

# Effect of socioeconomic, nutritional status, diet, and oral habits on the prevalence of different types of malocclusion in school-children

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**Abstract.** *Objective:* Although there have been many reports on the prevalence of malocclusion, there is a paucity of data concerning factors associated with it. The present study aimed to study the effects of three environmental factors namely socio-economic status (SES), nutritional status, and oral habits on malocclusion. *Material and Methods:* A total number of 765 students [Low socio-economic status (LSS; 369 subjects) and High socio-economic status (HSS; 396 subjects)] based on Modified Kuppuswamy scale were examined within the age group of 13- 15 years amongst various government and private schools in Chandigarh, India. A survey questionnaire was filled up by the subjects, which was followed up with clinical examination using the Dental Aesthetic Index (DAI index). Additionally, the provisional diagnosis, retained, transposed teeth, and overbite were estimated. *Results:* The total prevalence of malocclusion in the population was 49.7%. The prevalence of malocclusion in LSS was found to be 42.90% and in HSS was 57.10% (P: 0.003). The mean DAI score in LSS was 26.011 and in HSS was 27.179. The mean DAI score in soft eaters was 29.527, average eaters was 26.369 and hard eaters was 26.410. *Conclusion:* The total prevalence of malocclusion in Chandigarh was 49.7%. Class I type 1 was the most prevalent type of malocclusion. Adolescents belonging to HSS had more malocclusion as compared to those belonging to LSS. Soft diet caused increased malocclusion. The present study highlighted the effect of diet pattern on the prevalence of malocclusion. ([www.actabiomedica.it](http://www.actabiomedica.it))

**Key words:** socioeconomic status, malocclusion, LSS, HSS, eating habits, DAI score

## Introduction

A significant difference in the prevalence of malocclusion can be seen in various geographical regions of India which can be owed to the variations in the ethnic background, nutritional status, dietary habits, and religious beliefs. The variations in the prevalence of malocclusion amongst Indian children have been reported as low as 19.6 % in Chennai and as high as 90% in Delhi (1).

There has been a significant improvement in oral health conditions over the last century, but this improvement has not been experienced uniformly

amongst various socioeconomic groups as depicted by the various studies that have been performed in the past to examine the relation between socio-economic status (SES) and the prevalence of malocclusion among the school children of various SES backgrounds (2). Similarly, oral habits can invariably become an environmental etiological factor if they extend beyond the preschool age, leading to malocclusion. Digit and dummy sucking habits are quite prevalent amongst pre-school children (3). Moreover, nutritional status has also been associated with oral health. Multiple factors are responsible for causing malnutrition which

may arise either during intrauterine life or childhood or maybe a result of an individual's exposure to deprived nutrition or recurrent instances of infectious or chronic ailments (4). Developing countries have recorded increased incidences of Protein Energy-Malnutrition (PEM) which constitutes a considerable nutritional problem, both owing to their significance and the health problems that arise with it. Economic deprivation has an association with PEM and is a strong indicator of the quality of life of a population (5,6). Malnutrition has also shown an association with malocclusion, especially dental crowding, which arises when the teeth have insufficient space to erupt in a correct position. Poor nutrition also alters the bone development in the craniofacial complex which could reflect in the decreased space present for tooth eruption (7). A change in diet pattern with a trend towards a softer and a refined diet that requires a weaker masticatory action is amongst the most common environmental factors. Masticatory function dictates the jaw development. A variety of occlusal variations may be seen in laboratory animals raised on soft food as proven by the various studies, which may be attributed to normal-sized teeth erupting in undersized jaws (8).

Malocclusion has multifactorial causes making it necessary to study the influence of various etiologies. There has been a paucity of data and conflicting studies regarding the environmental causes of malocclusion. Therefore, in the present study, the environmental factors namely socioeconomic status, diet, nutritional status, and oral habits were studied to decipher their possible role in the involvement in different types of malocclusion amongst school children of Chandigarh.

