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ORIGINAL ARTICLE

Oral health in relation to nutritional status, age and sex among 14-18 years children of Naraingarh, Haryana

Saúde Bucal em relação ao estado nutricional, idade e sexo de crianças de 14-18 anos de Naraingarh, Haryana

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ABSTRACT

Objective: To describe prevalence dental caries and to study the association between nutritional status and oral health based on various indices among adolescents from under privileged communities. **Material and Methods:** The study was based on a cross-sectional sample of 196 apparently healthy children (104 males and 92 females) in the age range of 14 to 18 years belonging to under-privileged communities. Each subject was measured for height, body weight to assess nutritional status and clinically observed for various oral health traits like dental caries, plaque, calculus and gingivitis. **Results:** Decayed, missing due to caries and filled teeth (DMF) index was low among adolescent children; it was 0.48 in males and 0.93 in females. Prevalence of calculus was higher among females through all age groups, while prevalence of plaque was higher among males. Sex differences were significant only for plaque index and DMF index. The inadequacy of nutrition was not a major determinant for the observed magnitude of soft deposits, plaque and calculus indices except for Oral health status index and DMF index where higher magnitude of the indices were observed in underweight children than the normal. **Conclusion:** The inadequate nutritional status was not a major determinant of oral health indicating the general awareness of oral hygiene and its observance was a major factor. Females were more prone to dental caries than the males and the severity was also significantly higher in the former.

KEYWORDS

Oral health; Nutritional status; BMI-for-age Z-scores; Periodontal health indices; Adolescence.

RESUMO

Objetivo: Descrever a prevalência de cárie dentária e estudar a associação entre o estado nutricional e de saúde bucal baseada em vários índices, em adolescentes de comunidades sob privilegiados. **Material e Métodos:** O estudo teve uma amostra transversal de 196 crianças aparentemente saudáveis (104 meninos e 92 meninas), na faixa etária de 14 a 18 anos, pertencentes a comunidades menos privilegiadas. Cada indivíduo teve a altura e o peso corporal medidos para determinar o estado nutricional. Vários traços de saúde bucal como cárie dental, placa, cálculo e gengivite foram analisados clinicamente. **Resultados:** O índice CPOD (dentes cariados, perdidos devido à cárie e dentes obturados) foi baixo entre os adolescentes; sendo 0,48 para os meninos e 0,93 para as meninas. A prevalência de cálculo foi maior entre as meninas de todas as faixas etárias, enquanto a prevalência de placa foi maior entre os meninos. As diferenças entre os gêneros foram significantes apenas para os índices de placa e CPOD. A falta de adequação da alimentação não foi um fator determinante para a magnitude observada de depósitos, placa e índices de cálculo, com exceção para os índice de condições de saúde bucal e CPOD, nos quais foram observados maiores índices em crianças com baixo peso. **Conclusão:** O estado nutricional inadequado não foi um dos principais determinantes da saúde oral, indicando a consciência geral de higiene oral e sua observância como ator importante. As meninas foram mais propensas a cárie dentária do que os meninos, sendo a severidade da cárie também maior para as meninas.

PALAVRAS-CHAVE

Saúde bucal; Estado nutricional; Índice Massa Corporal; IMC-para-idade escores-Z; Índices de saúde periodontal; Adolescente.

INTRODUCTION

Dental ecology refers to interactions between dentition and environment factors to which it is exposed. These interactions result in a long list of consequences having applications in pathology, human growth, development and maturation, environmental science and forensics (reviewed in Cuozzo and Sauther 2012) [1]. Oral health is a gateway to body health of an individual and is affected by a host of factors like dental crowding, spacing, facial morphology, diet, life style factors, oral hygiene and oral habits [2]. Dental caries and other oral diseases are common in human populations and so also the populations of North India [3]. The risk factors of caries inter alia include tooth susceptibility, amount of saliva, bacteria, dietary sugars and the time the sugars are in contact with the bacteria [4,5].

