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Original article

Gender Differences in Malocclusion Awareness Among Adolescents in Zawia, Libya: A Cross-Sectional Questionnaire-Based Study

Fatimah Khadhar[1]*, Rasheed Abdulsalam[1], Fatihah Azhar Nor[1], Shokri Halila[2]

[1]*Departments of Orthodontics, Lincoln University College, Petaling Jaya, Selangor, Malaysia*
[2]*Departments of Biology, Faculty of Education, University of Zawia, Zawia, Libya*
Email. *fatimah.masterscholar@lincoln.edu.my*

Abstract
Malocclusion is highly prevalent among adolescents and significantly impacts oral function, aesthetics, and psychosocial well-being. Late adolescence (15-17 years) represents a critical period for self-image development and orthodontic treatment-seeking. However, data on knowledge and awareness of malocclusion in Western Libya remain scarce. This study was conducted to assess and compare knowledge and awareness of malocclusion, its etiology, problems, complications, prevention, and benefits of treatment between male and female late adolescents in Zawia City, Libya. A cross-sectional questionnaire-based study was conducted among 610 school students (310 males, 50.8% and 300 females, 49.2%) aged 15-17 years in Zawia City during 2026. A validated self-administered questionnaire comprising seven axes (forms, causes, problems, complications, prevention, benefits, and personal experience) was used. Data were analyzed using the chi-square test and Cramer's V coefficient to measure association strength. Ethical approval was obtained and informed consent was secured. Females demonstrated significantly higher knowledge of spaces between teeth ($p=0.038$, $V=0.104$), protruding jaws ($p<0.001$, $V=0.159$), and protruding teeth ($p=0.002$, $V=0.141$). Regarding etiology, females showed superior awareness of genetic causes ($p=0.010$, $V=0.122$) and bad oral habits ($p=0.017$, $V=0.116$), while males were more aware of tooth decay ($p=0.015$, $V=0.117$). Highly significant gender differences favoring females were observed for aesthetic problems ($p<0.001$, $V=0.208$), functional problems ($p=0.001$, $V=0.158$), premature tooth loss ($p=0.010$, $V=0.122$), jaw problems ($p<0.001$, $V=0.179$), avoidance of bad habits ($p=0.005$, $V=0.131$), use of space maintainers ($p<0.001$, $V=0.225$), improving smile aesthetics ($p=0.007$, $V=0.127$), and improving speech ($p<0.001$, $V=0.176$). Females also reported higher concern about alignment ($p<0.001$, $V=0.216$) and previous professional diagnosis ($p=0.002$, $V=0.142$). No significant gender differences were found for history of previous orthodontic treatment ($p=0.440$). Female late adolescents in Zawia exhibited significantly higher knowledge and awareness across most domains, particularly aesthetic and preventive aspects, reflecting greater aesthetic self-monitoring. School-based gender-targeted oral health education programs are recommended to improve awareness, especially among males.
Keywords. Malocclusion, Knowledge, Awareness, Adolescents, Gender, Zawia, Libya, Orthodontics.

Introduction

Oral health is an essential component of general health and well-being, extending beyond the absence of oral diseases to include functional, psychological, and social aspects of daily life. According to the World Health Organization (WHO), good oral health enables individuals to eat, speak, smile, and interact confidently without pain, discomfort, or embarrassment. Consequently, oral health has become an important determinant of oral health-related quality of life (OHRQoL), particularly during adolescence, when physical appearance and social acceptance play a crucial role in psychological and emotional development [1, 2].

Malocclusion is one of the most common oral health disorders worldwide and is considered the third most prevalent oral disease after dental caries and periodontal diseases. It is characterized by irregular alignment of the teeth or an abnormal relationship between the dental arches resulting from disturbances in craniofacial growth and development. The prevalence of malocclusion varies among different populations due to genetic, environmental, and socioeconomic factors; however, it remains a significant public health concern because of its high prevalence and potential impact on oral function, facial aesthetics, and psychosocial well-being [3-5].

