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ORIGINAL RESEARCH

Prevalence of Occlusal Features and Their Relation to Sociodemographic Variables in Northwest Ethiopia: A Cross-Sectional Study

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Background: Malocclusion affects the chewing, dental aesthetics, jaw development, and overall attractiveness of individuals. The negative impact of malocclusion is high, particularly in adolescents who can be the target of teasing, intimidation, and name-calling. Even if, malocclusion is a common problem in developing countries, there was a paucity of data in Ethiopia. Therefore, this study aimed to determine the prevalence and associated factors of malocclusion in northwest Ethiopia.

Methods: This cross-sectional study was done at the University of Gondar comprehensive hospital from December 1, 2019, to October 30, 2020. Four hundred seventy-six study participants were selected using a systematic random sampling method. Data collection was done using a structured interviewer-administered questionnaire. Qualified dental professionals examined malocclusion traits according to the WHO oral health survey tool and evaluated for the presence of malocclusion in terms of angles classification, open bite, crossbite, spacing, and crowding. Data entry was done using Epi-Info 7, and analyzed by SPSS 26. Descriptive statistics and logistic regression was done to analyze the data.

Results: A total of 476 subjects were included in the study with a mean age of 29.83 (SD ±14.013). The prevalence of malocclusion was 55.9% (95% CI: 51.39–60.28). The common occlusal traits were class-I malocclusion with minor discrepancy (34.9%), anterior crowding (22.9%), and anterior open bite (21.6%). The prevalence of anterior crossbite, posterior crossbite, class-II, and class-III malocclusion was 5.9%, 3.8%, 10.9%, and 8.0%, respectively. Males (AOR=1.6, 95% CI: 1.11, 2.30), urban residents (AOR=1.64, 95% CI: 1.06, 2.56), monthly income of ≤2500 Ethiopian Birr (AOR=1.27, 95% CI: 1.02, 1.59) and mouth breathers (AOR=2.50, 95% CI: 1.72, 2.63) were significantly associated with malocclusion.

Conclusion: Significant amount of the study participants had malocclusion. Males, urban residents, low monthly income, and mouth breathing habits were independent factors for a malocclusion. Therefore, early attention to the development of the dentition and occlusion, and necessary functional correction during childhood are important to reduce its prevalence and lifelong adverse effect. Moreover, publicly financed orthodontic treatment should be scheduled, and supplied to individuals in desperate need of orthodontic care.

Keywords: malocclusion, dentofacial deformity, angles malocclusion, crossbite, open bite

Background

Malocclusion is defined as an irregularity of the teeth or a mal-relationship between the dental arches beyond the normal range. It is one of the common problems in the oral cavity along with caries and periodontal disease.[1] Malocclusion affects chewing, speech, articulation, dental aesthetics, jaw development, and overall

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attractiveness,[2–7] and adults become the target of teasing, intimidation, and name-calling.[8]

Malocclusion is considered a multifactorial condition, which is linked to genetic and environmental factors.[9,10] Oral habit is one of the environmental factors that affect the occlusal relation of the jaw.[11,12] Non-nutritive sucking habits that last longer than 3 years are linked to the development of anterior open bite.[13] A cross-sectional study in China showed that malocclusion had a statistically significant association with residency (OR = 1.741:95% CI: 1.384–2.162), dental caries (OR = 2.045; 95% CI: 1.665–2.539), tongue thrusting (OR = 2.833; 95% CI: 1.640–3.649), and finger sucking (OR = 1.573, 95% CI: 1.098–2.014).[14] Previous literature showed the etiological role of genetic factors in malocclusion has been reduced, bearing in mind that most malocclusions recognize a post-natal origin, related to non-nutritive or nutritive sucking habits at early stages of life and trauma.[15–19]

In Africa, the prevalence of class-I malocclusion was 89%.[20] The prevalence of malocclusion was 24.7% in Malaysia,[21] and 23.7% in Ethiopia.[22] An institution-based cross-sectional study in children in Southwest Ethiopia found a high prevalence of Overjet (30.8%) and Crowding (23.3%).[23] A study done in brazil found a high prevalence of anterior open bite (21.0%) and posterior crossbite (11.6%),[24] while Zhou et al in China reported a high prevalence of overjet (34.99%), deep overbite (37.58%), and midline deviation (25.32%) in adults.[14]

