Prevalence and Determinants of Malocclusion among Adolescents in Kathmandu Valley: A Cross-Sectional Study

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ABSTRACT

Background: Malocclusion is a common dental condition with functional, aesthetic, and psychosocial impacts. This study aimed to assess the prevalence, type, and severity of malocclusion among adolescents in Kathmandu Valley using Angle's classification and the Dental Aesthetic Index (DAI).

Objective: The primary objective of this study was to determine the prevalence of malocclusion among adolescents aged 13 to 15 years in Kathmandu Valley. Furthermore, it aimed to classify the types of malocclusion according to Angle's classification and to assess the severity and orthodontic treatment need using the Dental Aesthetic Index. Additionally, the study sought to analyze the associations between gender and both the type and severity of malocclusion, and to compare the findings across different age groups within the adolescent cohort.

Methods: A cross-sectional study was conducted among 1,000 adolescents (500 boys, 500 girls) aged 13 to 15 years. Clinical examinations were performed using standard orthodontic assessment criteria. Chi-square tests determined associations between gender and malocclusion type/severity, with $p < 0.05$ considered significant.

Results: Class I malocclusion was most common (50.0%), followed by Class II (29.9%) and Class III (20.1%). Dental Aesthetic Index (DAI) severity showed 27.5% normal/minor, 39.9% definite, 19.8% severe, and 12.8% very severe malocclusion. Gender differences were statistically significant for both classification ($p<0.001$) and severity ($p<0.001$) of malocclusion.

Conclusion: The high prevalence and significant gender differences emphasize the need for early orthodontic screening among Nepalese adolescents

Keywords: Adolescent; malocclusion; Nepal; orthodontics; severity of malocclusion.

INTRODUCTION

Malocclusion is defined as an irregularity in the alignment of teeth or an incorrect relation between dental arches beyond normal limits. It is recognized as the third most common dental health problem worldwide, after dental caries and periodontal

Citation
Malla S. Prevalence and Determinants of Malocclusion among Adolescents in Kathmandu Valley: A Cross-Sectional Study. J Nepal Dent Assoc. 2025 Jan-Jun;25(40):11- 6.

disease.[1,2] It has both functional consequencessuch as mastication difficulties, speech problems, and temporomandibular joint disordersand psychosocial impact due to compromised aesthetics.[3,4] The global prevalence of malocclusion varies widely, with estimates ranging from 39% to 93% depending on the population and assessment methods used.[5] In South Asia, studies have reported prevalence rates of 62% to 88%, with Class I malocclusion being the most frequent type.[6,7] The Dental Aesthetic Index (DAI), recommended by the World Health Organization (WHO), is a standardized tool that assesses both the functional and aesthetic components of malocclusion, enabling classification of treatment needs.[8]

In Nepal, limited studies have explored malocclusion epidemiology among adolescents, and few have combined Angle's classification with DAI scoring for comprehensive assessment.[9–11] Adolescence is a critical period for orthodontic intervention, as craniofacial growth is near completion and treatment outcomes can be optimized.[12] Early detection during this stage not only improves oral health but also enhances self-esteem and social well-being.[13] This study aimed to determine the prevalence, type, and severity of malocclusion among adolescents in Kathmandu Valley and to analyze gender-based differences using both Angle's classification and DAI.

METHODS

After obtaining ethical clearance from IRC-PDCH, a cross-sectional study was conducted between September 2013 and September 2014. The sample size was calculated as 1000 using the formula for estimating a single population proportion, based on a prevalence (p) of 70% as reported by Shrestha et al.[14], with a 95% confidence level, and a 5% margin of error (d). Schools were randomly selected from the District Education Office list, and participants were chosen through convenience sampling after obtaining parental consent. The inclusion criteria were being a student in the specified age group at the selected schools and providing parental consent. Students with current or previous orthodontic treatment were excluded. Clinical examinations were conducted in school infirmaries under natural daylight following WHO guidelines, using sterilized mouth mirrors, CPI probes, tweezers, and disposable masks and gloves to ensure infection control.