## Material and Methods

### *Study design:*

This descriptive cross-sectional study was conducted in Chandigarh, India on 13 to 15 years old school children/ adolescents. Private and government schools were selected for examination with the assumption that the maximum sample of high socioeconomic status (HSS) would be concentrated in the private schools and that of low socioeconomic status

(LSS) in the government schools. The necessary official permissions were obtained from their respective competent school authorities. Informed consents and assents were obtained from the parents or guardians of participants and from the same participants respectively. The present study was approved by the Panjab University Institutional Ethics Committee (PUIEC), Chandigarh (No. PUIEC/2018/A-1/09/01).

The sample was divided into two groups based on the socioeconomic status of the children according to the Modified Kuppaswamy scale of socioeconomic status (9). The total sample size comprised 765 (409 males and 356 females) adolescents, of which 396 adolescents belonged to high socioeconomic status (HSS) and 369 adolescents belonged to low socioeconomic status (LSS). A food frequency questionnaire (FFQ), adapted from Persic et al. (10) was used to assess the diet pattern. The diet pattern of the adolescents was assessed on the basis of food which was consumed over a period of one month, therefore, considering it as a regular or general trend of food consumed by the individual over the years. To study the reliability and validity of the FFQ, Cronbach's alpha test and Intra-class-Correlation Coefficient (ICC) was applied and it was found to have a reliability score of 0.739 and a validity score of 0.838 therefore; it had good reliability and validity.

The inclusion criteria of the study were: (a) Children in the age group of 13-15 years from the various schools of Chandigarh (b) Children who had not undergone any previous orthodontic treatment. The exclusion criteria were: (a) Any congenital craniofacial anomalies like cleft lip and palate, facial hemiatrophy, cleidocranial dysplasia, etc. (b) Physically handicapped or immobile individuals because of trauma, as measurements could not be done (c) Those who had reportedly undergone or were undergoing treatment with orthodontic or dentofacial orthopedic appliances.

### *Characteristics of survey:*

- a. General information: The children were asked to fill up the demographic data i.e., name and address of the school, name, age, sex and residence.

- b. Modified Kuppuswamy socioeconomic scale: Education, occupation of the head of the family, and monthly income of the family from all sources were required to be filled up as a part of the Modified Kuppuswamy scale of measurement of the socioeconomic status. Scores were generated accordingly and are presented in Table 1.
- c. Habits- The subjects were asked to mark on the appropriate habit or habits of which the subject/parent/teacher was aware. The habits comprised namely thumb sucking, finger sucking, nail, lip and/or pencil biting, mouth breathing, or tongue thrusting.
- d. "Food Frequency Questionnaire (FFQ)"- This involved marking on an appropriate answer against the various hard food items consumed by the subject over the past one month. The hard food items included different categories like fruits, non-vegetarian items, raw vegetables, dry fruits, and miscellaneous food items. The response of each question was given a score based on Likert scale. The scores for all the individual questions were added up and a mean score was generated which reflected the eating pattern of the subject. Based on the score, children were classified into three broad categories: Those with a score of 0-1.9 were termed soft eaters, 2-2.9 were average eaters and those with a score of 3.0-4 were hard eaters.

#### *Clinical examination questionnaire:*

After the characteristics of the survey were collected, the subjects who fulfilled the inclusion criteria

**Table 1.** Classification of Socioeconomic Status (SES) according to Kuppuswamy scale

Socioeconomic class		Total score
I	Upper	26-29
II	Upper middle	16-25
III	Lower middle	11-15
IV	Upper lower	5-10
V	Lower	<5

of LSS and HSS, were taken up for the oral examination. A clinical examination questionnaire regarding the oral and clinical characteristics of the sample was prepared.

#### *Data Collection:*

According to WHO, the Body Mass Index (BMI) (weight in kilograms by height in meter square) is a suitable indicator for appraising the nutritional status of adolescents and was used in the present study.

#### *Oral examination:*

The examination was conducted in the schools after the subject was made to sit on a chair with satisfactory natural light. Radiographs were not taken. Necessary infection control measures in hand hygiene and personal protective equipment (PPE) were undertaken. The principal investigator's measurements of DAI parameters were standardized with an experienced orthodontist to avoid any gross error in the assessment of the scores.

