Malocclusion among children in Vietnam: Prevalence and associations with different habits

Dung Anh Vu [a], Hai Minh Vu [b,*], Quyet Tri Nguyen [a], Hoang Minh Vu [a]

[a] *Department of Odonto Stomatology, Thai Binh University of Medicine and Pharmacy, Thai Binh, 410000, Viet Nam*
[b] *Department of Trauma, Thai Binh University of Medicine and Pharmacy, Thai Binh, 410000, Viet Nam*

ARTICLE INFO

ABSTRACT

Background: This study aimed to measure the prevalence of malocclusion and identify associated factors among elementary school students in Vietnam.

Method: A cross-sectional study was conducted from March to December 2022 at six primary schools located in the province of Thai Binh, Vietnam. A total of 873 students were recruited for research purposes. Students were classified into normal, malocclusion classes I, II and III. Bad habits were examined. Multivariate logistic regression was used to detect associations.

Results: The prevalence of malocclusion was 60.7 %; 19.0 % had Class I, 31.0 % had Class II and 10.7 % had Class III. Having finger sucking habit was associated with Class I malocclusion (OR: 3.28), and Class II malocclusion (OR: 3.22). Having lip biting habit was related to a higher odds of having Class II malocclusion (OR = 4.37) Class III malocclusion (OR = 6.83). Having tongue thrusting habit was associated with higher odds of having Class I (OR: 5.25), and Class II malocclusion (OR: 6.42). Mouth breathing was related to a higher likelihood of having Class II malocclusion (OR = 2.71). Having early loss of deciduous teeth was associated with a higher odds of having Class III malocclusion (OR = 3.83).

Conclusion: Findings showed high prevalence of malocclusion, mostly class II, in elementary students in Vietnam. Bad habits such as finger sucking, biting the lower lip, tongue thrusting, mouth breathing, and early loss of deciduous teeth play important roles in developing malocclusion, which should be considered in the development of interventions.

1. Introduction

Malocclusion, also known as an incorrect bite or dental malalignment, is the misalignment of the relationship between the teeth within one dental arch or between the upper and lower jaws. Malocclusion can have significant implications for the health of individuals, including joint dislocation, decreased chewing function, predisposition to the development of certain oral diseases, impacts on facial aesthetics, speech impediments, and psychological issues. Various causes can result in malocclusion, such as early loss of deciduous teeth or poor oral habits. The timely detection and intervention to prevent malocclusion in children have not received adequate attention. A study examining the prevalence of malocclusion in children and investigating the associated factors to propose effective, economical, and simple intervention methods is essential. Among the various types of occlusal malformations, Type II malocclusion prevalence is relatively high and often leads

to patients seeking treatment in adulthood. As a result, treatment is usually prolonged and challenging. The prompt advocates for early intervention in Class II malocclusion to minimize the degree of misalignment, reduce the duration of orthodontic treatment, restrict the need for tooth extraction, and minimize the necessity of surgical orthodontic intervention.[1] There are several methods for treating Class II malocclusion, among which functional appliances are believed to restore facial harmony by influencing the teeth and stimulating the development of the mandible in growing patients.

Understanding the prevalence of malocclusion is crucial in the development of suitable preventive and orthodontic intervention initiatives. Research studies have documented the prevalence of malocclusion in various populations,[2–4] with significant variations even within the same population. These disparities may potentially arise from divergent factors such as ethnic backgrounds, sample sizes, data collection techniques, or age distribution within the study cohorts.[5] A

---

study in Saudi Arabia showed that a Class I molar relationship in 1219 participants, accounted for 61% of the 1998 school children. Additionally, Class II and Class III molar relationships were observed in 326 participants (16.3%) and 154 participants (7.7%).[6] In China, 79.4% of children have malocclusion, with Class II malocclusion accounting for 50.9 %.[7] Another study in India showed that 49.7% of students had malocclusion.[8] Recently, a systematic review synthesized 123 studies and revealed that the prevalence rates of Angle Class I, Class II, and Class III malocclusion among healthy children and adolescents exhibited considerable variation, yielding mean prevalences of 51.9% (standard deviation [SD] = 20.7), 23.8% (SD = 14.6), and 65% (SD = 6.5), respectively.[9]