The self-respect and self-confidence of adults and children were largely dependent on their physical and facial appearance.[25–27] However, the presence of misaligned teeth embarrass individuals' social interaction and deliberately affect their dental appearance.[9,10] Moreover, Malocclusion causes psychological problems, functional difficulties, low quality of life, and halitosis, which results from open-mouth breathing habits.[26,28] A previous study revealed that determining the occlusal features at early permanent dentition would have a significant role in modifying the preventive and interceptive treatment plans.[29,30]

Assessing the prevalence of malocclusion in children and adults may reduce or eliminate future treatment needs, reduce the treatment cost, and plan preventive and curative measures.[31] Moreover, it is also important for resource planning and funding.[32,33] This study also will aid in comprehending the required assets and preventive measures and in planning oral health care programs. To date, there is no documented evidence on the prevalence of malocclusion in Northwest Ethiopia. Therefore, this study aimed to assess the prevalence of occlusal features and their relation to sociodemographic variables in Northwest Ethiopia.

Methods

Study Design

A hospital-based cross-sectional study design was employed.

Study Area and Period

This study was conducted in the University of Gondar compressive hospital, northwest Ethiopia, from December 1, 2019, to October 30, 2020. This hospital is one of the tertiary hospitals in the country, which is serving about 7 million populations in the catchment area. The dental clinic is one of the specialty centers in the University of Gondar comprehensive hospital that has both outpatient departments and inpatient services. All above 12 years old patients who visited the dental clinic within the study period were candidates for the study. All the study participants were selected using a systematic random sampling method.

Populations

All patients who visited the University of Gondar comprehensive specialized hospital were the source population, whereas those who visited the dental clinic during the data collection period were the study populations.

Inclusion and Exclusion Criteria

Study participants that met the following inclusion criteria were included in the study;

- Age of 12 and above years
- Participants who had no previous orthodontic treatment
- A patient who sign the consent form

Exclusion Criteria

- A patient with developmental anomalies (eg Cleft lip and palate, Down syndrome)
- Permanent dentition present with remaining deciduous teeth
- All participants with missed 1st permanent molar

Sample Size Determination and Sampling Procedures

The sample size was calculated by using the single population proportion formula by assuming; a prevalence of

23.7%,[22] 95% confidence interval of Zα/2=1.96, a margin of error (d) =4, and a 10% non-response rate. By considering this, the final sample size became 476.

A systematic random sampling method was employed to select the study subjects. The sampling interval (K) was calculated by dividing the predicted number of participants per month by the sample size. A lottery method was used to determine the first study participant and every third patient was included in the study (K=3) until the desired sample size was achieved.

Study Variables

Dependent Variable: The outcome variable to be investigated was malocclusion.

Independent Variables: The independent variables include; socio-demographic Characteristics (gender, age, marital status, educational status, occupation, religion, residency, and monthly income), history of exclusive breastfeeding, bottle-feeding, and thumb sucking habit.

Data Collection Tools and Quality Assurance

Data were collected using a structured and interviewer-administered questionnaire. Qualified dentists evaluated the presence of malocclusion using the WHO oral health survey tool. The data collectors to collect the sociodemographic characteristics (age, sex, age, marital status, educational level, occupation, residency, and monthly income) used a structured questionnaire.

A comprehensive orthodontic examination was done for each study participant by one examiner. The basic Angles classification was used to categorize patients' malocclusion traits,[34] and each participant was classified into one of the following categories: Class-I (normal occlusion, mild deviation from the ideal occlusion and does not compromise aesthetics of function), class II malocclusion, and class III malocclusion. For extra-oral (skeletal malocclusion); patients were seated in normal position and the following parameters were recorded: Facial profile relationship in the anteroposterior dimension, Facial profile convexity, Vertical proportions of the face, and Lips at rest.

To assure the quality of the study, a pretest was done in 10% of the sample size on participants with similar sociodemographic characteristics. Based on the results, some amendments were done to the prepared tool. A three-day training was given for the data collectors (3 dentists) and two supervisors on the research ethics, objectives of the study, data confidentiality, and consent.