Over the years, the prevalence of dental caries is declining in most of the countries due to improvement in dental hygiene, but there are contrarian reports of marked increased prevalence of dental caries due to human migrations and changes in life style [6]. Socioeconomic differences are also one of the correlates of dental caries among various segments of different communities. WHO (2001) data [7] show that the mean number of decayed, missing or filled permanent teeth (DMFT) at age 12 years in low-income countries is 1.9, 3.3 in middle-income countries and 2.1 in high-income countries.

Periodontal diseases (gingivitis and periodontitis) are due to chronic bacterial infection that affects the gums and bone supporting the teeth. Periodontitis / gingivitis begin when the bacteria in plaque (the sticky, colorless film that constantly forms on teeth) cause the gums to become inflamed. In the mildest form of the disease, gingivitis, the gums redden, swell and bleed easily. The dental plaque, being host-associated biofilm, is involved in the pathogenesis of both caries and periodontal diseases and the oral microbes are so diverse that these run into hundreds of species [8]. The presence of bacterial colonies in the plaque on the tooth surfaces initiate inflammatory reaction due to toxic products and then the dental disease begins [9]. Dental calculus is a mineralized plaque, and as such, it is not known to play any significant role in periodontal health. But levels and location of calculus formation are population specific and are affected by oral hygiene habits [10]. Subgingival calculus levels in low hygiene populations are known to be correlated with enhanced periodontal attachment loss [10].

The relationship of nutrition with optimal functioning of the immune system is well documented. In light of this, the role of nutrition as a risk factor in dental and periodontal diseases has also been studied. Significantly higher prevalence of dental caries has been reported among the underweight Bengali girls from Howrah district of West Bengal compared to that of the overweight and normal [11]. De Marchi et al. [12] have shown that older people with a compromised oral status had higher odds for risk of malnutrition and the maintenance of a few teeth had a crucial role in increasing the chance of maintaining an adequate nutritional status in the South Brazilian population.

Measuring oral health of people is a complicated issue as there are many dimensions of oral health. Of these, dental caries and periodontal diseases are most commonly used parameters. Marcus et al. [13] utilized expert opinions to identify key factors and their respective weights and these contributed to defining a clinical measure of oral health status. Body mass index (BMI) has been commonly used as an index for the analysis of nutritional status and obesity. Some studies have been carried to assess the association of the BMI and periodontitis [14-16]. Since there are not many studies on adolescents with reference to nutritional status and periodontal health, the present study was conducted with the following major aims and objectives: 1) to study differences in body height, weight and body mass index (BMI) during adolescence among males and females; 2) to study prevalence of various oral

health traits through various age groups in the two sexes; 3) to study the role of mode of tooth cleaning in periodontal health; 4) and to study oral health status index (OHSI) with reference to BMI Z-score categories (as a nutritional status index) in the two sexes.

MATERIAL AND METHODS

The Materials

The data was collected on a cross-sectional sample of 196 children (104 males and 92 females) in the age range of 14 to 18 years from Naraingarh Tehsil of Ambala district in the state of Haryana (India) situated in geographical coordinates of 30° 29' 0" North, 77° 8' 0" East. They were apparently physically and mentally healthy. The children predominantly belonged to Dalit castes, which is a conglomeration of under-privileged communities given schedule caste status under Indian constitution. The subjects of the present study belonged to lower or lower-middle class socioeconomic group. The education level of their parents was low as only 1.5% parents had studied beyond high or senior secondary school. There were no differences between males and female subjects in their parental literacy rates, education levels and socio-economic status. The study confirmed to code of human research ethics. The informed consent of the subjects was taken as per requirements of the ethical committee. All the subjects were explained the purpose and objectives of the study, the measurements/ observations to be made on them and questions to be asked. They were free to quit the study at any stage of the study.