Orthodontic status and treatment need were assessed using DAI, which evaluates 10 occlusal traits related to dentofacial anomalies: missing visible teeth, crowding, spacing, diastema, maxillary and mandibular anterior irregularities, maxillary and mandibular overjet, anterior open bite, and anteroposterior molar relation. Each trait is assigned a weight, and a constant of 13 is added to obtain the final DAI score, categorizing malocclusion severity as normal/minor (<25), definite (26–30), severe (31–35), or very severe (>36), with corresponding treatment recommendations.

In addition to objective measurement, a short self-assessment questionnaire was administered to evaluate subjective perceptions of dental aesthetics and orthodontic need. Data were analyzed using SPSS version 21, with frequencies computed for all variables. Chi-square tests (χ^2) were applied to assess associations between DAI components and demographic factors, and Student's t-test was used to compare mean DAI scores between age and sex groups. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 1000 students participated in this study. The demographic distribution of the participants is presented in Table 1. Age distribution analysis revealed no significant gender differences (χ^2 = 2.10, p = 0.35).

Malocclusion was present in 73.0% of participants (27.0% normal occlusion). Malocclusion classification showed no significant difference by gender type, as shown in Table 2 (χ^2 = 0.12, p = 0.941)

Table 1: Distribution of study participants by age.

Age (yrs)	No. of students	Percent
13	300	30
14	350	35
15	350	35
Total	1000	100

Table 2: Distribution of malocclusion types by gender.

Malocclusion type	Boys	Girls	Total	p-value
Class I	248	252	500	
Class II	152	147	299	0.941
Class III	100	101	201	
Total	500	500	1000	

The severity of malocclusion based on the DAI score is detailed in Table 3. The analysis revealed significant gender-based severity differences ($\chi^2 = 21.52$, $p < 0.001$), with females exhibiting higher rates of severe and very severe malocclusion.

A comparison of the mean DAI scores across different age groups is shown in Table 4. No significant differences in mean DAI scores were observed across age groups ($p > 0.05$)

Table 3: Severity of malocclusion by gender based on Dental Aesthetic Index (DAI) score.

Severity level	Boys	Girls	Total	p value
Normal minor (<25)	142	133	275	
Definite(26-30)	226	173	399	0.001
Severe(31-35)	87	111	198	
Very Severe (>36)	45	83	128	
Total	500	500	1000	

Table 4: Age-wise comparison of mean Dental Aesthetic Index (DAI) scores.

Age Group	Mean DAI± SD	p value
13	28.5±4.8	
14	29±5.1	0.08
15	29.3±5.3	

DISCUSSION

This study revealed a strikingly high malocclusion prevalence (73%) among 13 to 15-year-old adolescents in Kathmandu Valley, significantly exceeding Nepal's previously reported national average of 63.9%[14] and regional studies such as Poudel et al.'s in 2019 which reported 65.2%.[15]This suggests distinct epidemiological patterns potentially attributable to Kathmandu's rapid urbanization, dietary shifts toward processed foods affecting dental development[16] and differences in access to preventive care across Nepal's diverse regions. The pronounced gender disparity in malocclusion severity showed that girls exhibited substantially higher rates of severe (22.2% vs. 17.4%) and very severe (16.6% vs. 9.0%) DAI categories. This contrasts with the equitable distribution of malocclusion types (Class I/II/III), a phenomenon not previously documented in Nepalese literature but aligns with Indian studies where Kumar et al[17] attributed similar gradients to earlier female growth spurts, amplifying skeletal discrepancies and heightened aesthetic awareness, increasing treatment-seeking behaviour .[18]

