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An epidemiological study of deleterious oral habits among pre-school children in India

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Abstract:
Deleterious oral habits can interfere with normal dentofacial growth when they persist during early childhood. Therefore, it is of interest to assess the prevalence and gender association among 502 pre-school children aged 3-6 years in India using a bilingual questionnaire and clinical examination. Tongue thrusting (p=0.009) and pacifier use (p=0.034) were significantly more common among boys. Thus, early identification and timely intervention may help prevent the development of malocclusion in affected children.

Keywords: Deleterious oral habits (DOH), preschool children, non-nutritive sucking, tongue thrusting, malocclusion, cross-sectional study

Background:
Oral health has a critical impact on overall well-being critically affects particularly in growing children **[1]**. Depending on their frequency, intensity and duration, deleterious oral habits (DOH), especially non-nutritive sucking habits, are associated with malocclusions **[2].** Socio-demographic factors influence their prevalence among preschool children (20%–50%) **[3],** with varying rates reported in India and limited data from Bihar **[4].** Oral deleterious habit is linked to a number of oral and dental health problems such as emotional or psychological effects, malocclusion, abnormal facial growth and difficulty speaking **[5].** Deleterious oral habits (DOH) have been described as a common finding in pediatric patients **[6].** Mouth breathing, thumb or finger sucking, tongue thrusting, lip biting, nail biting and bruxism are common DOH behaviours seen in kids **[7].** In a cross-sectional study of Indian schoolchildren aged 7–13 years, bruxism was the most common deleterious oral habit, followed by mouth breathing, digital sucking, nail biting, lip biting and tongue thrusting **[8]**. According to a comprehensive review by Abreu *et al.*, 55% of children experienced mouth breathing **[7].** Artificial intelligence chatbots may also provide supplementary information to parents about deleterious oral habits, although their accuracy and readability vary and they should not replace professional dental advice **[9].** Therefore, it is of interest to determine the prevalence of developmental occlusal disorders among 3–6 year old children in Darbhanga and evaluate their association with gender.

Methods:
Study design:
The present study was conducted as a cross-sectional, observational study. On the scheduled PTM day, mothers' caregivers were approached individually and provided with a self-designed structured questionnaire available in English and Hindi. This questionnaire had been developed after reviewing validated survey formats used in earlier research **[10].** Written explanations about the purpose of the study and instructions for completing the questionnaire were included in the proforma.

Study setting:
The study was conducted in selected preschools, the Department of Pediatric and Preventive Dentistry and pediatric outpatient clinics in Darbhanga, Bihar, India.

Sample size:
The sample size was calculated using the prevalence reported by Dhull *et al.*, **[11]** considering a 95% confidence level and 5% precision.

Clinical examination:
All completed questionnaires reporting at least one deleterious oral habit were identified and the corresponding children were enlisted for clinical examination. The examinations were performed on same day, following the standard diagnostic criteria. The extraoral assessment included the resting position of the lips, nasal airflow and an evaluation of facial symmetry to identify the presence of mouth breathing. Subsequently, an intraoral examination was conducted, entailing an inspection of occlusal patterns, palatal morphology, the identification of anterior open bite or posterior crossbite and the detection of wear facets indicative of bruxism. Thumb and digit-sucking habits were identified through the presence of specific clinical indicators, including skin wrinkling, finger malformation, callus development, an anterior open bite or proclination of maxillary incisors. Mouth breathing was evaluated using the mirror and water-holding tests.

Inclusion criteria:
Children were included in the study if they were between 3–6 years of age, were apparently healthy and had parents or caregivers who provided written consent.

Exclusion criteria:
Children were excluded if they had special healthcare needs, presented with skin disorders affecting the fingers, had a history of orofacial trauma, or if their parents or caregivers declined to provide consent.

Statistical analysis:
Statistical analysis was performed using IBM-SPSS software (version 26). The Chi-square test was applied to assess the

association between categorical variables. A p-value of less than 0.05 was considered statistically significant. The sample comprised 502 children, with age ranging from 3 to 6 years and a mean ages of 5.38 (± 0.80) years.

Ethical considerations:

Ethical approval was obtained from the Institutional Ethics Committee of Mithila Minority Dental College and Hospital, Darbhanga, Bihar, India (EC/NEW/INST/2023/4152). Parents/Caregivers were informed about the study objectives and informed consent was obtained prior to participation. All data were anonymised before analysis.

