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Prevalence and Socio-Demographic Correlates of Deleterious Oral Habits in 5-12 Year-Old School Children in Modinagar, India: A Cross-Sectional Study

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Abstract

Background: Oral habits are common in children and, when persistent beyond the early years, can lead to significant dental and facial abnormalities. Understanding the prevalence and distribution of these habits is crucial for effective intervention and prevention. This study aimed to determine the prevalence of deleterious oral habits among school-going children in Modinagar, India, and to evaluate the influence of socio-demographic factors such as age, gender, and socio-economic status.

Methods: A cross-sectional survey was conducted involving 2000 children aged 5-12 years from both rural and urban schools in Modinagar. Data were collected using structured questionnaires and clinical examinations. Statistical analysis was performed using SPSS Version 23, with Chi-Square tests used to assess associations between socio-demographic factors and the prevalence of oral habits.

Results: The overall prevalence of oral habits was 18%, with mouth breathing (5.6%) and nail biting (5.4%) being the most common. The prevalence was significantly higher in urban areas (22.8%) compared to rural areas (13.2%) ($p < 0.05$). Age-wise, the highest prevalence was observed in the 7-9 years age group (47.5%), followed by the 10-12 years (27.8%) and 5-6 years (24.7%) age groups. No significant gender differences were noted. Socio-economically, the lower middle class exhibited the highest prevalence (36.7%), followed by the upper middle class (31.7%).

Conclusion: Deleterious oral habits are prevalent among children in Modinagar, with significant variations based on urbanization and socio-economic status. Early identification and targeted interventions are essential to mitigate the potential long-term impacts on dental and overall health. The study emphasizes the need for public health initiatives focused on educating parents and caregivers about the risks associated with persistent oral habits.

Keywords: oral habits, pediatric dentistry, deleterious oral habits, stomatognathic system, craniofacial development, pediatric public health

Introduction

Habits are defined as tendencies toward acts that become repeated performances, relatively fixed, consistent, and easy to perform, often becoming almost automatic (Boucher OC) ^[1]. Moyers described habits as learned patterns of muscle contraction, which are complex in nature. From birth, the neonate's survival relies on instinctive sucking when the lips and tongue are stimulated. This reflex soon evolves into the use of the mouth as a primary tool for environmental exploration. For instance, when an object is placed within an infant's reach, the first response is to bring the item to the mouth, essentially using the mouth as a sensory

organ to 'explore' the new environment.

Through random movements, infants discover their hands and toes, using these for continued oral stimulation [2]. The development of such habits during early childhood is a concern not only to parents but also to pediatricians, psychiatrists, psychologists, pediatric dentists, orthodontists, and speech pathologists. Therefore, identifying the etiology and addressing these habits require a multidisciplinary approach.

The American Academy of Pediatric Dentistry (AAPD) emphasizes that the identification of abnormal oral habits and the assessment of their immediate and long-term effects on the craniofacial complex and dentition should be made as early as possible [3]. Mouth breathing, often categorized under oral habits, may involve significant medical or physiological components, necessitating thorough evaluations.

Psychologists view the development of habits as part of the normal maturation sequence in children, recognizing that these activities have the potential to become problematic under certain conditions. Specifically, habits may become problematic if they persist longer than typical, cause physical damage, or interfere with ongoing physical, social, or cognitive development [4]. While certain repetitive behaviors are recognized as normal and necessary stages in a child's physical and emotional development, it is critical for practitioners to differentiate between acceptable (normal) and unacceptable (abnormal or harmful) habits. When a child's behavior falls into the latter category, intervention may be required.

Repetitive behaviors are common during childhood, and both biological and environmental factors contribute to their development and maintenance. Many of these behaviors, such as hand sucking, are benign and self-limiting. Hand sucking is one of the most common behaviors, occurring in 89% of normally developing infants within two hours of birth and nearly 100% of children within their first year of life. These behaviors, essential for survival and environmental exploration, are considered intrinsic movement patterns generated by the developing nervous system. The American Academy of Pediatrics, in collaboration with the American Psychiatric Association, has developed a classification system for repetitive behaviors, categorizing them as normal variations, problems, or specific disorders based on the degree of dysfunction or stigmatization associated with the behaviors [3].

The etiology of oral habits can include various factors, such as family conflicts, jealousy, school pressure, stress, inadequate satisfaction through nourishment, imitation of inappropriate media activities, irritation from tooth eruption, occlusal interferences, malocclusion, and breathing obstruction. Oral habits encompass behaviors such as digit sucking, pacifier sucking, lip sucking and biting, bruxism, self-injurious habits, mouth breathing, and tongue thrusting. Non-nutritive sucking behaviors (e.g., finger or pacifier sucking) are considered normal in infants and young children, typically associated with the need for contact and security.