Data Processing and Analysis

The collected data were entered into Epi-Info (version 7) to clean and code. In 10% of the collected questionnaires, double-entry was done. Data analysis was done using SPSS software version 26. Frequencies and percentages were calculated and presented using tables and texts. Binary logistic regression was done to explore the association between independent variables and malocclusion. Variables with P≤0.25 were entered into the multivariate model to control the possible confounders. Variables independently associated with malocclusion were explored on the bases of adjusted odds ratio (AOR) and 95% confidence interval.

Ethics Approval and Consent to Participate

The study was approved by the Institutional Review Board of the University of Gondar and complied with the Declaration of Helsinki Ethical Principles for Medical Research. Written informed consent was taken from each participant before commencing the study. Moreover, written informed consent was obtained from parents or legal guardians for 12–18 years old children. The authors tried to minimize the study participant's confidentiality by avoiding identifiers such as; name and personal ID.

Results

Sociodemographic Characteristics of the Study Participants

A total of 476 study participants with a mean age of 29.83 (SD±14.013) years with a range of 12 to 85 years were involved in the study. The age range of the study participants was 12 years to 65 years old. More than half (51.1%) of the study participants were males. The majority of the study participants were 12–34 years old (73.7%), married (46.2%), orthodox (89.7%), urban residents (78.6%), and earn ≤2500 Ethiopian Birr monthly (73.7%) (Table 1).

The Prevalence of Malocclusion Among the Participants

The prevalence of malocclusion among the study participants was 55.9% (95% CI: 51.39–60.28). The commonly occurred malocclusion types in the study participants were; angles Class-I with minor discrepancy (34.9%), lower anterior crowding (22.9%), and anterior open bite

Table 1 Sociodemographic Characteristics of the Study Participants

Sociodemographic Characteristics		Frequency (n)	Percentage (%)
Gender	Male	243	51.1
	Female	233	48.9
Age	12–34	351	73.7
	35–49	66	13.9
	≥50	59	12.4
Marital status	Single	220	46.2
	Married	237	49.8
	Divorced	19	4.0
Educational status	Illiterate	105	22.1
	1–4	70	14.7
	5–8	69	14.5
	9–12	55	11.6
Occupation	Farmer	71	14.9
	Student	168	35.3
	Governmental employee	86	18.1
	Non governmental organization employee	11	2.3
	Merchant/personal business	140	29.4
Religion	Orthodox	427	89.7
	Muslim	30	6.3
	Protestant	11	2.3
	Catholic	8	1.7
Residency	Urban	374	78.6
	Rural	102	21.4
Monthly income	≤2500 ETB	351	73.7
	> 2500 ETB	125	26.3

Abbreviation: ETB, Ethiopian Birr.

(21.6%). Anterior crossbite (5.9%), posterior crossbite (3.8%), angles class-II malocclusion (10.9%), and class-III malocclusion (8%) were relatively low in the study participants (Table 2).

Table 3 presents the distribution of different types of malocclusion based on the socio-demographic characteristic of the study participants.

Males have been affected more by class-I malocclusion with minor discrepancy (41.6% vs 28.3%) and posterior crossbite than females (9.5% vs 4.3%). Adults within the age group of 12–34 years had a high prevalence of anterior cross-bite (8.3%), posterior crossbite (5.7%) than other age groups. Besides, elders had a high prevalence of angle class-III malocclusion than adults (16.9%).

Anterior crowding (39.3%) and anterior crossbite (10.4%) were relatively high in low socioeconomic status participants (≤2500 Ethiopian birr). Rural residents had a higher prevalence of class-I malocclusion with minor discrepancy (45.5% vs 42.2%), anterior crossbite (8.8% vs 5.3%), class II subdivision 1 (13.7% vs 6.7%), and class II subdivision 2 malocclusions (9.8% vs 1.3) than urban residents. However, angle class-III malocclusion (7.5% vs 4.9%) was higher in urban residents. Mouth breathers had a high prevalence of angle class-1 malocclusion (31.4%), anterior crossbite (6.4%), class-II subdivision 1 (11.8%), and class-III (11.5%) malocclusion than the nasal breathers (Table 3).

Table 4 showed the distribution of different types of malocclusion based on the risk factors (oral habits) of the participants of 12–18 years.

In participants with a history of exclusive breastfeeding, 67.8% had no malocclusion and 23.7% had developed class-I malocclusion with a minor discrepancy. Besides, 20.8% of the study participants with a history of thumb sucking had an anterior open bite and class-II subdivision malocclusion. However, there was no reported class-III and posterior crossbite among 12–18 years adults (Table 4).