The Methods

Each subject was measured for height and body weight following methods given in Weiner and Lourie [17]. Body mass index (BMI) is calculated as weight (in kilograms) divided by height (in meters) squared. The BMI-for-age growth data is often used to assess nutritional status of a child by comparing with internationally accepted growth norms. A frequently used method for constructing various nutritional status categories is Z-score [18]. A Z-score indicates how many standard deviations above or below the mean or median a measurement is compared to BMI-for-age growth norms. The z-score of zero would mean that weight for height is at the median value of the reference norms. The BMI z-score between +1 and -1 indicates normal nutritional status; between -1 and -2 indicates underweight and between +1 and +2 indicates overweight. The BMI for age Z-scores was used to assess nutritional status by using NCHS (1977) BMI-for-age growth data [19].

The subjects were asked questions about their dental cleaning habits number of major meals, and snacks in-between the major meals and other related dietary habits. For dental clinical observations, each subject was seated in the best lighted place. If the natural light was inadequate, the torch was used to illuminate oral cavity. Teeth were checked for the presence and state of caries (decayed, missing and filled), soft deposit (debris), dental plaque, dental calculus, and gingivitis. For making these observations, each dental arcade (maxillary and mandible) was divided into three segments: anterior (C I_2 I_1 I_1 I_2 C); right lateral (P_1 P_2 M_1 M_2) and left lateral (P_1 P_2 M_1 M_2).

Dental caries were assessed as per recommendations of WHO [20]. Teeth of each subject were seen for being decayed, filled or missing due to caries (DMF). DMF index was recorded for each individual. The presence or absence of oral debris (soft deposit) was recorded in each of the three segments of the two jaws. The extent or degree (measured on an ordinal scale) of debris, dental plaque, dental calculus and gingivitis were assessed following Spolsky [21]. The oral health status index (OHSI) was calculated as a sum total of soft deposit index, plaque index, calculus index, and DMF and gingivitis indices.

RESULTS

Food habits analysis revealed that the staple diet of people mainly consisted of various millets: maize or *bajra* in winter or wheat and gram mixed in summers. The other eatables included leafy and other vegetables, pulses, milk and milk products. Rice was also frequently eaten. The analysis of data revealed no statistically significant differences among different age groups and between sexes in their tooth cleaning habits and frequency of meals. About 62% subjects cleaned their teeth with brush while, 22% used twig tooth brush (*datum*). Males used *Accacia* twig brush while females preferred *Azadirachta indica* (*neem*) twig brush.

Table 1 shows age changes from 14 to 18 years in body height, weight and BMI and sex differences. Increase in body height was 7% among males while only 2% in females. For body weight, the increase was 32.4% in males and 17.16% in females. For BMI sex differences were not very sharp. Increase in BMI in males was 15.95% and 13.02% in females. Sex differences were significant for body height and weight through all age groups, while for BMI sex differences were significant in 15, 16 and 17 years age groups.

Prevalence of various dental pathological traits among various age groups and sexes are presented in Table 2. There were significant sex differences. Prevalence of dental caries and calculus (lingual) was higher in females through all age groups, while prevalence of plaque was higher among males. None of the subjects had calculus on the buccal side of the teeth.

Table 1 - Mean, standard deviation (S.D.) and t-tests between means of males and female for height, weight and BMI

Age	Sex	N	Height			Weight			Body-Mass-Index		
			Mean	SD	t	Mean	SD	t	Mean	SD	t
14	M	18	155.32	8.49	2.59*	38.14	7.24	0.52	15.74	1.67	-1.81
	F	17	148.86	5.95		37.06	4.80		16.67	1.32	
15	M	25	159.44	7.50	3.58**	41.02	6.87	0.35	16.09	1.92	-2.86**
	F	18	152.49	3.90		41.72	6.05		18.09	2.68	
16	M	20	163.00	10.13	4.28**	43.67	6.68	0.67	16.34	1.03	-4.04**
	F	19	152.36	3.97		42.42	4.76		18.18	1.75	
17	M	20	165.71	8.87	5.23**	46.03	3.82	2.74	16.88	1.64	-2.25*
	F	18	153.31	4.98		42.39	4.37		18.02	1.46	
18	M	16	166.25	4.94	9.67**	50.50	2.40	3.74	18.25	2.40	0.88
	F	15	151.82	4.60		43.40	4.38		18.84	1.81	