Oral habits, especially those persisting beyond the preschool age, are significant environmental etiological factors linked to the development of malocclusion. These habits are associated with dentoalveolar and/or skeletal deformation in some patients. According to Finn [5], deleterious oral habits are concerning because they can cause changes in oral structures, behavioral problems, and socially unacceptable behaviors. The extent of dentoalveolar-skeletal deformation

is related to the frequency, duration, direction, and intensity of these habits, and should be carefully assessed by the dentist. Potential changes include anterior or posterior open bite, interference with normal tooth positioning and eruption, alterations in bone growth, and crossbites [6]. Mouth breathing, in particular, can initiate a sequence of events leading to molar over-eruption, steep mandibular plane angle, clockwise mandibular rotation, increased lower facial height, narrow maxillary arches, retroclined mandibular incisors, mandibular retrognathism, and increased frequency of crossbites [6].

Impaired breathing during critical growth periods in childhood can result in localized oral issues such as xerostomia and gingivitis, as well as facial and occlusal problems. Sucking habits are significantly associated with class II malocclusion and posterior crossbite, often resulting in a symmetrical gap between the incisors. Studies have shown that children who engage in digit sucking tend to have proclined lower incisors and dentoalveolar changes. Sucking habits can also modify the skeletal pattern in a growing child [7].

Oral habits manifest in various ways, and their presence may or may not be a concern for parents. Likewise, these habits may or may not significantly impact a child's developing facial structures and dentition. Therefore, a thorough evaluation of the habit, the presence of or potential for oral health repercussions, and a sensitive assessment of the child's physical and emotional status, as well as the parent-child relationship, are crucial [7]. Dentists can provide patients and their parents or guardians with information on the consequences of these habits. Treatment modalities may include patient and parent counseling, behavior modification techniques, myofunctional therapy, and appliance therapy. Recognizing these habits is the first step towards their treatment and elimination [6, 7].

The relative prevalence of oral habits among school-going children in India has been reported to range from as low as 3% in rural children in Ambala (North India) [7] to 29.7% in Mangalore (South India) [8]. However, the prevalence of oral habits among children in Modinagar is unknown. This study was therefore conducted to determine the prevalence of oral habits, along with their distribution according to sex, age, and demographic status among school-going children in Modinagar.

Methodology

Study Design and Setting: A descriptive cross-sectional survey was conducted by the Department of Public Health Dentistry at D.J. College of Dental Sciences & Research, Modinagar, targeting children aged 5-12 years attending both rural and urban schools in Modinagar city. The study aimed to determine the prevalence of deleterious oral habits and evaluate any socio-demographic differences in their prevalence.

Sampling: The sample size was calculated using the formula: $n = Z^2 \times P \times (1-P) / d^2$ where n is the sample size, Z is the Z-value, P is the estimated prevalence, and d is the margin of error.

Where

- Z is the Z-value (1.96 for 95% confidence interval)
- P is the estimated prevalence (60%)
- d is the margin of error (2%)

Using G*Power Version 3.1.9.6, the required sample size

was determined to be 1,987, which was rounded off to 2,000 participants (**Fig 1**). A pilot study was conducted with 50 randomly selected subjects to assess the prevalence of

deleterious oral habits and the feasibility of the survey; these subjects were not included in the main study.