The consequences of malocclusion extend beyond aesthetic concerns. Moderate-to-severe malocclusion may impair mastication, speech, oral hygiene maintenance, and periodontal health while increasing the risk of temporomandibular disorders and traumatic dental injuries. Furthermore, visible dental irregularities may negatively affect facial appearance, resulting in reduced self-esteem, poor body image, social anxiety, and difficulties in interpersonal relationships. [6, 7, 8].

Adolescence represents a critical period of physical, emotional, and psychosocial development during which individuals become increasingly conscious of their appearance and more sensitive to peer opinions. Dental aesthetics play an important role in self-confidence and social acceptance during this developmental stage. Consequently, adolescents' awareness of malocclusion and their perception of orthodontic treatment need may strongly influence their willingness to seek orthodontic care and comply with treatment recommendations [9, 10].

Although orthodontic treatment need is commonly determined using standardized clinical indices, self-perceived treatment need often differs from professionally assessed need. Previous studies have shown that awareness and perception of malocclusion are influenced by several factors, including gender, educational level, socioeconomic status, parental awareness, and accessibility to orthodontic services [11,12]. Recent international studies continue to highlight inadequate awareness of malocclusion among adolescents. A study conducted in China in 2024 reported insufficient

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knowledge and awareness of malocclusion and orthodontic treatment among adolescents and their parents, emphasizing the importance of oral health education programs. Similarly, a Turkish cross-sectional study demonstrated that self-perceived orthodontic treatment need was significantly associated with oral health-related quality of life. Furthermore, a recent study conducted in India identified a high prevalence of orthodontic treatment need among adolescents and reported significant gender differences in aesthetic perception [13, 14, 15].

Evidence regarding adolescents' awareness of malocclusion in Libya remains limited. A recent Libyan study conducted among schoolchildren in Sirte reported relatively low awareness of orthodontic treatment and identified gender-related differences in orthodontic knowledge, highlighting the need for further community-based investigations across different regions of the country. However, to the best of our knowledge, no published study has comprehensively evaluated knowledge and awareness of malocclusion together with self-perceived orthodontic treatment needs among adolescents in Zawia City, western Libya. This gap limits the ability to develop targeted preventive and educational strategies tailored to the local population [16]. Therefore, this cross-sectional study was conducted to assess the level of knowledge and awareness of malocclusion and self-perceived orthodontic treatment needs among adolescents in Zawia City, Libya. The specific objectives were: (1) to evaluate adolescents' knowledge regarding the forms, etiology, complications, and prevention of malocclusion, and (2) to investigate gender differences in knowledge, awareness, and perceived orthodontic treatment needs. The findings are expected to provide baseline evidence to support school-based oral health education programs and future orthodontic service planning in Libya.

Methods

Study Design and Setting

A descriptive, school-based, cross-sectional questionnaire survey was conducted among adolescents in Zawia City, western Libya. The study was carried out across public and private secondary schools during the academic year 2026.

Study Population and Sampling

The final study population comprised 610 school-going adolescents, including 310 males (50.8%) and 300 females (49.2%). Participants were stratified by age into late adolescence (15-17 years): 190 students aged 15 years (31.1%), 291 students aged 16 years (47.7%), and 129 students aged 17 years (21.1%).

Inclusion criteria

School students aged 15-17 years enrolled in secondary schools in Zawia City who provided written assent and parental informed consent.

Exclusion criteria

Students with a history of previous or ongoing orthodontic treatment and students with major congenital craniofacial anomalies or syndromes were excluded.

Questionnaire Design and Scoring

A structured, self-administered questionnaire was developed specifically for this study to assess knowledge and awareness regarding malocclusion. The instrument consisted of two sections:

Section 1: Sociodemographic characteristics

Including age, gender, and school type.

Section 2: Knowledge and awareness of malocclusion

Comprising 31 statements distributed across seven clinical domains including etiology, complications, functional disruptions, and preventive methods.

Responses were recorded on a three-point Likert scale: “Yes”, “I don’t know”, and “No”. Scoring was assigned as 1.0 for knowledgeable responses (Yes), 0.5 for uncertain responses (I don’t know), and 0 for unaware responses (No). Higher total scores indicated a higher level of knowledge and awareness.

