**Oral Health Status in relation to Body Mass, Nutritional status, Age and Sex Differences among 14-18 Years Children of Naraingarh, Haryana**

**ABSTRACT**

**Background and Objectives**

Nutrition is known to influence human growth, development and metabolic peridontium activity and hence is expected to play an important role in determining dental and periodontal health. But few studies have assessed whether oral health status is associated with nutritional status among adolescents.

**Materials and Methods**

The study was based on a cross-sectional sample of 196 children (104 males and 92 females) in the age range of 14 to 18 years.

**Results**

DMF 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 score. Dental and periodontal health was poorer among the persons with poor nutritional status as mean composite oral health index **(**COHI) was lowest (indicating better periodontal health status) among subjects having BMI for age Z-score greater than zero than the other two categories (Z scores varying from 0 to -1.0, and < -1.0) representing lower nutritional status categories; and the lower COHI index value showed better oral health status.

**Conclusion**

Nutritional status has definitive bearing on dental caries; poor nutritional status adolescents had higher DMF score than those with better nutritional status. The periodontal health was better among adolescents with having good nutritional status, but principally it was on account of inclusion of DMF index in COHI. For occurrence of plaque, calculus and gingivitis a host of factors other than nutritional status were major determinants.

**Key words:** Oral health, nutritional status, BMI-for-age Z-scores, periodontal health indices, adolescence

**1. INTRODUCTION**

Dental ecology refers to interactions between dentition and environment factors to which these are exposed. These interactions result in a long list of consequences having applications in pathology, human growth, development and maturation, environmental science and forensics. Dental variations across species help in the understanding of evolution and palaeoecology. There are now sizable data on demographic, ecological, and reproductive aspects of mammalian and primate dentition (reviewed in Cuozzo and Sauther 2012) 1. Dental crowding, spacing, facial morphology, diet, dental hygiene and oral habits have bearing on dental health2. Oral health is considered as a gateway to body health of an individual.

Dental caries and other oral diseases are common among human populations. Oral health practices, life style and behavior are major determinants of variations in prevalence of dental caries and periodontal diseases. Dental caries have been studied among different populations of North India3-11. The pathogenic mechanisms of caries involves five main factors, tooth susceptibility, saliva, bacteria, dietary sugars and the time the sugars are in contact with the bacteria12. Over the years, the prevalence of dental caries is declining in most of the countries due to improvement in dental hygiene. There has been marked decline in permanent dental caries prevalence in developed countries during the last thirty years. Socioeconomic level is one of the factors for variations in the prevalence of dental caries in various communities. WHO (2001)13 data 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 a chronic bacterial infection that affects the gums and bone supporting the teeth. Periodontitis/gingivitis begins when the bacteria in plaque (the sticky, colorless film that constantly forms on teeth) causes 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. 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. Dental plaque is composed primarily of micro-organisms14. Dental calculus is a mineralized plaque and as such 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. 15 Subgingival calculus levels in low hygiene populations are known to be correlated with enhanced periodontal attachment loss. 15

The role of nutrition as a risk factor for dental caries, dental and periodontal diseases has been studied because of relationship of nutrition with optimal functioning of the immune system, in combating infection and to promote optimal periodontal health. Experimental studies on gingivitis model have shown increased levels of bleeding on probing when participants were fed with a diet high in carbohydrates when compared to those on a low sugar diet16. Cheese has the cariostatic nature as demonstrated in several experimental studies17-18, and in human observational studies19 (Burt et al.1988) and intervention studies20. Cow’s milk contains calcium, phosphorus and casein, all of which are thought to inhibit caries. Chatterjee and Bandyopadhyay (2012)21 found significant association (p< 0.05) with occurrence of dental caries among the underweight Bengali girls from

Howrah district of West Bengal compared to that of the overweight and normal. De Marchi et al. (2008)22 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 as there are many dimensions of oral health. Of these, dental caries and periodontal diseases are most commonly used parameters. Marcus et al. (1983)23 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 periodontitis24-26. 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 document changes in body height, weight and body mass index (BMI) during adolescence and to study sex differences for these traits through various age groups; 2) to study incidence of various oral health markers through various age groups and in the two sexes; 3) to study the role of mode of tooth cleaning in periodontal health; 4) and to study association of BMI as a nutritional status index and sex with a composite index of oral status.

**2. MATERIAL AND METHODS**

The present study was conducted in Naraingarh Tehsil of Ambala district in the state of Haryana (India). Naraingarh town is situated in geographical coordinates of 30° 29' 0" North, 77° 8' 0" East. It is surrounded by Panchkula district on North, the state of Punjab on West, the state of Himachal Pradesh in Northeast and district of Yamunanagar on East. On the southern side, it has Ambala and Barara Tehsils. The population of Naraingarh consisted predominantly of Hindus. The important social/ethnic groups were Rajputs, Jats, Sainis, Gujjars, Brahmins, and certain marginalised castes (Dalits) including Ravidassias and Balmikis. The artisan castes were Goldsmith, Blacksmith, Potter, *Teli* (manufacturer and trader of cooking oil) and Barbers. 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 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. 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. They were traditionally employed as sweepers, cremation ground attendants, to keep and manage unclean and dead animals. Dalits own less land than other communities. They were subjected to discrimination for centuries together. However, their leaders enjoy considerable political clout in the present democratic India, because in an effort to redress the injustice of ages. The constitution of free India provides generous statutory privileges to Dalits. Due to government affirmative actions/policies, positive discrimination for job and education, easy loans, tax benefits/facilities, etc has provided many new avenues for these people, but has also created what is called, “vested interest in backwardness” for those who have enjoyed its fruit. 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.