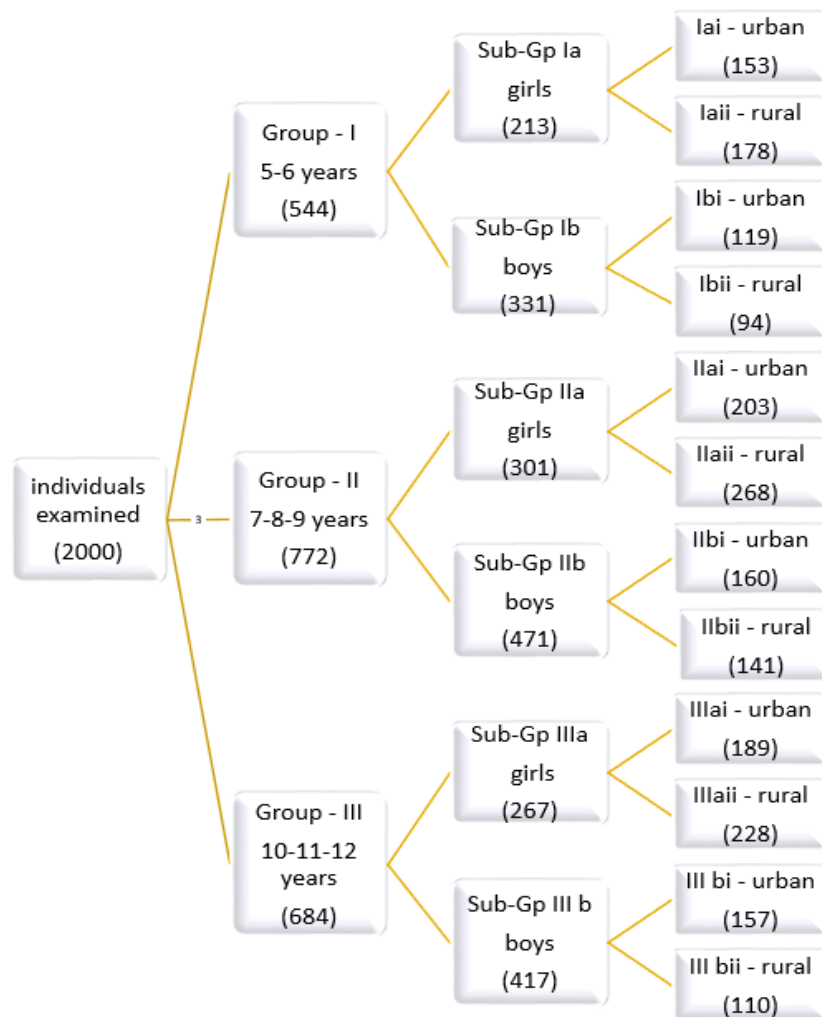


Fig 1: Distribution of individuals examined according to Age, Gender and Area (Urban and Rural) during the survey

Study Population and Sampling Frame: The study population comprised students from government and private schools in Modinagar. Stratified random sampling was employed, with Modinagar arbitrarily divided into four administrative zones: East, West, North, and South. The sampling frame included 32 private and 60 government schools, as documented by the District Education Office, Ghaziabad.

Inclusion & Exclusion Criteria

The study included school-going children aged 5-12 years from both private and government schools in Modinagar, provided the schools granted ethical approval for the survey. Exclusion criteria were students with special needs or disabilities and those undergoing medical or dental treatment that could interfere with the examination process.

Ethical Considerations: Ethical clearance was obtained from the Institutional Review Board of D.J. College of Dental Sciences and Research, Modinagar. Permission was also secured from the principals of the selected schools. Written informed consent was obtained from all study participants after explaining the purpose and methodology of the study.

Survey Scheduling: The survey was systematically scheduled over a period of four months, from December 2022

to April 2023. A detailed weekly and monthly schedule was prepared and communicated to the school authorities in advance. Based on the pilot study, the average time for each interview and clinical examination was estimated at 10-15 minutes, with a maximum of 40 subjects examined per day, four days a week.

Training and Calibration: The examiner was standardized and calibrated in the Department of Public Health Dentistry at D.J. College of Dental Sciences and Research. Calibration involved practicing the examination on a group of 20 subjects with varying levels of disease conditions to ensure consistent interpretation and application of the diagnostic criteria. An expert examiner (Professor and Guide) supervised the calibration process to minimize errors.

Personnel and Organization: The examination team consisted of an examiner and a recording clerk, who was also a dentist familiar with the indices and coding system used in the study. The recording clerk was trained in recording procedures and completing the questionnaire.

Armamentarium: The armamentarium for the examination included plane mouth mirrors, CPI probes conforming to WHO specifications, tweezers, kidney trays, disposable masks and gloves, gauze pieces, cotton swabs, Savlon antiseptic solution, cloth or hand towels, and a torch for

additional illumination when needed.

Infection Control: Standard infection control procedures were strictly followed. Instruments were immersed in Glutaraldehyde solution for at least 30 minutes before being cleaned and sterilized in an autoclave. Disposable gloves and masks were used and changed after each examination, with all waste collected and appropriately disposed of in the college's designated bins.

Examination Area and Lighting: Examinations were conducted in the respective schools under natural daylight conditions, supplemented by artificial battery-operated lights when necessary.

Data Collection: A structured, pre-tested assessment form was utilized for data collection, consisting of three components: socio-demographic data, a questionnaire, and a clinical examination. The close-ended questionnaire, covering personal data and the presence of various oral habits (e.g., mouth breathing, digit sucking, tongue thrusting, nail biting, bruxism, and lip biting), was distributed to parents in both Hindi and English.

