسم لتقييم وتسجيل تسوس الأسنان سريريا. تم رسم النتائج التي تم الحصول عليها على منحنيات النسبة المئوية الخاصة بالعمر والجنس من قبل مراكز السيطرة على الأمراض والوقاية منها وتصنيفها وفقا لذلك. تم تغذية البيانات إلى الكمبيوتر وتحليلها باستخدام الإصدار 20.0 من حزمة برامج IBM SPSS.ً .

النتائج: . أوضح أداء الأسرة جزئيا العلاقة بين SES العائلية وتسوس الأسنان في مرحلة الطفولة. DMFT للعينة بأكملها (2.5 ± 2.1 و 1.2 ± 1.4) على التوالي.

الخلاصة: أظهرت هذه الدراسة أن الأداء الأسري غير الصحي كان مرتبطا بتسوس الأسنان بين الأطفال الصغار

الكلمات المفتاحية: تسوس الاسنان . الارتباط العائلى . اطفال المدارس . زيادة الوزن . مؤشر كتلة الجسم