*p<0.05, **p<0.01

Table 2 - Mean, standard deviation (S.D.) and t-tests between means of males and female for height, weight and BMI

Pathological trait	Sex	Prevalence through various age groups					
		14 yr	15 yr	16 yr	17 yr	18 yr	chi square
Caries	M	16.67	24.00	20.00	40.00	19.05	12.11*
	F	52.94	50.00	42.11	38.89	55.00	
Plaque	M	83.33	92.00	90.00	95.00	90.48	23.67*
	F	64.71	55.56	47.37	50.00	85.00	
Calculus (lingual)Ä	M	44.44	28.00	40.00	65.00	19.05	20.84*
	F	70.59	88.89	68.42	44.44	60.00	

*P< 0.05; Ä there was no case of buccal calculus

Table 3 - Analysis of Variance of various oral health indicators with reference to age and sex

Index	Sex	Mean Values in different age groups				
		14 yr	15 yr	16 yr	17 yr	18 yr
A: Descriptive Statistics						
No. of subjects	M	18	25	20	20	21
	F	17	18	19	18	20
Soft deposit	M	0.89	0.72	0.70	0.40	0.67
	F	0.88	0.67	0.32	0.22	0.30
Plaque	M	0.74	1.02	0.66	0.66	0.47
	F	0.40	0.61	0.36	0.43	0.51
Calculus	M	0.35	0.58	0.25	0.43	0.51
	F	0.34	0.34	0.55	0.44	0.55
DMF Score	M	0.17	0.48	0.60	0.90	0.29
	F	0.77	1.06	1.05	0.89	0.90
Gingivitis	M	0.83	1.48	1.70	1.20	1.33
	F	1.29	1.50	1.63	1.33	1.40
Composite oral health index	M	2.98	4.40	4.33	3.78	3.41
	F	3.74	4.23	4.06	3.43	3.81

B: Two-way ANOVA					
Index	**Source of variation**	**Sum of Squares**	**df**	**Mean squares**	**F-ratio**
Soft deposit	A (Age)	0.35	4,186	0.09	2.47*
	B (Sex)	0.11	1,186	0.11	3.08
	AÄB	0.05	4,186	0.01	0.36
Plaque	A (Age)	0.14	4,186	0.03	1.62
	B (Sex)	0.15	1,186	0.15	7.16**
	AÄB	0.06	4,186	0.01	0.68
Calculus	A (Age)	0.05	4,186	0.01	2.07
	B (Sex)	0.00	1,186	0.00	0.48
	AÄB	0.03	4,186	0.01	1.21
DMF score	A (Age)	0.25	4,186	0.06	0.84
	B (Sex)	0.50	1,186	0.50	6.73**
	AÄB	0.14	4,186	0.03	0.47
Gingivitis	A (Age)	0.41	4,186	0.10	2.07
	B (Sex)	0.04	1,186	0.04	0.75
	AÄB	0.08	4,186	0.02	0.41
Composite oral health index	A (Age)	1.37	4,186	0.34	1.16
	B (Sex)	0.01	1,186	0.01	0.05
	AÄB	0.47	4,186	0.12	0.40

*p < 0.05, **p < 0.01

Table 3 shows no discernible age trend for various oral health indices except for soft deposits which tended to decrease with increase in age and differences were statistically significant. Two-way ANOVA (Table 3) results revealed significant differences for Plaque index and DMF score. Plaque index was higher among males than females, while DMF score was higher in females than males.