Each subject was measured for height and body weight following methods given in Weiner and Lourie (1969)27. 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. 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 BMI for age Z-scores was used to assess nutritional status by using NCHS (1977) BMI-for-age growth data.28

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. 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.

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 I2 I1 I1 I2 C); right lateral (P1 P2 M1 M2) and left lateral (P1 P2 M1 M2).

Dental caries were assessed as per recommendations of W. H. O. (1997)29. Teeth of each subject were seen for being decayed, filled or missing due to caries. DMF score 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 of debris, dental plaque, dental calculus and gingivitis were assessed following Spolsky (1996)30.

**2.1 Plaque**

Presence of plaque was recorded by use of Plaksee solution. 2-3 drops of this solution were mixed in one-quarter of glass of water. Each subject was asked to keep this solution in the mouth for 3-4 minutes and then teeth were checked. Plaque was detected by presence of red stains on buccal/lingual sides of both mandible and maxillary teeth in each of the three segments. Plaque index was calculated as follows: 0 score for absence of plaque; 1 score for presence of plaque in the interproximal area or at the gingival margins covering less than 1/3rd of the gingival half of the tooth facial surface; 2 score for dental plaque covering more than one-third but less than two-third of the gingival half of the tooth facial surface; 3 score for dental plaque covering two-third or more of the gingival half of the tooth facial surface. The plaque index score per person was obtained by total scores of each jaw segment and dividing by number of segments (i.e. 6).

**2.2 Calculus**

A dental mirror and dental probe were used on the examination of dental calculus. The probe was scratched on the yellow coloured material on teeth. If these were not swept off, it was termed calculus. The presence of calculus was assessed on both buccal and lingual surfaces of the dental arch as defined for calculus and dividing by the number of segments (i.e. 12). The criteria for calculating index were as follows: 0 score for absence of calculus; 1 score for supra gingival calculus extending only slightly below the free gingival margins (not more than 1 mm); 2 score for moderate amount of supra gingival and sub gingival calculus or sub gingival calculus alone; 3 score for abundance of supra gingival and sib gingival calculus.

**2.3 Gingivitis Index**

Gingivitis (inflammation of the gingiva) is caused by bacterial plaque attached to the tooth surface. Gingivitis was recorded to be present if there was bleeding from gingival sulcus on gentle probing/ visual signs of inflammation/change in colour the gingival from coral pink to varying shades of red, reddish blue/deep blue/loss of surface stippling. Gingivitis index was calculated as: 0 score for absence of signs of inflammation; 1 for mild to moderate inflammatory gingival changes not extending around the tooth; 2 for mild to moderately severe gingivitis extending all around the teeth; 3 for severe gingivitis characterized by marked redness, swelling, tendency to bleed and ulceration. The data so collected was subjected to various statistical tests.

**2.4 Composite Oral Health Index (COHI)**

The COHI was calculated as a sun total of soft deposit index, plaque index, calculus index, DMF and gingivitis index scores.

**3. RESULTS**

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 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 indicators 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. It is apparent from the results that periodontal health was poorer among the persons with poor nutritional status as mean COHI was lowest (indicating better periodontal health status) among subjects having z-score greater than zero than the other two categories (0 to -1.0, < -1.0 ) representing lower nutritional status categories. However these differences did not reach the statistically critical level of significance. But the results in Table 5 definitively showed that nutritional status was significantly associated with DMF.

**4. DISCUSSION**

When the results of the present study were compared with other studies, it was found that mean DMF was low in the present sample; it was 0.48 in males and 0.93 in females. The mean DMF in Northwest and at other places of India varied from 0.5 to 5.18 among adolescent children 10, 31. Mean dmft/DMFT varied from 0.23 in private school children in Brazil32 to 14 in children from remote areas of the rain forest of Suriname33. DMFT scores among 11-13 year–old-children of the Tibetans and Hans in Tibet were 0.8 and 0.4 respectively34.

Many studies have explored relationship between oral health status and different measures of socioeconomic status (reviewed in Locker 2000)35. Prevalence of caries was higher among children living in deprived areas36. However deprived people may not be necessarily poor. Reasons related to tooth loss among adolescents in Brazil have been attributed to socioeconomic factors37, 38 and ultimately it may be linked with differences in nutrition and dental health care. These results do indicate that nutritional status may have some role in dental pathology, which may be related to overall immunity level as nutrition and immunity factors are correlated. The American Dietetic Association avers that Oral health and nutrition have a synergistic bidirectional relationship39.

A better index of nutritional status of an individual during adolescence is BMI. On the basis of that, results of the present study reveal that nutritional status is associated with DMF scores. These results are in conformity with the studies reporting association between malnutrition and increased risk of dental caries40. The malnourished growing children are known to have higher incidence of caries41, but there are contradictory reports on association between dental caries and nutritional status. Some studies showed no correlation between obesity and dental caries42. Chen et al. (1998)43 also found no association between BMI and dft among Chinese three years old children. Willershausen et al (2007)44 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. 2006, 45 and Hooley et al. 201246) have also reported similar findings; some supporting the contention and other showing no substantial evidence between dental caries and high and low BMI. In the present study, except for DMF, nutrition was not significantly associated with other dental/ periodontal diseases like plaque, calculus, and gingivitis.

**5. 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. 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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