## Results

#### *Sample Characteristics:*

The sample comprised of 53.5% males and 46.5% females with a mean age of 14.35.

Type and severity of malocclusion: Normal occlusion was seen with a maximum frequency of 50.3% and when definite, severe, and handicapping malocclusion were clubbed together as a single parameter of "malocclusion", it comprised 49.7% of the sample. Class I malocclusion was highly prevalent (43.9 %) with Type 1 being the most common type and Class III malocclusion being least common (0.05%).

The features of the study population are presented in Table 2.

Retained deciduous teeth: The number of retained deciduous teeth in the population was determined. The second deciduous molars were the most frequently

**Table 2.** Sample characteristics

Sex:	Numbers and Frequency(%)
Males	409(53.5)
Females	356(46.5)
<b>SES:</b>	
LSS	369(48.2)
HSS	396(51.8)
<b>Eating Habits:</b>	
Soft Eater	55(7.2)
Average Eater	339(44.3)
Hard Eater	371(48.5)
<b>DAI severity:</b>	
Normal Occlusion	385(50.3)
Definite Malocclusion	216(28.2)
Severe Malocclusion	92(12.0)
Handicapping Malocclusion	72(9.4)
<b>Malocclusion:</b>	
Class I	336(43.9)
Class II	229(29.9)
Class III	4(0.05)

Legend: LSS- Lower Socioeconomic Status; HSS- Higher Socio-economic Status; DAI- Dental Aesthetic Index

retained teeth (17.1%), followed by canines (6.6%), deciduous first molars (3.6%), central incisors (0.7%) and the deciduous lateral incisors (0.5%) were the least retained teeth.

Oral habits prevalence: Amongst the children examined, the maximum number of children had a habit of nail-biting (18.2%) followed by lip biting (13.7%). The prevalence of other habits was (4.4%) for pencil biting, (3.1%) for mouth breathing, (1.3%) for tongue thrusting, (0.7%) for thumb sucking and finger sucking (0.5 %) was the least prevalent habit (Table 3).

SES and eating habit correlation with the mean DAI and BMI scores: The mean DAI score in HSS category was found to be 27.179, which was significantly higher than that for LSS category (P: 0.019). Also, the mean BMI scores for HSS category was 21.5, as compared to 17.2 in LSS category and the difference was found to be highly significant (P: <0.001) (Table 4).

**Table 3.** Frequency of oral habits amongst adolescents

Oral Habits	Numbers and Frequency(%)
Thumb Sucking	5(0.7)
Finger Sucking	4(0.5)
Nail Biting	139(18.2)
Lip Biting	105(13.7)
Pencil Biting	34(4.4)
Mouth Breathing	24(3.1)
Tongue Thrusting	10(1.3)

The mean DAI scores varied significantly with eating habits (P: 0.005). The mean DAI score of hard eaters (26.41) was significantly lower (P: 0.005) than that of the soft eaters (29.52) (Table 5).

Intragroup comparison with regards to SES, BMI, gender, and oral habits: Malocclusion was significantly associated with SES (P: 0.003) and with gender (P: 0.028). However, it was not found significantly associated with BMI (P: 0.874) and with oral habits (P: 0.777). A significantly higher proportion (P: 0.003) of HSS had more malocclusion (57.1%) as compared to LSS. Concerning the BMI category, a higher proportion of underweight children had more malocclusion (50%). A higher percentage (50.5%) of females had malocclusion as compared to a higher percentage of males who had normal occlusion (57.4%) and the difference between these two percentages was statistically significant (P: 0.028) (Table 6).

Intergroup comparison of oral habits with SES revealed that nail-biting and mouth breathing habits were significantly higher for HSS group as compared to that in the LSS group (P: <0.001). No other oral habit was found to differ significantly in the two groups (Table 7).