Table 2 Frequency Distribution of the Types of Malocclusion Among the Study Participants

Malocclusion		Frequency (n)	Percentage (%)
Angles class I without minor discrepancy	Yes	210	44.1
	No	266	55.9
Angles class-I with minor discrepancy	Yes	166	34.9
	No	310	65.1
Lower anterior crowding	Yes	109	22.9
	No	367	77.1
Anterior cross-bite	Yes	28	5.9
	No	448	94.1
Posterior Cross-bite	Yes	18	3.8
	No	458	96.2
Anterior open bite	Yes	103	21.6
	No	373	78.4
Angles class-2 subdivision 1 malocclusion	Yes	40	8.4
	No	436	91.6
Angles class-2 subdivision 2 malocclusion	Yes	12	2.5
	No	464	97.5
Angles class-3 malocclusion	Yes	38	8.0
	No	438	92.0

Factors Associated with Malocclusion in the Study Participants

Bivariate and multivariate logistic regression analysis was done to search for factors associated with malocclusion among the study participants. Males were 1.6 times more likely to develop malocclusion than females with AOR: 1.60; 95% CI: 1.11–2.30; p=0.011. Urban residents were 1.64 times at risk of developing malocclusion than rural residents (AOR=p=0.026). Low socioeconomic status and mouth breathing played a critical role in the morbidity of malocclusion (P<0.05). There was no significant difference in the prevalence of malocclusion among the different age categories (p=0.218) (Table 5).

Discussion

The prevalence of malocclusion in the present study was 55.9%, which corresponds with a study done in Kenya (47%) (25), Nigeria (42%),[35] India (53%),[36] Tanzania (63.8%),[25] Italy (59.5%)[9] and China (45.50%).[37] However, this result is low compared with a study done in Kenya (72%) (29), Rwanda (93%),[38] Iran (87%),[39] Colombia (88%), global burden of malocclusion in Africa (89%)[20] and Sudan (85.3%).[40] Besides, lower results were reported in Brazil (20.0%)[41] and Bangladesh (24.7%).[21] The difference between our study and others might be due to the ethnicity difference and the use of variable criteria for the classification of the malocclusion.

According to our study class-I malocclusion with a minor discrepancy was found in 34.9% of our study participants which is similar to a study done in Turkey (34.9%).[42] However, this figure is low compared with the global burden of class-I malocclusion in Africa (89.0%),[20] and the study done in Libya (66.5%).[43] The present study also revealed that the prevalence of anterior open bite was 21.6%, which is high compared to a study done in Sudan (8.5%).[44] This might be due to the difference in ethnicity and environmental factors among the study participants.

The present study revealed that 22.9% of the study participants had lower anterior teeth crowding, which is similar to a study done in Nigeria (21.6%).[45] Moreover, a similar finding (23.3%) was reported in an epidemiological study done in Southwest Ethiopia.[23] Nevertheless, other studies done in Nairobi (47.2%)[46] and Rwanda (45–51%)[38] have reported higher rates of crowding in the lower jaw. The present study also found that 5.9% of the study participants had an anterior cross-bite, which is in line with a study done in India (8.48%),[36] and Rwanda (12%).[38] However, this result is high compared with a study done in Brazil (2.14%).[47] Besides, this study