In Vietnam, limited published data is currently accessible regarding malocclusion. Only a prior study in 12- and 18-year-old students found that the prevalence rates of Angle Class I, Class II, and Class III malocclusion were 67%, 17.5%, and 15.5%, respectively.[10] However, the research has not addressed the role of students' health behaviors in malocclusion. Therefore, this study aimed to measure the prevalence of malocclusion and identify associated factors among elementary school students in Vietnam. Providing this information plays a crucial role in developing appropriate strategies for the advancement of oral care services for children. Furthermore, this information also helps the school to have evidence-based grounds to develop oral care plans for the school, guiding and educating students on oral health communication, and limiting inappropriate behavior that could affect the oral health of children.

2. Materials and methods

2.1. Study design and participants

A cross-sectional study was conducted from March to December 2022 at six primary schools located in the province of Thai Binh, Vietnam. These schools were categorized as follows: two schools in urban areas, two schools in rural areas, and two schools in coastal regions. Students aged 9–10 have been selected for the research study. The selection criteria included: 1) currently enrolled in selected schools; 2) no prior orthodontic or maxillofacial corrective treatment; 3) no history of maxillofacial trauma or congenital deformities; and 4) having all permanent first molars and intact teeth to determine the type of bite occlusion. The exclusion criteria consist of: 1) the presence of systemic pathologies affecting craniofacial development and dental arch; and 2) students or parents who did not consent to participate in the study or did not cooperate during the research process.

The size of the sample is calculated using an estimated ratio formula with relatively accurate precision, where α = 0.05, ε (relative accuracy) = 0.085, and the expected malocclusion ratio in each elementary school is 79.4%.[7] The required sample size for the study was 828. Furthermore, an additional 10% sample size was included as a dropout prevention measure, resulting in a total of 910 students being invited to participate in the study, with data from 873 students being included in the research. To begin with, primary schools in Thái Bình province were classified into three regions: urban, rural, and coastal. Afterward, two elementary schools were randomly selected in each region. At each primary school, two classes were randomly selected from the 4th and 5th grades, and all the students from these two classes were invited to participate in the study. A total of 873 students were recruited for research purposes. The research has been approved by the Provincial People's Committee of Thai Binh (Decision No. 1302/QD-UBND dated June 3, 2021).

2.2. Data collection

The data collection process involved clinical examinations performed by two skilled general dental practitioners. The practitioners employed various tools, including gloves, a light source, a mouth mirror, and a calibrated ruler. The training and calibration process for

malocclusion involved the theoretical evaluation of clinical images and a detailed discussion of each category, including the resolution of possible disagreements. The training session was concluded upon reaching a satisfactory level of agreement and comprehension.

The occlusal parameters documented by evaluators encompass molar and canine interrelationships, overbite and overjet measurements, anterior open bite assessment, spacing, and crowding analysis, identification of anterior crossbite, presence of a scissors bite, and observation of posterior crossbite. Moreover, students were asked to report their habits regarding finger sucking, lip biting, tongue thrusting, mouth breathing, and early loss of deciduous teeth[11,12] through observation and clinical examination. Information about nail biting and thumb/finger sucking was gathered through a survey given to parents/guardians, while the habit of lip/tongue interposition was assessed during a clinical examination conducted in both natural and artificial light. Disposable tongue depressors were used to aid in the examination.