Validity and Reliability

Content validity was established through expert review by a panel of senior orthodontists and public health specialists. A pilot study was conducted on a small independent group of adolescents who met the inclusion criteria but were excluded from the final sample. Internal consistency was assessed using Cronbach’s alpha coefficient, with a value of ≥0.70 considered acceptable.

Ethical Considerations

The study protocol was approved by the Research Ethics Committee of Lincoln University College, Malaysia (Ref: LUC/DVCECA/23042026/028) and the Libyan National Bioethics Committee (Ref: NBC: 018.H.24). Administrative approval was obtained from the Ministry of Education, Zawia City. Written informed parental consent and student assent were obtained from all participants prior to enrolment. Confidentiality and anonymity were maintained throughout the

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study, and the study was conducted in accordance with the ethical standards of the Helsinki Declaration of 1964, as revised in 2000.

Statistical Analysis

Data were coded and analyzed using Statistical Package for Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as frequencies and percentages. Pearson's Chi-square test was used to assess gender-based differences in knowledge and awareness. A p-value of <0.05 was considered statistically significant.

Result and Discussion

The present study evaluated knowledge and awareness of malocclusion among 610 late adolescents (15-17 years) in Zawia City. The sample demonstrated a balanced gender distribution (310 males, 50.8% and 300 females, 49.2%), providing adequate power to detect gender-based variations. This age group is particularly relevant as global data indicates high prevalence of malocclusion traits during late adolescence [4, 17, 22].

Table 1. Interpretation of Cramer's V coefficient (Conformity coefficient)

S No.	Cramer's V Value	Interpretation
1	0.00-0.09	Negligible
2	0.10-0.19	Very weak
3	0.20-0.29	Weak
4	0.30-0.39	Average
5	0.40-0.49	Moderate
6	0.50-0.69	Strong
7	0.70-0.89	Very strong

Regarding knowledge of malocclusion forms, significant gender differences were observed for spaces between teeth (p=0.038), protruding jaws (p<0.001), and protruding teeth (p=0.002), favoring females (Table 2). This is consistent with Cunha et al. and Al-Zawiya et al., who reported that female adolescents exhibit heightened visual sensitivity to sagittal discrepancies due to greater aesthetic self-monitoring and social integration concerns. No significant difference was found for general misalignment (p=0.311) and awareness of treatment options (p=0.865), indicating a uniformly high baseline awareness in Al-Zawiya. Similarly high awareness was reported among schoolchildren in Jordan [2, 3, 23, 24].

Table 2. Axis 1 - Knowledge of Malocclusion Forms (N=610)

Question	Gender	Yes n (%)	No n (%)	I don't know n (%)	Chi-square (p)	Cramer's V
Misalignment	Male	166 (53.5%)	70 (22.6%)	74 (23.9%)	2.335 (0.311)	0.062
	Female	179 (59.7%)	58 (19.3%)	63 (21.0%)		
Spaces between teeth	Male	113 (36.5%)	135 (43.5%)	62 (20.0%)	6.535 (0.038*)	0.104
	Female	128 (42.7%)	134 (44.7%)	38 (12.7%)		
Protruding jaws	Male	92 (29.7%)	140 (45.2%)	78 (25.2%)	15.359 (0.000*)	0.159
	Female	127 (42.3%)	129 (43.0%)	44 (14.7%)		
Protruding teeth	Male	107 (34.5%)	124 (40.0%)	79 (25.5%)	12.165 (0.002*)	0.141
	Female	143 (47.7%)	105 (35.0%)	52 (17.3%)		
Awareness of treatment options	Male	207 (66.8%)	98 (31.6%)	5 (1.6%)	0.290 (0.865)	0.022
	Female	195 (65.0%)	99 (33.0%)	6 (2.0%)		

**Significant at p<0.05*

Concerning etiology, females demonstrated superior knowledge of genetic causes (p=0.010) and bad oral habits (p=0.017), while males showed higher awareness of tooth decay as an etiological factor (p=0.015) (Table 3). This aligns with Närhi et al. and Al-Hussaini et al., who concluded that females actively seek more health information and show greater health-seeking behavior. The female predominance in awareness of bad habits is clinically important, as oral habits are strongly associated with malocclusion in late adolescence, as emphasized by Laganà et al. Interestingly, males showed higher awareness of tooth decay as a cause (p=0.015). This may reflect higher caries experience among males in Libya due to poorer oral hygiene practices as documented by Omar et al [13, 19, 20, 16].