Diagnosis of Oral Habits: Detailed diagnostic criteria were employed for identifying oral habits such as thumb sucking, tongue thrusting, mouth breathing, bruxism, lip habits, and nail biting, involving a combination of history, clinical examination, and specific tests. For instance, the Mirror Test and Massler's Water Holding Test were used to diagnose mouth breathing, while a provocation test was employed for bruxism.

Socio-Economic Status: Socio-economic status was assessed using Kuppuswamy's Socioeconomic Status Scale, updated in 2013, which considers education, occupation, and income to classify participants into high, middle, and low socio-economic groups.

Statistical Analysis: Data were analyzed using SPSS Version 23. Descriptive statistics included frequency and percentage distributions. Ordinal variables were compared

using the Chi-Square test to establish correlations between socio-demographic factors and the prevalence of oral habits. The Chi-Square test was utilized to assess the association between observed and expected values under the hypothesis of independence in two-way tables. The test statistic was calculated to determine the fit of the model to the observed data.

Results

Distribution of Oral Habits in the Study Population

In this study, a total of 2000 children aged 5-12 years were examined to determine the prevalence of various deleterious oral habits. Among the total population, 18% (n=360) exhibited one or more oral habits. The most frequently observed habit was mouth breathing, affecting 5.6% (n=111) of the children, which suggests a significant prevalence that may be linked to underlying respiratory or habitual factors. Nail biting was the second most common habit, present in 5.4% (n=107) of the children, indicating a potential association with stress or anxiety-related behaviors typical in this age group. Digit sucking was observed in 3.6% (n=73) of the children, which, although less common than mouth breathing and nail biting, still represents a notable proportion of the population, potentially influencing dental arch development if prolonged. Tongue thrusting was present in 2.5% (n=50), a habit known to affect occlusal and speech development. Less prevalent habits included bruxism, observed in 0.6% (n=12), which may have implications for dental wear and temporomandibular joint issues. Lip habits, including lip sucking or biting, were seen in 0.2% (n=5), and masochistic habits, such as self-injurious biting, were the least common, noted in only 0.1% (n=2). These findings underscore the varied nature of oral habits in children, with a significant proportion exhibiting behaviors that could have long-term dental or psychosocial consequences (**Table 1**).

Table 1: Distribution of Oral Habits in the Study Population

Oral Habits	n	%
Tongue Thrusting	50	2.5%
Mouth Breathing	111	5.6%
Digit Sucking	73	3.6%
Lip Habit	5	0.2%
Bruxism	12	0.6%
Nail Biting	107	5.4%
Masochistic	2	0.1%
Total	360	18%

Sex-Wise Distribution of Oral Habits

The distribution of oral habits was further analyzed according to gender, revealing that boys exhibited a higher overall prevalence of oral habits (64.1%, n=231) compared to girls (35.9%, n=129). This gender difference, while noticeable, was not statistically significant for most habits, indicating that while boys may exhibit these habits more frequently, the difference is not large enough to conclusively attribute it to gender alone.

Specifically, tongue thrusting was slightly more common in girls (2.7%) compared to boys (2.4%), but this difference was not statistically significant (p=0.384 NS). Similarly, mouth breathing was slightly more prevalent in boys (5.9%) than in girls (5.0%), though this difference was also non-significant (p=0.222 NS). Digit sucking was more common among boys

(4.1%) compared to girls (2.9%), approaching statistical significance but not reaching it (p=0.110 NS). Bruxism showed a higher prevalence in boys (0.8%) compared to girls (0.2%), though this too was not statistically significant (p=0.093 NS). Nail biting was nearly equally distributed between boys (5.3%) and girls (5.4%) (p=0.520 NS), indicating that this habit is similarly common across genders. Masochistic habits, although rare, were observed only in boys (0.2%) and not in girls, though this difference was not statistically significant (p=0.371 NS). Overall, while there are variations in the prevalence of specific oral habits between boys and girls, none of these differences reached statistical significance, suggesting that gender alone may not be a strong determinant of these habits in this population (**Table 2**).