Malocclusion was observed in cases where there was a Class II or Class III molar relationship, or a Class I molar relationship accompanied by at least one of the following conditions according to Table 1.[13]

2.3. Statistical analysis

The data collected was subjected to analysis using Statistical Packages for the Social Sciences (SPSS). The occurrence rate of malocclusion was measured using proportions. The statistical analysis employed in this study involved the utilization of the Chi-square test to examine disparities in proportion within the various groups. Multivariate logistic regression was used to identify associations between different habits of students and malocclusion after adjusting to demographic characteristics. Significance levels were determined based on p-values less than 0.05, denoting statistical significance.

3. Results

Table 2 shows that among 873 students, most of them were male (53.4%), aged 9 years old and living in urban areas (38.2%). The prevalence of malocclusion was 60.7%; 19.0% had Class I, 31.0% had Class II and 10.7% had Class III.

Table 3 shows that the rate of students having finger-sucking habits was the highest among those with Class II (5.5%), and Class I (5.4%) (p < 0.03). The proportion of students having lip-biting habits was the highest in those with Class III (6.5%) (p < 0.01). The highest rates of students having tongue thrusting and early loss of deciduous teeth were in students with Class II (4.4%) and Class III (10.8%) (p < 0.05), respectively. No difference was found among groups of malocclusion according to mouth breathing habits.

Table 4 illustrates the results of a multivariate regression analysis examining the impact of bad habits and early tooth loss on malocclusion. Students with a finger-sucking habit were found to have 3.28 times higher odds of developing Class I malocclusion (OR: 3.28; 95 % CI: 1.07–10.10; p < 0.05), and 3.22 times higher odds of developing Class II malocclusion (OR: 3.22; 95 % CI: 1.13–9.16; p < 0.05) compared to

Table 1
Criteria for diagnosing malocclusion.

	Criteria	Normal	Malocclusion
1	Correlation with R6	I	I, II, III
2	Crown angulation	2.79 ± 1.29 mm (1.5–4.08 mm)	<1.5 mm or > 4.08 mm
3	Crown inclination	2.89 ± 1.45 mm (1.44–4.34 mm)	<1.44 mm or > 4.34 mm
4	Rotation	None	Yes
5	Spaces	None	Yes
6	Flat occlusal planes	None	Yes

Table 2

Demographic characteristics of students.

Characteristics	Freq. (n)	Percent (%)
Gender		
Male	466	53.4
Female	407	46.6
Age		
9	475	54.4
10	398	45.6
Living location		
Urban	334	38.2
Rural	273	31.3
Seaside	266	30.5
Malocclusion		
Normal	343	39.3
Class I	166	19.0
Class II	271	31.0
Class III	93	10.7

those without this habit. When students had the habit of biting their lips, the odds ratio (OR) of developing a Class II malocclusion increased 4.37 times (OR = 4.37, 95%CI: 1.19–16.00; p < 005), and the odds ratio of developing a Class III malocclusion increased 6.83 times (OR = 6.83, 95 % CI: 1.64–28.42; p < 005). When students had tongue thrusting habit, the odds ratio for Class I malocclusion increased by 5.25 times (OR: 5.25; 95%CI: 1.03–26.71; p < 0.05), and the odds ratio for Class II malocclusion increased by 6.42 times (OR: 6.42; 95%CI: 1.40–29.41; p < 0.05). When individuals had a habit of mouth breathing, the odds of having Class II malocclusion increased by 2.71 times (OR = 2.71, 95% CI: 1.02–7.21, p < 0.05). For students having early loss of deciduous teeth, the odds of having Class III malocclusion increased 3.83 times (OR = 3.83, 95%CI: 1.48–9.94 p < 0.05) compared to students who did not early lose their deciduous teeth.

4. Discussion

Malocclusion represents a prevailing dental issue among individuals. Maloccluded teeth have been linked to psychosocial issues associated with compromised dentofacial aesthetics, disruption of oral functionality including mastication, swallowing, and speech, as well as an increased vulnerability to trauma and periodontal disease.