For awareness of problems associated with malocclusion, highly significant differences were found for aesthetic (p<0.001) and functional problems (p=0.001), favoring females (Table 4). This pronounced gender gap supports the psychosocial impact model where late adolescent females place greater emphasis on smile aesthetics as a determinant of self-esteem and quality of life, as reported by Roberts et al. and Alhaija et al. The impact of dental aesthetics on psychosocial well-being and bullying has been well documented [2, 7, 9, 23].

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Regarding complications of untreated malocclusion, awareness of premature tooth loss (p=0.010) and functional jaw problems (p<0.001) was significantly higher in females. No significant differences were found for soft tissue injuries (p=0.053), dental caries (p=0.086), and gingivitis (p=0.190). The lack of awareness regarding periodontal complications mirrors findings by Thilander et al., who emphasized that adolescents often underestimate the periodontal risks of crowding and functional limitations [6].

Table 3. Axis 2 - Causes of Malocclusion (N=610)

Cause	Gender	Yes n (%)	Direction	Chi-square (p)	V
Genetic causes	Male	123 (39.7%)	Female	9.133 (0.010*)	0.122
	Female	152 (50.7%)			
Bad habits	Male	157 (50.6%)	Female	8.139 (0.017*)	0.116
	Female	186 (62.0%)			
Tooth loss	Male	118 (38.1%)	No diff	0.436 (0.804)	0.027
	Female	122 (40.7%)			
Tooth decay	Male	134 (43.2%)	Male	8.409 (0.015*)	0.117
	Female	99 (33.0%)			
Diet	Male	146 (47.1%)	No diff	0.593 (0.744)	0.031
	Female	132 (44.0%)			

Note: Data display frequencies and percentages of "Yes" responses only.

Table 4. Axis 3 - Knowledge of Problems (N=610)

Problem	Gender	Yes n (%)	Direction	Chi2 (p)	V
Aesthetic problems	Male	192 (61.9%)	Female	26.315 (0.000*)	0.208
	Female	240 (80.0%)			
Functional problems	Male	149 (48.1%)	Female	15.180 (0.001*)	0.158
	Female	191 (63.7%)			

Note: Data display frequencies and percentages of "Yes" responses only.

Table 5. Axis 4 - Complications of Malocclusion (N=610)

Complication	Gender	Yes n (%)	Direction	Chi2 (p)	V
Soft tissue injury	Male	172 (55.5%)	No diff	5.869 (0.053)	0.098
	Female	195 (65.0%)			
Tooth decay	Male	149 (48.1%)	No diff	4.896 (0.086)	0.090
	Female	127 (42.3%)			
Gum infection	Male	165 (53.2%)	No diff	3.327 (0.190)	0.074
	Female	180 (60.0%)			
Premature tooth loss	Male	141 (45.5%)	Female	9.144 (0.010*)	0.122
	Female	167 (55.7%)			
Jaw problems	Male	150 (48.4%)	Female	19.603 (0.000*)	0.179
	Female	198 (66.0%)			

Note: Data display frequencies and percentages of "Yes" responses only.

For preventive knowledge, females showed significantly higher awareness regarding avoidance of unhealthy oral habits (p=0.005) and use of space maintainers (p<0.001) (Table 6). This aligns with Taylor et al., who reported that female adolescents dominate preventive orthodontic consultations due to proactive attitudes. No significant differences were found for preventing premature tooth loss (p=0.058) and timely treatment (p=0.065), with both genders showing relatively high awareness, consistent with recent trends [11, 14].

Regarding benefits of orthodontic treatment, significant differences were found for improving smile aesthetics (p=0.007) and speech (p<0.001), favoring females. This supports the concept that aesthetic-driven motivation is the primary catalyst for help-seeking, especially under the influence of social media, as reported by Feldens et al. No significant differences were observed for chewing improvement (p=0.098) and gum preservation (p=0.168). The generally high awareness indicates that adolescents are well-informed about the advantages of treatment, which positively affects oral health-related quality of life [1, 10, 18, 21].