Results:

A total of 502 preschool children aged 3-6 years participated in the study, comprising 289 (57.6%) boys and 213 (42.4%) girls. The prevalence of deleterious oral habits among the study participants is presented in **Table 1 and Figure 1.** Thumb sucking was the most prevalent habit, observed in 60 (12.0%) children, followed by teeth grinding in 47 (9.4%), nail biting in 44 (8.8%) and mouth breathing in 40 (8.0%) children. Digit sucking was present in 27(5.4%) children, tongue thrusting in 24(4.8%), lip sucking/biting in 19(3.8%) and pacifier use in 6(1.2%) children. Cheek/lip chewing was the least prevalent habit, reported in only 2 (0.4%) children. **Table 2 and Figure 2** present the association between deleterious oral habits and gender. Although most habits were more prevalent among boys than girls, statistically significant gender differences were observed only for tongue thrusting and pacifier use. Tongue thrusting was significantly more common among boys (6.9%) compared with girls (1.9%) (x^2 = 6.849, p =0.009). Similarly, pacifier use was reported exclusively among boys (2.1%), while no cases were observed among girls, demonstrating a statistically significant association with gender (x^2 = 4.476, p = 0.034). No significant association with gender was observed for thumb sucking (p = 0.336), mouth breathing (p = 0.097), digit sucking (p= 0.074), lip sucking/biting (p= 0.329), nail biting (p=0.916), teeth grinding (p= 0.222), or cheek/lip chewing (p =0.224). **Table 3** summarizes the oral habits that demonstrated statistically significant associations with gender. Tongue thrusting and pacifier use were significantly more prevalent among boys than girls.

Table 1: Prevalence of deleterious oral habits among study participants (n = 502)

Habit	Present n (%)	Absent n (%)
Thumb sucking	60 (12.0)	442 (88.0)
Tongue thrusting	24 (4.8)	478 (95.2)
Mouth breathing	40 (8.0)	462 (92.0)
Digit sucking	27 (5.4)	475 (94.6)
Lip sucking/biting	19 (3.8)	483 (96.2)
Nail biting	44 (8.8)	458 (91.2)
Pacifier use	6 (1.2)	496 (98.8)
Teeth grinding	47 (9.4)	455 (90.6)
Cheek/lip chewing	2 (0.4)	500 (99.6)

Table 2: Association of deleterious oral habits with gender

Habit	Boys n (%)	Girls n (%)	χ^2	p-value
Thumb sucking	38 (13.1)	22 (10.3)	0.927	0.336
Tongue thrusting	20 (6.9)	4 (1.9)	6.849	0.009*
Mouth breathing	28 (9.7)	12 (5.6)	2.749	0.097
Digit sucking	20 (6.9)	7 (3.3)	3.182	0.074
Lip sucking/biting	13 (4.5)	6 (2.8)	0.952	0.329
Nail biting	25 (8.7)	19 (8.9)	0.011	0.916
Pacifier use	6 (2.1)	0 (0.0)	4.476	0.034*
Teeth grinding	31 (10.7)	16 (7.5)	1.494	0.222
Cheek/lip chewing	2 (0.7)	0 (0.0)	1.480	0.224

**Statistically significant ($p < 0.05$)*

Table 3: Summary of significant gender associations

Habit	Higher Prevalence	p-value	Interpretation
Tongue thrusting	Boys	0.009*	Significant association with gender
Pacifier use	Boys	0.034*	Significant association with gender

**Statistically significant ($P < 0.05$)*

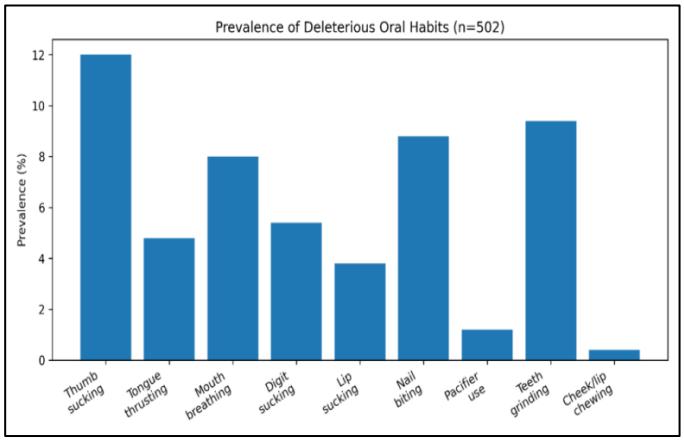


Figure 1: Prevalence of deleterious oral habits among study participants (n = 502)

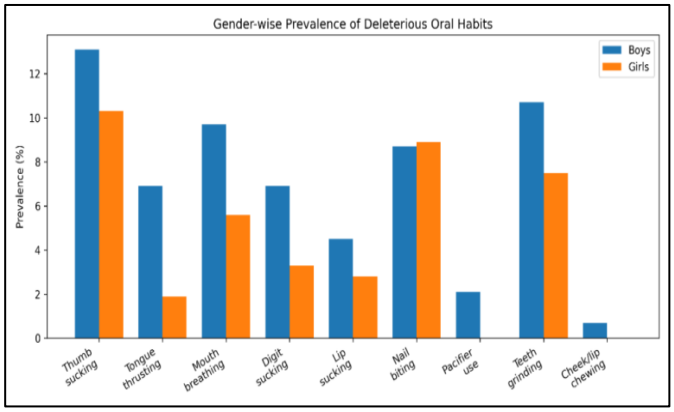


Figure 2: Association of deleterious oral habits with gender

Discussion:

Oral habits are commonly observed during early childhood and are considered a normal part of psychological and neuromuscular development. **[9]** The present study evaluated the prevalence of various oral habits among children aged 3–6 years and assessed their association with gender. In the present study, boys constituted 57.6% of the study population, while girls accounted for 42.4%. Similar gender distributions have been reported by Gyra *et al.* **[4],** Özdemir *et al.* **[9]** and Surana *et al.* **[12],** who observed a male predominance in pediatric dental

outpatient attendance. This finding may reflect sociocultural preferences, parental attitudes toward healthcare utilization and greater concern for male children in certain populations. Additionally, boys have been reported to exhibit a higher prevalence of certain DOH, which may lead to increased dental consultations. Thumb sucking was observed in 12% of the children, with a slightly higher prevalence in boys (13.1%) compared to girls (10.3%); however, the difference was not statistically significant. Similar prevalence rates and lack of gender association were reported by Katz *et al.* **[13]** and Adair *et al*. **[14],** indicating that thumb sucking is not strongly influenced by gender. According to Warren and Bishara **[15]**, thumb sucking serves as a self-soothing mechanism that provides emotional security during early childhood. The observed decline in prevalence with age may reflect the natural cessation of the habit, increased parental awareness, early dental care and timely habit-intervention during the preschool years. Tongue thrusting was present in 4.8% of the total sample and showed a highly statistically significant association with gender, with a markedly higher prevalence among boys (6.9%) compared to girls (1.9%) ($p = 0.009$). This finding is in agreement with studies conducted by Sharma *et al.* **[16]** and Kharbanda *et al.* **[17]**, who also reported a male predilection for tongue thrusting. Goel *et al.* **[18]** described that tongue thrusting is associated with persistent infantile swallowing patterns and abnormal oral muscle activity, with its higher prevalence among boys possibly reflecting delayed neuromuscular maturation. Early identification is important because persistent tongue thrusting may contribute to malocclusion and speech problem. Rodríguez-Olivos *et al.* reported that children with atypical swallowing habits were more likely to have malocclusion in the vertical, transverse and sagittal planes **[19]**. Nguyen *et al.* also found that mouth breathing and tongue thrusting were significantly associated with anterior open bite, while tongue thrusting was associated with posterior crossbite and increased overbite **[20].** Mouth breathing was observed in 8% of the study population, with a higher prevalence among boys; however, the association with gender was not statistically significant. Similar findings have been reported by Souki *et al.* **[21]**, Lessa *et al.* **[22]** and Harari *et al.* **[23]**, who concluded that mouth breathing does not demonstrate a consistent gender predilection. Mouth breathing is primarily associated with airway related conditions rather than behavioural factors and its lack of significant gender association in the present study are consistent with previous reports, highlighting the need for multidisciplinary management. Digit sucking was observed in 5.4% of children, with no statistically significant difference between boys and girls. Similar findings have been reported by Warren and Bishara **[15],** Sadoun *et al.* **[24]** and Faryad *et al.* **[25],** reported similar findings and suggested that Digit sucking tends to decline with age due to increasing social interaction, school exposure and parental discouragement. The low prevalence observed may be attributed to improved parental awareness and early habit intervention, although persistent digit sucking remains a risk factor for malocclusion and warrants early management. İlisulu *et al.* reported associations between deleterious oral habits and dental caries and periodontal parameters among Turkish twins, including higher caries scores with bruxism and increased plaque index with mouth breathing **[26].** Lip sucking or biting was present in 3.8% of the children, with no statistically significant gender association. Similar observations were reported by Garde *et al.* **[3]** and Leme *et al*. **[27],** who identified lip biting as a transient habit commonly associated with emotional stress, anxiety or psychological factors rather than gender. These habits are usually self-limiting and may diminish with emotional maturation and supportive parental counselling. Nail biting was observed in 8.8% of the study population, with nearly equal prevalence among boys and girls. Serra-Negra *et al.* **[28]** and Ghanizadeh **[29]** reported comparable prevalence rates and emphasized that nail biting is more closely associated with anxiety, stress and behavioural disorders than with gender differences. The findings of the present study further support the concept that nail biting is a psychologically driven habit rather than a biologically gender-determined behaviour. Pacifier use was observed in only 1.2% of children; however, a statistically significant association with gender was found, with the habit being present exclusively among boys ($p = 0.034$). Similar low prevalence rates have been reported by Peressini **[30]** and Viggiano *et al.* **[31]**, particularly in populations where prolonged breastfeeding is common and prolonged pacifier use is less prevalent. Faryad *et al.* **[25],** reported that prolonged pacifier use may result in posterior crossbite, increased overjet and altered tongue posture. Although the prevalence was low in the present study, the statistically significant gender association underscores the importance of parental education regarding the potential adverse effects of prolonged pacifier use. Teeth grinding was present in 9.4% of children, with no statistically significant gender difference. Similar results were reported by Serra-Negra *et al.* **[28]** and Storari *et al.* **[32],** who identified paediatric bruxism as a multifactorial condition associated with sleep disturbances, emotional stress and neuromuscular factors rather than gender. The absence of a significant gender association in the present study supports the multifactorial aetiology proposed in earlier research. Cheek or lip chewing was rare in the present study, observed in only two boys, with no statistically significant gender association. Similar findings were reported by Sharma *et al.* **[16]** and Gyra *et al.* **[4],** who identified lip or cheek chewing as one of the least prevalent oral habits in children. Previous studies have suggested that this habit is more frequently encountered in older children and adolescents and is often associated with emotional stress and behavioural factors. The present study demonstrates that most oral habits among children aged 3–6 years do not show a statistically significant association with gender, which is consistent with the majority of published literature. Tongue thrusting and pacifier use were the only habits showing significant gender association, with higher prevalence among boys and other habits, *i.e.,* Thumb sucking, Mouth breathing, Digit sucking, Lip sucking or biting, Nail biting, grinding of teeth, Cheek or lip chewing, did not show any statistically significant association with gender. Out of the 502 preschool children examined in the present study from Darbhanga, various DOH were identified, with thumb sucking