## Discussion

According to Soh et al. (11), Asian communities generally have dental appearances requiring more orthodontic treatment. India, being a developing and multicultural country, observes numerous ethnicities, religions, and dietary habits throughout its vast expanse

with an absolute racial, cultural, and geographical difference existing between the North and South Indian population. North India has a much higher prevalence of malocclusion (10-15%) with bimaxillary protrusion being more common in South India (12). Also, as a major proportion of Indians have rural dwellings, many hurdles have to be faced in contributing to oral health needs. Next, to dental caries, malocclusion is the second most prevalent condition in children and young adults (13).

The DAI index was used to evaluate malocclusion in the present study, based on socially defined

**Table 4.** SES correlation with the mean DAI and BMI scores

SES	Mean DAI Score	Mean BMI Score
LSS	26.011	17.2
HSS	27.179	21.5
<b>P-value</b>	0.019*	<0.001**

Legend: \*Statistically significant (P value < 0.05); \*\* Statistically highly significant (P value <0.001)

**Table 5.** Eating habits correlation with the mean DAI

EATING HABITS	Mean DAI Score	P- value
Soft Eater	29.52	0.005*
Average Eater	26.36	
Hard Eater	26.41	

**Table 6.** Intragroup comparison with regards to SES, BMI, gender and oral habits

SES	Normal Occlusion(Numbers and %)	Malocclusion(Numbers and %)	P-value
LSS	206(53.5)	163(42.9)	0.003*
HSS	179(46.5)	217(57.1)	
<b>BMI category</b>			
Under weight	185(48.1)	190(50.0)	0.874
Normal	161(41.8)	149(39.2)	
Over weight	29(7.5)	32(8.4)	
Obese	10(2.6)	9(2.4)	
<b>gender</b>			
Males	221(57.4)	118(49.5)	0.028*
Females	164(42.6)	192(50.5)	
<b>Oral habits</b>			
Absent	255(66.2)	248(65.3)	0.777
Present	130(33.8)	132(34.7)	

aesthetic criteria. The gap between the aesthetic and clinical aspects of occlusal conditions can be filled by mathematically providing a single score and can be used across various populations and countries including India (14,15).

"Updated Modified Kuppaswamy SES" which is the most popular and widely used scale, by social researchers, investigators in community and hospital-based examinations, in India was used in this study which includes three key parameters like education, occupation, and total income.

In the present study, the adolescents of LSS examined had rural dwellings leading to a difference in the diet pattern compared to that consumed by HSS. The development of dentition and jaw musculature is known to be dependent on dietary consistency.

**Table 7.** Intergroup comparison of oral habits with SES

ORAL HABITS	LSS (%)	HSS(%)	P-value
<b>Thumb sucking</b>	20.0	80.0	0.205
<b>Finger sucking</b>	25.0	75.0	0.351
<b>Nail biting</b>	33.1	66.9	< 0.001**
<b>Lip biting</b>	53.3	46.7	0.260
<b>Pencil biting</b>	41.2	58.8	0.399
<b>Mouth breathing</b>	8.3	91.7	< 0.001**
<b>Tongue thrusting</b>	30.0	70.0	0.245

According to some animal studies, consumption of soft and refined foods, seen mainly in urban areas and less often in rural populations, results in reduced biting force and biting duration. This affects stimulation of the jaw bones and oral musculature, causing inadequate development of jaws and musculature and an improper eruption of teeth. The attritional wear and mesial migration of teeth do not take place with a soft diet, which decreases the space for the accommodation of all teeth in the jaws leading to crowded arches.

A food frequency questionnaire (FFQ) comprising of seven questions regarding the kind of diet taken by the sample, as adapted from a study by Peršić et al., was used in the present study. A five-point Likert scale, which had better test-re test properties as compared to larger scales, was used. The FFQ showed good reliability and validity, when Cronbach's alpha test and Intraclass-Correlation Coefficient (ICC) were applied.