Table 2: Sex-Wise Distribution of Oral Habits

Oral Habits	Boys (n, %)	Girls (n, %)	p-value
Tongue Thrusting	29 (2.4%)	21 (2.7%)	0.384 NS
Mouth Breathing	72 (5.9%)	39 (5.0%)	0.222 NS
Digit Sucking	50 (4.1%)	23 (2.9%)	0.110 NS
Lip Habit	3 (0.2%)	2 (0.3%)	0.647 NS
Bruxism	10 (0.8%)	2 (0.2%)	0.093 NS
Nail Biting	65 (5.3%)	42 (5.4%)	0.520 NS
Masochistic	2 (0.2%)	0 (0.0%)	0.371 NS
Total with Habits	231 (64.1%)	129 (35.9%)	0.101 NS
Total without Habits	988 (60.3%)	652 (39.7%)	

NS: Non-significant, meaning the p-value is greater than 0.05, indicating no statistically significant difference or association

Distribution of Oral Habits According to Urban and Rural Areas

The study also explored the distribution of oral habits across urban and rural populations, revealing significant disparities between the two groups. Urban children exhibited a notably higher prevalence of certain oral habits compared to their rural counterparts. For instance, tongue thrusting was more prevalent among urban children (3.4%) compared to rural children (1.7%), with this difference reaching statistical significance ($p=0.011^*$). This finding may suggest environmental or lifestyle factors associated with urban living that could contribute to the development of tongue thrusting.

Digit sucking was also significantly more common in urban children (5.0%) than in rural children (2.4%) ($p=0.001^{**}$), which may reflect differences in parenting practices, stress levels, or access to pacifiers and other comfort items. Nail biting showed the most substantial urban-rural difference,

with 7.5% of urban children exhibiting this habit compared to 3.2% of rural children ($p<0.001^{***}$), potentially indicating higher stress or anxiety levels in urban environments.

On the other hand, mouth breathing was similarly prevalent in both urban (5.7%) and rural (5.4%) populations, with no significant difference between the two ($p=0.418$ NS). This suggests that factors contributing to mouth breathing, such as respiratory issues or anatomical predispositions, may be equally common across these environments. Lip habits and bruxism were slightly more common in urban children, though these differences did not reach statistical significance ($p=0.176$ NS and $p=0.361$ NS, respectively). The total prevalence of oral habits was significantly higher in urban areas (62.4%) compared to rural areas (37.6%) ($p<0.001^{***}$), indicating a substantial urban influence on the development of these habits. This disparity highlights the need for targeted public health interventions in urban settings to address and mitigate the factors contributing to these behaviors (**Table 3**).

Table 3: Distribution of Oral Habits According to Urban and Rural Areas

Oral Habits	Urban (n, %)	Rural (n, %)	p-value
Tongue Thrusting	33 (3.4%)	17 (1.7%)	0.011*
Mouth Breathing	56 (5.7%)	55 (5.4%)	0.418 NS
Digit Sucking	49 (5.0%)	24 (2.4%)	0.001**
Lip Habit	4 (0.4%)	1 (0.1%)	0.176 NS
Bruxism	7 (0.7%)	5 (0.5%)	0.361 NS
Nail Biting	74 (7.5%)	33 (3.2%)	0.000***
Masochistic	2 (0.1%)	0 (0.0%)	0.240 NS
Total with Habits	360 (62.4%)	135 (37.6%)	0.000***
Total without Habits	757 (46.1%)	884 (53.9%)	

NS: Non-significant, meaning the p-value is greater than 0.05, indicating no statistically significant difference or association.

* $p < 0.05$: Statistically significant at the 5% level, meaning there is a less than 5% probability that the observed difference or association is due to chance.

** $p < 0.01$: Statistically significant at the 1% level, meaning there is a less than 1% probability that the observed difference or association is due to chance.

*** $p < 0.001$: Highly statistically significant at the 0.1% level, meaning there is a less than 0.1% probability that the observed difference or association is due to chance.

Age-Wise Distribution of Oral Habits

The prevalence of oral habits was further analyzed across different age groups to understand how these behaviors evolve with age. The highest prevalence of oral habits was observed in the 7-9 years age group, which accounted for 47.5% ($n=171$) of the total cases. This finding suggests that middle childhood, typically associated with school entry and increased social interactions, may be a critical period for the development or persistence of oral habits.

In the 5-6 years age group, oral habits were observed in 24.7% ($n=89$) of the children. This age group is often

characterized by the continuation of habits formed during early childhood, with some habits potentially persisting due to lack of early intervention or reinforcement of comfort behaviors. The 10-12 years age group had a prevalence of 27.8% ($n=100$), indicating that while some habits may diminish with age, a significant proportion of children continue these behaviors into late childhood.