(12.0%), teeth grinding (9.4%), nail biting (8.8%) and mouth breathing (8.0%) being the most prevalent, while pacifier use (1.2%) and cheek/lip chewing (0.4%) were the least common. These findings are comparable with reports from other Indian states such as Odisha, South India, Karnataka, Rajasthan, Tamil Nadu and Delhi **[3–7, 17].** Studies from South India have similarly identified thumb sucking as one of the most prevalent non- nutritive oral habits among preschool children, with overall patterns of deleterious oral habits comparable to those observed in the present Darbhanga cohort **[4, 18].** Similarly, the prevalence of teeth grinding and nail biting in the present study aligns with observations reported by Leme *et al.* **[27]** and Gyra *et al.* **[4],** who emphasized the role of psychological stress and behavioural factors rather than regional or gender-specific influences. The prevalence of mouth breathing in the present study was comparable to findings from previous studies conducted in India and elsewhere, which have identified mouth breathing as a common deleterious oral habit in children and have emphasized the role of upper airway obstruction, adenoid hypertrophy, allergic rhinitis and other airway-related factors in its etiology **[1, 24].** The present study demonstrated a statistically significant male predominance for tongue thrusting and pacifier use. However, previous epidemiological studies have generally reported inconsistent findings regarding the association between gender and deleterious oral habits, with most habits showing little or no consistent sex predilection. Overall, the findings from the present study are consistent with the existing literature regarding the prevalence and distribution of deleterious oral habits, suggesting that these behaviours are influenced predominantly by behavioural and environmental factors rather than gender**.** These findings emphasize the importance of early screening, parental counselling and timely habit interception therapy, particularly in male children, to prevent the development of malocclusion, functional disturbances and speech problems. Early intervention during the preschool years offers the greatest potential for successful habit cessation and favourable dentofacial development. Being the first study from Darbhanga, Bihar, its Large sample size (n=502) and the combined questionnaire and clinical examination strengthen the reliability and validity of the findings. This study has several limitations. Its cross-sectional design precludes causal inference. The study included only children aged 3-6 years, limiting the generalizability to other age groups. Some oral habits may have been underreported because the information was obtained from parents or caregivers. Finally, the duration and severity of individual habits were not evaluated.

Conclusion:

We show the prevalence of oral habits among children aged 3-6 years and their association with gender. Oral habits were commonly observed, with a higher prevalence among boys. These findings highlight the parental awareness, importance of early identification and timely intervention to help prevent the development of malocclusion and other craniofacial abnormalities.

Ethical approval and consent to participate:

Ethical approval was obtained from the Institutional ethics committee of Mithila minority dental college and hospital, Darbhanga, Bihar, India. Parents Caregivers were informed about the study objectives and informed consent was obtained prior to participation. All data were anonymised before analysis.

Consent of publication:

Not applicable. The manuscript contains no identifiable participant information and all data were anonymized prior to analysis.

Availability of data and materials:

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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