However, for individuals with particular food demands, such as soft diet or vegans, or people consuming some precise food items, this questionnaire stood unsuitable. A statistically significant correlation ( $P:0.005$ ) was determined between the kind of diet and the severity of malocclusion, which increased with the increased softness of diet. Studies on Alaskan Eskimo inhabitants revealed that their diet comprised of animals like bear, whale, seal, walruses, birds and their eggs, and the vegetation they could collect during the short Arctic summer which required excessive mastication. As a result, their maxillary arch form had a broad and "U" shaped morphology. Also, their teeth were nearly abraded to the gingival level and an edge-to-edge bite resulted. This corrected the tooth irregularity, and neither was caries observed in the population (16). Corruccinni & Whitley (17) associated an increase in the frequency of all classes of malocclusion with the westernization of diet.

Females had a higher prevalence of malocclusion because of poor nutritional status, lesser quantity, and softer and more refined food consumption. This was consistent with the findings of Shekar et al (18), who had disclosed that the prevalence of malocclusion was significantly higher amongst females (23.6%) compared to males (13%).

More adolescents in the underweight category had malocclusion as compared to those with a normal BMI. Though, not statistically significant, since the frequency of children in the overweight and obese categories were already less, the values showed a decrease in the tendency towards malocclusion as we go further down the BMI chart, suggesting an inverse correlation exists between the DAI score and BMI.

The nutritional status can be determined using the BMI, which can be used to estimate a healthy body weight based on height. It is simple to understand, easy to measure, and widely used to classify the nutritional status of a population. Alves et al. (19) in their experiment concerning lab rat samples deduced that malnutrition could limit the growth and development of skull bones in anteroposterior, transversal, and longitudinal directions. The development of skeletal muscles could also be affected, also affecting the bone-muscular systems associated with chewing and respiratory functions.

In the present study, the maximum frequency seen was of nail biters, and lip biters, and the habit with a minimum prevalence was finger sucking. These results were in agreement with the findings of Pruthi et al. (20), which reported a high prevalence of habits like pen/pencil/nail-biting (12.0%), followed by tongue thrusting affecting 6.3% of the population. They were also similar to the findings of "National Oral Health Survey", which recorded the highest prevalence of "habit of biting nails, lips or objects like pencils" amongst all habits at both 12 and 15 years of age in the two areas of Himachal Pradesh (21).

Supplementary information regarding a correlation between SES and oral habits was drawn from the study. Most of the habits were more prevalent amongst the HSS subjects as compared to LSS subjects of which, nail-biting, and mouth breathing habits were statistically significantly more in the HSS group. It is difficult to determine the primary cause of onychophagia, although the leading cause maybe anxiety. It is commonly substituted by smoking or gum chewing in adulthood (22). The next common habit, i.e., mouth breathing which was most frequently observed in HSS adolescents, has can be associated with either nasal obstruction or may have an anatomic etiology owing to a short upper lip. In the current scenario, it is also one

of the Public Health issues, because the general health and quality of life of an individual are affected by this pathology. It may be seen in HSS more frequently because of early weaning off breastfeeding of the child, since most of the mothers may be educated and belong to a working class.

Therefore, it may be interpreted that the effects of socioeconomic status and diet have a major role to play in the causation of malocclusion. Because the present study was a cross-sectional one, the exact diet pattern could not be followed up over a long period, making us draw an assumption that soft diet leads to smaller sized jaws, which increased crowding of the arches. The second assumption that can be drawn is that there has been a secular change in not only the diet pattern but also various other factors, over a period, which has led to increased malocclusion prevalence in HSS.

## Conclusions

It can be concluded that the total prevalence of malocclusion in and around Chandigarh was 49.7%, Class I Type 1 was the most prevalent type of malocclusion, adolescents belonging to HSS had more malocclusion as compared to those belonging to LSS, soft diet caused more malocclusion than an average or hard diet, girls had more malocclusion than boys and nail-biting and mouth breathing were more prevalent amongst HSS subjects.

## Limitations

The present evaluation of diet was a qualitative and not a quantitative one. Also, since most of the food frequency questions were answered by the subjects based on their memory, as it encompassed the diet pattern followed up over the past one month, odds of recall bias might have been present.

**Conflict of Interest:** Each author declares that he or she has no commercial associations (e.g., consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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