When examining the distribution by gender within each age group, urban boys consistently exhibited higher prevalence rates of oral habits compared to their rural counterparts, particularly in the 7-9 years group, where 79.4% of urban

boys exhibited at least one habit. Urban girls also showed higher prevalence rates compared to rural girls, though the differences were less pronounced. These findings suggest that age and urban living may interact to influence the persistence and development of oral habits, possibly due to

increased stressors, lifestyle factors, or peer influences in urban settings. The data also highlight the importance of early intervention, particularly in urban environments, to prevent the continuation of deleterious oral habits into later childhood (**Table 4**).

Table 4: Age-Wise Distribution of Oral Habits

Age Group	Urban Boys (n, %)	Rural Boys (n, %)	Urban Girls (n, %)	Rural Girls (n, %)	Total (n, %)
5-6 Years	36 (57.1%)	15 (57.7%)	27 (42.9%)	11 (42.3%)	89 (24.7%)
7-9 Years	74 (79.4%)	48 (62.3%)	19 (20.4%)	29 (37.7%)	171 (47.5%)
10-12 Years	38 (55.9%)	19 (59.4%)	30 (44.1%)	13 (40.6%)	100 (27.8%)
Total	148 (66.1%)	76 (33.9%)	82 (60.7%)	53 (39.3%)	360 (100%)

Socio-Economic Status and Prevalence of Oral Habits

Socio-economic status (SES) was also found to be a significant factor influencing the prevalence of oral habits among the study population. Children from the lower middle class exhibited the highest prevalence of oral habits across all age groups, accounting for 36.7% (n=132) of the total cases. This may be attributed to factors such as higher stress levels, less access to preventive dental care, or differing parental practices in this socio-economic group.

The upper middle class also showed a considerable prevalence of oral habits (31.7%, n=114), suggesting that while these children may have better access to healthcare, other factors such as parental pressure, academic stress, or social expectations could contribute to the development of these behaviors. The upper class had a relatively lower prevalence (15.8%, n=57), which could be due to better access to early intervention and preventive care, as well as

potentially lower stress levels.

Children from the upper lower and lower socio-economic classes exhibited the lowest prevalence of oral habits, at 10.0% (n=36) and 5.8% (n=21), respectively. This could reflect underreporting or a lack of awareness among parents in these groups, or it may suggest that other priorities, such as basic needs, overshadow concerns about oral habits. Across all age groups, the lower middle and upper middle SES groups consistently showed higher percentages of oral habits, indicating that these groups may be particularly vulnerable to the development of such behaviors. These findings underscore the need for targeted educational and preventive programs aimed at lower-middle and upper middle-class families to reduce the prevalence of oral habits and mitigate their long-term impacts on dental health (**Table 5**).

Table 5: Socio-Economic Status and Prevalence of Oral Habits

SES Group	5-6 Years (n, %)	7-9 Years (n, %)	10-12 Years (n, %)	All Ages (n, %)
Upper	13 (14.6%)	24 (14.0%)	18 (18.0%)	57 (15.8%)
Upper Middle	26 (29.2%)	58 (33.9%)	31 (31.0%)	114 (31.7%)
Lower Middle	37 (41.6%)	65 (38.0%)	36 (36.0%)	132 (36.7%)
Upper Lower	11 (12.4%)	17 (9.9%)	12 (12.0%)	36 (10.0%)
Lower	2 (2.2%)	7 (4.1%)	3 (3.0%)	21 (5.8%)
Total	89 (100%)	171 (100%)	100 (100%)	360 (100%)

Discussion

Habits are repetitive practices that, through constant repetition, can become ingrained behaviors, often carried out subconsciously. Oral habits are common in children and, when within physiological limits, may not cause harm to the stomatognathic system. In fact, some oral habits are considered beneficial for oral motor development. However, when these activities exceed an individual's physiological tolerance, they can lead to significant alterations in the dentofacial structures, including abnormal bone growth, tooth malpositions, speech difficulties, imbalances in facial musculature, and psychological issues (Hegde *et al.*)^[9]. Early diagnosis of these destructive habits is crucial, allowing both dentists and parents to intervene before permanent damage occurs. Comprehensive diagnostic procedures should include thorough examination of the stomatognathic system, evaluating the form and function of the teeth, temporomandibular joints, and related musculature (Shetty & Munshi, Guaba *et al.*, Hegde *et al.*)^[7-9]. Identifying oral habits should be a primary focus during the examination and diagnosis of pediatric patients, with ongoing monitoring to detect any associated changes in the permanent dentition and facial morphology as the child grows (Kharbanda *et al.*,

Bhaya *et al.*)^[10-11].