Results of analysis of variance of various oral health traits with reference to the mode of tooth cleaning are present in Table 4. Mean soft deposit index and plaque index were lowest in subjects cleaning their teeth with both tooth brush and twig brush. But no such difference was seen for other indices. Sex differences were significant only for plaque index and DMF score.

Results of analysis of variance of various periodontal health indicators with reference to BMI Z-scores and sex are presented in Table 5. The table shows that 86.5% of males and 53.2% of females were underweight as they had BMI z- scores less than -1 and hence their nutritional status was not adequate. But It is evident from the table that inadequacy of nutrition was not a major determinant for the observed magnitude of soft deposits, plaque and calculus indices. Only in case of DMF index, where the differences among the groups were significant and for OHSI, the magnitude was lower among nutritional normal children than those subjects who were underweight. The mean OHSI was lowest (indicating better periodontal health status) among subjects having z-score greater than zero.

DISCUSSION

When the results of the present study were compared with other studies, it was found that mean DMF index was low in the present sample; it was 0.48 in males and 0.93 in females. The mean DMF index in Northwest and at other places of

Table 4 - Analysis of variance of various oral health indicators with reference to the mode of dental cleaning

A) Descriptive Statistics

Index	Mean values of various indices as per mode of tooth cleaning & sex					
	Tooth brush		Twig brush (Datun)		Both Brush and Datun	
	M	F	M	F	M	F
No. of Subjects	64	72	21	7	19	13
Soft deposit	0.64	0.49	0.95	0.57	0.47	0.23
Plaque	0.69	0.46	1.02	0.54	0.49	0.42
Calculus	0.48	0.41	0.49	0.50	0.49	0.61
DMF score	0.53	0.89	0.29	0.43	0.58	1.16
Gingivitis	1.42	1.42	0.95	1.86	1.42	1.31
Composite oral health index(COHI)	3.89	3.78	3.75	4.18	3.66	4.11

B) Two-way ANOVA

	Source of variation	Sum of Squares	Degree of freedom	Mean squares	F-ratio
Soft deposit	A (mode of cleaning)	0.17	2, 190	0.08	2.07
	B (sex)	0.10	1, 190	0.10	2.49
	AXB	0.01	2, 190	0.00	0.16
Plaque	A (mode)	0.11	2, 190	0.06	2.30
	B (sex)	0.10	1, 190	0.10	4.17*
	AXB	0.04	2, 190	0.02	0.89
Calculus	A (mode)	0.01	2, 190	0.01	0.74
	B (sex)	0.00	1, 190	0.00	0.10
	AXB	0.01	2, 190	0.00	0.70
DMF Score	A (mode)	0.44	2, 190	0.22	2.69
	B (sex)	0.32	1, 190	0.32	3.90*
	AXB	0.14	2, 190	0.07	0.88
Gingivitis	A (mode)	0.00	2, 190	0.00	0.03
	B (sex)	0.10	1, 190	0.10	1.82
	AXB	0.31	2, 190	0.16	2.77
COHI	A (mode)	0.02	2, 190	0.01	0.03
	B (sex)	0.10	1, 190	0.10	0.29
	AXB	0.10	2, 190	0.05	0.15

*p < 0.05, **p < 0.01

Table 5 - Analysis of variance of various periodontal health indicators with reference to BMI Z-scores and sex

A. Descriptive Statistics

Index	Mean value of index under BMI Z- score category					
	> 0		0 to -1.0		<-1.0	
	M	F	M	F	M	F
No. of subjects	4	7	10	36	90	49
Soft deposit	0.25	0.29	0.70	0.58	0.69	0.39
Plaque	0.12	0.47	0.58	0.51	0.76	0.43
Calculus	0.56	0.33	0.45	0.47	0.49	0.45
DMF score	0.50	0.57	0.00	0.83	0.54	1.06
Gingivitis	1.00	0.71	1.60	1.61	1.31	1.41
Composite oral health index (COHI)	2.43	2.38	3.53	4.14	3.92	3.86