In our study, it was observed that the rate of children with malocclusion accounted for 61.0 %. This finding exhibits a lower outcome compared to several international studies. Xin Yu's (2019) studied on the prevalence of malocclusion and characteristics of mixed dentition in early Chinese children and the author observed that 79.4% of children exhibited one or more malocclusion abnormalities.[7] In a study conducted on a sample of 503 preschool children, it was observed that 71.4% of the children displayed one or more malocclusion attributes, while 16.9% exhibited poor oral hygiene habits.[14]

The major type of malocclusion in our study was Class II. Our study differs from a previous study in Vietnam as it demonstrates the prevalence rates of Class I, Class II, and Class III malocclusion to be 67%, 17.5%, and 15.5%, respectively.[10] The findings of the research align with the work of Xin Yu et al. revealing that the prevalence of Class II malocclusion exhibited the highest proportion at 50.9%, followed by Class I malocclusion at 42.3 %, and Class III malocclusion at 5.9%.[7] However, results of this study were computed among students with a malocclusion rather than being computed collectively within the research sample size. A prior systematic review revealed that the average prevalence of normal occlusion was found to be 46.3 ± 27.3%. Specifically, the prevalence of malocclusion type I was estimated to be 46.5 ± 17.0%, type II malocclusion was found to be 25.0 ± 13.2%, and type III malocclusion was reported to be 7.0 ± 7.9%.[15] The findings of our study confirmed that malocclusion is one of the prevalent oral health issues among primary school students.

There is a consensus among studies that malocclusion can be caused by both genetic and environmental factors. The occurrence of poor oral habits serves as a prominent illustration of how children's habitual behaviours can influence the development of malocclusion.[16,17] The most common bad oral habits are finger-sucking, lip-biting, tongue-thrusting, and mouth-breathing over an extended period, which can result in unintended teeth movements and misalignment. In the age group of 8–10 years, corresponding to the mixed dentition period, which is a sensitive

Table 3

Malocclusion according to different habits of students.

Characteristics		Malocclusion								p-value
		No		Class I		Class II		Class III		
		N	%	N	%	N	%	N	%	
Finger sucking	Yes	5	1.5	9	5.4	15	5.5	4	4.3	0.03
	No	338	98.5	157	94.6	256	94.5	89	95.7	
Lip bitting	Yes	3	0.9	3	1.8	11	4.1	6	6.5	<0.01
	No	340	99.1	163	98.2	260	95.9	87	93.5	
Tongue thrusting	Yes	2	0.6	6	3.6	12	4.4	3	3.2	0.02
	No	341	99.4	160	96.4	259	95.6	90	96.8	
Mouth breathing	Yes	6	1.7	8	4.8	15	5.5	4	4.3	0.08
	No	337	98.3	158	95.2	256	94.5	89	95.7	
Early loss of deciduous teeth	Yes	9	2.6	8	4.8	13	4.8	10	10.8	0.01
	No	334	97.4	158	95.2	258	95.2	83	89.2	

Table 4

Multivariable logistic regressions in identifying associations between different habits and malocclusion.

Characteristics	Malocclusion (ref = Normal)					
	Class I		Class II		Class III	
	OR	95%Confidence interval	OR	95%Confidence interval	OR	95%Confidence interval
Finger sucking (No vs. Yes)	**3.28***	**1.07–10.10**	**3.22***	**1.13–9.16**	2.16	0.54–8.68
Lip biting (No vs. Yes)	1.91	0.38–9.63	**4.37***	**1.19–16.00**	**6.83***	**1.64–28.42**
Tongue thrusting (No vs. Yes)	**5.25***	**1.03–26.71**	**6.42***	**1.40–29.41**	4.5	0.72–28.05
Mouth breathing (No vs. Yes)	2.42	0.81–7.19	**2.71***	**1.02–7.21**	2.04	0.55–7.54
Early loss of deciduous teeth (No vs. Yes)	1.62	0.60–4.34	1.53	0.63–3.72	**3.83***	**1.48–9.94**