Prevalence of Oral Habits

In our study, the overall prevalence of deleterious oral habits among the 2000 schoolchildren aged 5-12 years was found to be 18% (n=360). This finding is consistent with the study by Hegde *et al.*, who reported a prevalence of 19.95% among 2636 children aged 4-15 years in South Kanara district, Karnataka (Hegde *et al.*)^[9]. In contrast, studies by Shetty and Munshi (1998)^[8] and Guaba *et al.* (1998)^[7] reported a much lower prevalence of 3% among children in Chandigarh aged 6-15 years (Shetty & Munshi, Guaba *et al.*). Other studies, such as those by Kharbanda *et al.* and Bhaya *et al.*, reported higher prevalences of 25.5% in Delhi schoolchildren aged 5-13 years and 38% in Gulbarga city schoolchildren aged 11-13 years, respectively (Kharbanda *et al.*, Bhaya *et al.*)^[10-11]. These discrepancies in prevalence rates can be attributed to variations in the study populations, diagnostic criteria, age groups, and socio-economic statuses. Notably, the studies with higher prevalence rates were often conducted in urban populations, suggesting that environmental factors in urban areas may contribute to the higher occurrence of these habits.

Urban vs. Rural Comparison

The prevalence of oral habits was significantly higher in the urban population (22.8%, n=224) compared to the rural population (13.2%, n=164), with the difference being statistically significant ($p < 0.05$). Nail biting was the most prevalent habit in the urban group (7.5%), while mouth breathing was more common in the rural group (5.4%). These findings align with previous studies by Shetty & Munshi in Mangalore, Bosnjak *et al.* in Zagreb, Croatia, and Hegde *et al.* in South Kanara, Karnataka, where nail biting was identified as a prevalent habit in urban settings (Shetty & Munshi, Hegde *et al.*, Bosnjak *et al.*)^[8, 9, 12]. Behavioral problems, social influences, and peer pressure are more prominent in urban schoolchildren compared to those in rural areas, potentially leading to an increased incidence of nail-biting as a stress-relief mechanism (Agarwal *et al.*)^[13].

Gender-Wise Comparison

The distribution of oral habits among boys (18.9%) and girls (16.5%) did not show a significant difference, as indicated by the Fisher's Exact Test ($p > 0.05$). These findings are consistent with previous studies, which also found no significant gender predilection for oral habits (John, Warren *et al.*, Kharbanda *et al.*, Onyiaso *et al.*, Bhayya *et al.*)^[14-16, 11]. Levin and Kaye's study on non-nutritive sucking in neonates reported no correlation between the habit and gender, suggesting that environmental factors may play a more significant role than genetic influences in the development of these habits (Levin & Kaye)^[17]. Although some studies, such as those by Quashie *et al.* and Bosnjak *et al.*, reported a slightly higher prevalence of certain oral habits among males, these differences were not statistically significant (Quashie *et al.*, Bosnjak *et al.*, Onyiaso *et al.*)^[18, 12, 16].

When examining individual oral habits in our study, it was observed that males had a slightly higher prevalence for most habits compared to females, although the differences were not statistically significant. Shetty *et al.* reported that digit sucking and bruxism were more prevalent among boys, while nail biting and pencil biting were more common among girls (Shetty *et al.*)^[8]. Similar gender differences have been noted in other studies, though these variations are often minor and may be influenced by environmental factors (Kharbanda *et al.*, Anjli *et al.*, Vasquez *et al.*)^[10, 19, 20].

Age-Wise Comparison

Our study divided the children into three age groups: 5-6 years, 7-9 years, and 10-12 years. The prevalence of oral habits showed a significant difference between these groups ($p < 0.05$). The highest prevalence was observed in the 7-9 years age group (47.4%, n=171), followed by the 10-12 years age group (27.9%, n=100), and the 5-6 years age group (24.8%, n=89). This pattern suggests that oral habits may peak during the middle childhood years, likely due to increased stress, competitiveness, and parental expectations during the early school years.

These findings are consistent with Bosnjak *et al.*, who reported a similar age-related trend in Zagreb, Croatia, where the prevalence of oral habits increased with age but declined slightly in the oldest group studied (Bosnjak *et al.*)^[12]. The increase in oral habits during middle childhood can be attributed to behavioral problems and the stress associated with school life. However, some studies, such as those by Quashie *et al.* and Bishara *et al.*, observed a decline in the

prevalence of oral habits as children aged, particularly after reaching 7-8 years (Onyiaso, Quashie *et al.*, Bishara *et al.*)^[16, 18, 21].