Concerning self-perception and personal experience, females reported significantly higher concerns about teeth alignment (p<0.001) and higher rates of previous professional diagnosis of malocclusion (p=0.002) (Table 7). This discrepancy has been extensively documented; Mandall et al. and Shaw et al. found that females are more critical of minor occlusal variations and more likely to seek professional evaluation due to peer evaluation and social stereotyping. Self-perception of dental aesthetics is a strong predictor of treatment demand. No significant difference was found for history of previous orthodontic treatment (p=0.440), indicating that despite greater concern, actual treatment uptake

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remains low in Zawia, possibly due to economic barriers, structural shortages, and limited public services as reported by El Tantawi et al. and Atia et al. in North Africa and Western Libya. This is further supported by evidence on smile aesthetic s perceptions in North Africa and global burden data [5, 8, 10, 11, 15, 21, 25].

In summary, female adolescents in Zawia City exhibited significantly higher knowledge and awareness across most dimensions, particularly aesthetic and preventive aspects, while male adolescents showed lower awareness of functional complications. These findings highlight the need for gender-targeted school-based education programs.

Table 6. Axis 5 - Prevention and Axis 6 - Benefits (N=610)

Item	*Gender*	*Yes n (%)*	*Direction*	*Chi2 (p)*	*V*
Prevent premature loss	M	168 (54.2%)	No diff	5.682 (0.058)	0.097
	F	183 (61.0%)			
Avoid bad habits	M	236 (76.1%)	Female	10.414 (0.005*)	0.131
	F	256 (85.3%)			
Space maintainer	M	156 (50.3%)	Female	30.907 (0.000*)	0.225
	F	205 (68.3%)			
Timely treatment	M	240 (77.4%)	No diff	5.462 (0.065)	0.095
	F	253 (84.3%)			
Improve chewing	M	227 (73.2%)	No diff	4.648 (0.098)	0.087
	F	197 (65.7%)			
Improve smile	M	259 (83.5%)	Female	9.867 (0.007*)	0.127
	F	270 (90.0%)			
Improve speech	M	175 (56.5%)	Female	18.820 (0.000*)	0.176
	F	202 (67.3%)			

Note: Data display frequencies and percentages of "Yes" responses only.

Table 7. Axis 7 - Personal Experience and Perception (N=610)

Question	*Gender*	*Yes n (%)*	*Direction*	*Chi2 (p)*	*V*
Concern about alignment	Male	178 (57.4%)	Female	28.58 (0.000*)	0.216
	Female	233 (77.7%)			
Diagnosed by dentist	Male	54 (17.4%)	Female	12.30 (0.002*)	0.142
	Female	85 (28.3%)			
Previous treatment	Male	16 (5.2%)	No diff	1.64 (0.440)	0.052
	Female	23 (7.7%)			

Note: Data display frequencies and percentages of "Yes" responses only.

Conclusion

This cross-sectional questionnaire-based study among 610 adolescents in Zawia City, Libya, revealed moderate levels of knowledge and awareness regarding malocclusion with significant gender disparities. Female adolescents demonstrated significantly higher awareness across most domains, including malocclusion forms, etiology, aesthetic and functional impacts, complications, and preventive measures, compared to male adolescents. The findings indicate that while baseline awareness of orthodontic treatment availability is high, awareness of periodontal complications and functional risks remains inadequate, particularly among males. Despite higher self-perceived concerns among females, actual orthodontic treatment uptake was low across genders, suggesting economic and accessibility barriers. These findings provide baseline evidence to support the implementation of targeted, gender-specific school-based oral health education and preventive orthodontic programs in Zawia City and similar Libyan communities.

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Authors' contributions

Fatimah Khadhar: Conceptualization, data collection, data curation, writing - original draft. Rasheed Abdulsalam: Supervision, methodology validation, review. Fatihah Azhar nor: Formal analysis, statistical consultation, review. Shokri Ayad Halila: Review, editing, local coordination. All authors have read and approved the final version of the manuscript and meet the ICMJE criteria for authorship.

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Conflict of interest

The authors declare no conflict of interest.

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