These models were adjusted to age, gender, and living location.

transition phase from primary dentition to permanent dentition, the examination and detection of occlusal discrepancies and their causes are of utmost importance (especially bad oral habits), to develop an appropriate intervention plan that can yield the highest effectiveness. The intervention of orthodontic correction during this phase is referred to as facial orthopaedics, which involves the implementation of several straightforward treatment methods to prevent dental malocclusions. Kristina Kasparaviciene (2014) found that lingual lip seal incompetence accounted for 71.4% of cases, while children with one or more negative habits affecting occlusion accounted for 16.9%.[14] Multiple studies have also suggested that mouth breathing has negative effects on the development of the craniofacial complex.[18,19] The findings of our study also clearly demonstrate a correlation between bad habits and malocclusion status, consistent with prior research. We also investigated the correlation between early loss of deciduous teeth and malocclusion. The premature loss of deciduous teeth, especially tooth number 5 in the upper jaw, can cause misalignment of the adjacent teeth. Additionally, the first permanent molar would move closer to the gap caused by the loss of deciduous tooth number 5. The early loss of deciduous tooth number 5 is often the leading cause of Class II malocclusion, characterized by dental misalignment. Similarly, the premature loss of deciduous tooth number 5 in the lower jaw usually leads to the first permanent molars moving closer, resulting in Class III malocclusion caused by dental misalignment. Additionally, the misalignment of occlusion in the anterior teeth can cause a narrowing of the dental arch and crowding in the anterior region. The findings of our study also support this viewpoint.

This study was conducted to examine the correlation between undesirable oral habits such as finger sucking, biting the lower lip, tongue thrusting, mouth breathing, and early loss of deciduous teeth in the mixed dentition stage. Various authors from both domestic and international backgrounds have confirmed the presence of a correlation between these habits and the aforementioned dental condition, albeit to varying degrees.[8,20] The consensus among scholars is that early intervention is crucial in addressing and rectifying poor oral hygiene habits, early milk teeth loss, as well as malocclusion. On the contrary, if early intervention is not implemented when transitioning to the permanent dentition stage, the malocclusion discrepancy will escalate, and the intervention process will become more complex and significantly more costly. The survey results indicate a correlation between poor oral hygiene habits, early milk tooth loss, and malocclusion, thus highlighting the importance of preventive dental care in school settings to contribute to the reduction of malocclusion among students.

When analyzing the findings, it is essential to acknowledge certain constraints associated with this study. First, the cross-sectional design did not allow us to draw causal conclusions about malocclusion and bad habits of children. Second, factors such as eating habits or parental practices regarding oral health care should be included in further studies, which might be important in developing interventions to prevent malocclusion in children. Third, this study was performed in one province, which might limit generalizability of findings to other provinces or other settings. Finally, information about other factors such as nutritional status, diet or other socioeconomic characteristics of families was absent in this study. Therefore, further studies should be warranted to examine the relationships of these variables and malocclusion.

5. Conclusion

Findings showed a high prevalence of malocclusion, mostly class II, in elementary students in Vietnam. Bad habits such as finger sucking, biting the lower lip, tongue thrusting, mouth breathing, and early loss of deciduous teeth play important roles in developing malocclusion, which should be considered in the development of interventions.

Data availability statement

The data are available upon request.