Prevalence of Individual Oral Habits

In terms of individual habits, our study found that mouth breathing was the most prevalent among the 5-6 years age group (6.4%), while nail biting was the most common habit in the 7-9 years (6.9%) and 10-12 years (6.0%) age groups. Mouth breathing, which accounted for 20.16% of the total habits recorded, was more common in boys and in the 5-6 years age group, aligning with the findings of Kharbanda *et al.*, who also reported a high prevalence of mouth breathing in Delhi schoolchildren (Kharbanda *et al.*)^[10]. Similarly, nail biting was more prevalent in the urban population, consistent with studies by Hegde *et al.* and Shetty & Munshi, who also identified nail biting as a common habit in urban settings (Hegde *et al.*, Shetty & Munshi)^[8, 9].

Digit sucking was observed in 3.6% of the children, with a higher prevalence among boys in the 7-9 years age group and among girls in the 5-6 years age group. This habit, which accounted for 12.96% of the total oral habits, was more prevalent in the urban population and younger children, reflecting the findings of other studies that report a decline in digit sucking with age (Farsi *et al.*, Warren *et al.*, Bishara *et al.*)^[15, 21, 22].

Tongue thrusting, with a prevalence of 2.5%, was slightly more common among girls, urban children, and those aged 7-9 years. This contrasts with findings from Bhayya *et al.* and Kharbanda *et al.*, who reported tongue thrusting as the most prevalent habit in their respective study populations (Bhayya *et al.*, Kharbanda *et al.*)^[10, 11]. However, our findings are consistent with studies by Garde *et al.* and Shetty *et al.*, who found a lower prevalence of tongue thrusting in Pune and Mangalore children, respectively (Garde *et al.*, Shetty *et al.*)^[8, 23].

Bruxism, which had a prevalence of 0.6%, was more common among boys, urban children, and those in the 10-12 years age group. This prevalence is in line with Hegde *et al.*, who reported bruxism as a less prevalent oral habit in South Kanara children (Hegde *et al.*)^[9]. In contrast, other studies, such as those by Garde *et al.* and Murshid *et al.*, reported higher prevalences of bruxism in their study populations (Garde *et al.*, Murshid *et al.*)^[23, 24].

Lip habits and masochistic habits were the least prevalent, with lip habits found in 0.2% of the population and masochistic habits in 0.1%. These habits were more common in girls and the urban population, with a decrease in prevalence with age. The low prevalence of these habits is consistent with findings from Shetty *et al.*, who reported similar low rates of these habits in Mangalore children (Shetty *et al.*)^[8].

Effects of Socioeconomic Status on Prevalence of Oral Habits

The analysis of socio-economic status revealed that the majority of children with deleterious oral habits belonged to the lower middle class (36.67%), followed by the upper middle class (31.67%). The prevalence was lowest among children from the lower socio-economic class (5.83%). These findings suggest that higher socio-economic status may be associated with a greater prevalence of oral habits, possibly due to increased stress, academic pressure, and access to resources that might inadvertently reinforce these behaviors.

Our findings are consistent with those of Quashie *et al.*, who reported a higher prevalence of oral habits among children from higher socio-economic backgrounds in Lagos (Quashie *et al.* 65). Similarly, Calisti *et al.* found that children from high socio-economic groups were more likely to exhibit oral habits such as finger sucking and nail biting (Calisti *et al.*) [25]. However, studies by Farsi *et al.* and Warren *et al.* found no significant association between socio-economic status and the prevalence of oral habits, suggesting that other factors, such as parental education and child-rearing practices, may play a more critical role (Farsi *et al.*, Warren *et al.*, Onyeaso) [15, 16, 22].

Conclusion

The present study highlights the significant prevalence of deleterious oral habits among school-going children aged 5-12 years in Modinagar, India. The overall prevalence was found to be 18%, with mouth breathing and nail biting emerging as the most common habits. The study also revealed that these habits were more prevalent in urban areas compared to rural settings, and among children from lower middle and upper middle socio-economic classes. While no significant gender differences were observed, age-related variations were evident, with the highest prevalence seen in the 7-9 years age group. These findings underscore the need for early identification and intervention, particularly in urban environments and among socio-economically vulnerable populations, to prevent the long-term impacts of these habits on dental and overall health. Targeted educational and preventive programs, along with multidisciplinary approaches, are essential to address these behaviors effectively and reduce their prevalence.

Conflict of interest

None

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Nil

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