The overwhelming burden of definitive treatment need (DAI ≥26: 71.3%) is particularly alarming when considered against WHO standards.[8] Of this, 39.9% fell into the "definite" category (DAI 26–30) and 32.6% into severe/very severe categories (DAI >30), far surpassing Poudel et al.'s[15] report of 28.1% severe cases. This underscores a critical public health gap in Kathmandu where orthodontic services remain inaccessible to most families despite higher urban incomes, compounded by Nepal's shortage of orthodontists[19] The absence of significant age-related DAI differences reinforces Poudel et al.'s[15] conclusion that malocclusion severity stabilizes by age 13 in Nepalese cohorts, contrasting with European studies where Dimberg et al. [20] noted progression into late adolescence, possibly reflecting genetic and environmental influences on craniofacial growth patterns in South Asian populations .[21]

The public health implications of this study are profound, as 50% Class I malocclusion dominance suggests that largely dentoalveolar rather than skeletal issues are present, which are potentially addressable through early interceptive interventions by trained general dentists - a pragmatic solution given Nepal's specialist shortage. Second, the urban-rural disparity (73% vs. national 63.9%)[14] signals an emerging "malocclusion transition" where processed diets and reduced breastfeeding in cities may impair jaw development, as hypothesized by Baheti and Toshniwal[16] in comparable Indian settings. Third, female severity disparities warrant gender-sensitive school programs combining screening with psychosocial support,[22] as Marques et al.[23] demonstrated such approaches reduce aesthetic-related distress.

Urgent policy actions should include integrating DAI screening into Nepal's School Oral Health Program,[24] expanding orthodontic training slots, subsidizing basic appliances for severe cases,[25] and validating culturally adapted versions of DAI accounting for Nepalese aesthetic perceptions.[26] Future research must prioritize longitudinal cohorts tracking malocclusion progression from primary dentition[27] and economic analyses quantifying productivity losses from untreated malocclusion.[28-30]

This study has several limitations that should be considered when interpreting the findings. Being cross-sectional in design, it cannot establish causal relationships between potential etiological factors and malocclusion. The sample was drawn from selected schools within Kathmandu Valley, which may not fully represent adolescents from rural areas or diverse socioeconomic backgrounds across Nepal. Furthermore, the assessment relied solely on the DAI and Angle's classification of malocclusion, which might not capture all aspects of malocclusion, such as masticatory function, temporomandibular joint status, or patient satisfaction with dental aesthetics.

CONCLUSIONS

This study highlights a high prevalence of malocclusion among adolescents in Kathmandu Valley, with significant gender differences in both type and severity as measured by Angle's classification and the Dental Aesthetic Index. The findings underscore the importance of early detection and intervention to prevent progression and associated functional and psychosocial impacts. Despite examiner calibration, some degree of subjectivity inherent in orthodontic assessment could have influenced results. Additionally, important confounding factors such as oral habits, genetic predisposition, nutritional status, and access to orthodontic treatment were not comprehensively analyzed. For a more complete understanding, future research should adopt longitudinal designs to track the natural progression of malocclusion and identify causative factors over time. Expanding the study to include a larger, nationally representative sample would improve generalizability, while combining both clinical assessments and self-perceived evaluations would provide deeper insight into the functional, aesthetic, and psychosocial impacts of malocclusion. Investigations into the influence of socioeconomic, environmental, and genetic variables on malocclusion prevalence could help in developing targeted preventive and early intervention strategies.

Moreover, evaluating the cost-effectiveness of integrating orthodontic screening into routine school dental programs and exploring the long-term benefits of early orthodontic treatment would provide essential evidence for public health planning. By addressing these gaps, future studies could contribute significantly to improving oral health outcomes, optimizing resource allocation, and guiding the formulation of comprehensive orthodontic care policies tailored to the needs of Nepalese adolescents.

Incorporating orthodontic screening into school dental health programs could facilitate timely referral and management. Future efforts should focus on expanding research to a national level, addressing underlying risk factors, and promoting awareness to improve oral health outcomes and quality of life among Nepalese adolescents.

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