References

1. Elhamouly Y, El-Housseiny AA, Ismail HA, Habashy LME. Myofunctional trainer versus twin block in developing class II division I malocclusion: a randomized comparative clinical trial. *Dent J.* 2020;8(2).
2. Asiry MA. Occlusal status among 12-16 Year-old school children in riyadh, Saudi Arabia. *J Int Oral Health : JIOH.* 2015;7(5):20–23.
3. Lux CJ, Dücker B, Pritsch M, Komposch G, Niekusch U. Occlusal status and prevalence of occlusal malocclusion traits among 9-year-old schoolchildren. *Eur J Orthod.* 2009;31(3):294–299.
4. Borzabadi-Farahani A, Borzabadi-Farahani A, Eslampour F. Malocclusion and occlusal traits in an urban Iranian population. An epidemiological study of 11- to 14-year-old children. *Eur J Orthod.* 2009;31(5):477–484.
5. Oshagh M, Ghaderi F, Pakshir HR, Baghmollai AM. Prevalence of malocclusions in school-age children attending the orthodontics department of Shiraz University of Medical Sciences. *Eastern Mediterranean health journal = La revue de sante de la Mediterranee orientale = al-Majallah al-sihhiyah li-sharq al-mutawassit.* 2012;16(12): 1245–1250.
6. Asiry MA, AlShahrani I. Prevalence of malocclusion among school children of Southern Saudi Arabia. *J Orthod Sci.* 2019;8:2.
7. Yu X, Zhang H, Sun L, Pan J, Liu Y, Chen L. Prevalence of malocclusion and occlusal traits in the early mixed dentition in Shanghai, China. *PeerJ.* 2019;7, e6630.
8. Anand T, Garg AK, Singh S. Effect of socioeconomic, nutritional status, diet, and oral habits on the prevalence of different types of malocclusion in school-children. *Acta Biomed.* 2022;93(3), e2022161.
9. De Ridder L, Aleksieva A, Willems G, Declerck D, Cadenas de Llano-Pérula M. Prevalence of orthodontic malocclusions in healthy children and adolescents: a systematic review. *Int J Environ Res Publ Health.* 2022;19(12).
10. Nguyen SM, Nguyen MK, Saag M, Jagomagi T. The need for orthodontic treatment among Vietnamese school children and young adults. *Int. J. dentistry.* 2014;2014, 132301.
11. Kerr WJ. The effect of the premature loss of deciduous canines and molars on the eruption of their successors. *Eur J Orthod.* 1980;2(2):123–128.
12. Hùng HT. *Giải Phẫu Răng. Bộ Y Tế*. Nhà xuất bản Y học; 2008.
13. Andrews LF. The six keys to normal occlusion. *Am J Orthod.* 1972;62(3):296–309.
14. Kasparaviciene K, Sidlauskas A, Zasciurinskiene E, et al. The prevalence of malocclusion and oral habits among 5-7-year-old children. *Med Sci Mon Int Med J Exp Clin Res : international medical journal of experimental and clinical research.* 2014; 20:2036–2042.
15. De Ridder L, Aleksieva A, Willems G, Declerck D, Cadenas de Llano-Perula M. Prevalence of orthodontic malocclusions in healthy children and adolescents: a systematic review. *Int J Environ Res Publ Health.* 2022;19(12).
16. Mistry P, Moles DR, O'Neill J, Noar J. The occlusal effects of digit sucking habits amongst school children in Northamptonshire (UK). *J Orthod.* 2010;37(2):87–92.
17. Klocke A, Nanda RS, Kahl-Nieke B. Anterior open bite in the deciduous dentition: longitudinal follow-up and craniofacial growth considerations. *Am J Orthod Dentofacial Orthop : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics.* 2002;122(4):353–358.
18. Souki BQ, Pimenta GB, Souki MQ, Franco LP, Becker HM, Pinto JA. Prevalence of malocclusion among mouth breathing children: do expectations meet reality? *Int J Pediatr Otorhinolaryngol.* 2009;73(5):767–773.
19. Gois EG, Ribeiro-Junior HC, Vale MP, et al. Influence of nonnutritive sucking habits, breathing pattern and adenoid size on the development of malocclusion. *Angle Orthod.* 2008;78(4):647–654.
20. Fadel MAV, Santos BZ, Antoniazzi RP, Koerich L, Bosco VL, Locks A. Prevalence of malocclusion in public school students in the mixed dentition phase and its association with early loss of deciduous teeth. *Dental Press J Orthod.* 2022;27(4), e2220120.