B. Two-way ANOVA

	Source of variation	Sum of Squares	df	Mean squares	F-ratio
Soft deposit	A (Z-score)	0.15	2, 190	0.07	1.15
	B (sex)	0.02	1, 190	0.02	0.38
	AÄB	0.03	2, 190	0.01	0.22
Plaque	A (Z-score)	0.10	2, 190	0.05	1.31
	B (sex)	0.00	1, 190	0.00	0.01
	AÄB	0.12	2, 190	0.06	1.57
Calculus	A (Z-score)	0.00	2, 190	0.00	0.03
	B (sex)	0.01	1, 190	0.01	0.86
	AÄB	0.02	2, 190	0.01	0.76
DMF Score	A (Z-score)	0.58	2, 190	0.29	3.27*
	B (sex)	0.01	1, 190	0.01	0.06
	AÄB	0.04	2, 190	0.02	0.23
Gingivitis	A (Z-score)	0.16	2, 190	0.08	0.60
	B (sex)	0.34	1, 190	0.34	2.59
	AÄB	0.15	2, 190	0.07	0.56
COHI	A (Z-score)	2.84	2, 190	1.42	2.72
	B (sex)	0.04	1, 190	0.04	0.08
	AÄB	0.15	2, 190	0.08	0.14

*p < 0.05, **p < 0.01

India varied from 0.5 to 5.18 among adolescent children [5,22]. Mean dmft/DMFT varied from 0.23 in private school children in Brazil to 14 in children from remote areas of the rain forest of Suriname [23,24]. DMFT indices among 11-13 year–old-children of the Tibetans and Hans in Tibet were 0.8 and 0.4 respectively [25].

Many studies have explored relationship between oral health status and different measures of socioeconomic status (reviewed in Locker 2000) [26]. Prevalence of caries was higher among children living in deprived areas [27]. The tooth loss among adolescents in Brazil has been attributed to socioeconomic factors [28,29] and ultimately it may be linked with differences in nutrition and dental health care. The American Dietetic Association avers that Oral health and nutrition have a synergistic bidirectional relationship [30].

The present study data showed that 86.5% of males and 53.2% of females were underweight as they had BMI z-scores less than -1 but. These subjects also had mean DMF and OHSI indices greater than the other two nutritionally better categories. These results are in conformity with the studies reporting that poorly nourished growing children are known to have higher incidence of caries [31,32]. But for other oral health traits, no clear picture emerged and the differences were not statistically significant including for OHSI, though the OHSI value was lowest among subjects having better nutritional status. So the results of the present study are only indicative, but not confirmatory. This finding shows that nutrition is not the only determinant of oral health, but other factors like the knowledge of oral hygiene and the related habits prevalent in the community or families also play significant role. That is why many studies found no significant correlation between obesity and dental caries [33]. Chen et al. [34] also found no association between BMI and dft among Chinese three years old children. Willershausen et al. [35] found linear trend between dft + DFT with weight for height in primary school children; the underweight children had a mean dft + DFT value of 1.67, those with normal weight had a value of a mean dft + DFT value of 1.67, those with normal weight had an average value of 2.64, and obese

had a mean value of 2.7. Other studies (reviewed in Kantovitz et al. [36] and Hooley et al. 2012 [37]) have also reported similar findings; some supporting the contention and other showing no substantial evidence between dental caries and high and low BMI. So it be concluded that the determinant factors for different oral health related traits may be different and the factors of poor oral health in different populations may also be different and hence population specific studies should be taken.

CONCLUSION

Despite belonging to an underprivileged community, the present sample showed that the DMF index was low during adolescence; being 0.48 in males and 0.93 in females. Sex differences in DMF index were evident. In the present study, except for DMF, nutrition was not significantly associated with other oral diseases/conditions like soft deposits, plaque, calculus, and gingivitis. The study suggested that etiological factors for dental caries could be different than the other dental and periodontal health traits like plaque, calculus and gingivitis.

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