Table 3 Malocclusion vs Sociodemographic Characteristics

Sociodemographic Characteristics		Angle Class 1 with No Minor Discrepancy (n (%))	Angle Class-1 with Minor Discrepancy (n (%))	Lower Anterior Crowding (n (%))	Anterior Cross-Bite (n (%))	Posterior Cross-Bite (n (%))	Anterior Open Bite (n (%))	Angle Class-2 Sub-1 (n (%))	Angle Class-2 Sub-2 (n (%))	Angle Angle Class-3 (n (%))
Sex	Male	95 (39.1)	101 (41.6)	59 (24.3)	15 (6.2)	20 (8.2)	48 (19.8)	5 (2.1)	5 (2.1)	23 (9.5)
	Female	118 (50.6)	66 (28.3)	43 (18.5)	14 (6.0)	0 (0.0)	50 (21.5)	34 (14.6)	10 (4.3)	10 (4.3)
Age	12–34	149 (42.5)	88 (40.0)	70 (19.9)	29 (8.3)	20 (5.7)	44 (20.0)	28 (8.0)	10 (2.8)	18 (5.1)
	35–49	35 (53.0)	74 (31.2)	22 (33.3)	0 (0.0)	0 (0.0)	53 (22.4)	6 (9.1)	0 (0.0)	5 (7.6)
	50–90	29 (49.2)	5 (26.3)	10 (16.9)	0 (0.0)	0 (0.0)	5 (26.3)	5 (8.5)	5 (8.5)	10 (16.9)
Marital status	Single	89 (40.5)	88 (40.0)	44 (20.0)	20 (9.1)	5 (2.3)	54 (24.5)	20 (9.1)	5 (2.3)	9 (4.1)
	Married	120 (50.6)	74 (31.2)	53 (22.4)	9 (3.8)	10 (4.2)	34 (14.3)	14 (5.9)	10 (4.2)	19 (8.0)
	Divorced	4 (21.1)	5 (26.3)	5 (26.3)	0 (0.0)	5 (26.3)	10 (52.6)	5 (26.3)	0 (0.0)	5 (26.3)
Educational status	Illiterate	41 (39.0)	35 (33.3)	24 (22.9)	4 (3.8)	0 (0.0)	20 (19.0)	19 (18.1)	5 (4.8)	5 (4.8)
	1–4	17 (24.3)	29 (41.4)	0 (0.0)	5 (7.1)	5 (7.1)	10 (14.3)	5 (7.1)	10 (14.3)	5 (7.1)
	5–8	50 (72.5)	10 (14.5)	19 (27.5)	0 (0.0)	5 (7.2)	5 (7.2)	0 (0.0)	0 (0.0)	9 (13.0)
	9–12	25 (45.5)	15 (27.3)	15 (27.3)	5 (9.1)	0 (0.0)	20 (36.4)	5 (9.1)	0 (0.0)	5 (9.1)
	College/ University	80 (45.2)	78 (44.1)	44 (24.9)	15 (8.5)	10 (5.6)	43 (24.3)	10 (5.6)	0 (0.0)	9 (5.1)
Occupation	Farmer	24(33.8)	23 (32.4)	19 (26.8)	9 (12.7)	5 (7.0)	8 (11.3)	14 (19.7)	0 (0.0)	10 (14.1)
	Student	80 (47.6)	64 (38.1)	35 (20.8)	10 (6.0)	5 (3.0)	46 (27.4)	10 (6.0)	10 (6.0)	0 (0.0)
	Governmental employee	50 (58.1)	26 (30.2)	20 (23.3)	5 (5.8)	5 (5.8)	10 (11.6)	0 (0.0)	0 (0.0)	5 (5.8)
	NGO-employee	5 (45.5)	1 (9.1)	0 (0.0)	5 (45.5)	0 (0.0)	1 (9.1)	0 (0.0)	5 (45.5)	0 (0.0)
	Merchant/personal business	54 (38.6)	53 (37.9)	28 (20.0)	0 (0.0)	5 (3.6)	33 (23.6)	15 (10.7)	0 (0.0)	18 (12.9)
Religion	Orthodox	198 (46.4)	143 (33.5)	92 (21.5)	24 (5.6)	20 (4.7)	84 (19.7)	34 (8.0)	10 (2.3)	33 (7.7)
	Muslim	10 (33.3)	15 (50.0)	5 (16.7)	5 (16.7)	0 (0.0)	5 (16.7)	5 (16.7)	0 (0.0)	0 (0.0)
	Protestant	2 (18.2)	9 (81.8)	5 (45.5)	0 (0.0)	0 (0.0)	4 (36.4)	0 (0.0)	0 (0.0)	0 (0.0)
	Catholic	3 (37.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	5 (62.5)	0 (0.0)	5 (62.5)	0 (0.0)
Residency	Urban	170 (45.5)	137 (36.6)	83 (22.2)	20 (5.3)	15 (4.0)	78 (20.9)	25 (6.7)	5 (1.3)	28 (7.5)
	Rural	43 (42.2)	30 (29.4)	19 (18.6)	9 (8.8)	5 (4.9)	20 (19.6)	14 (13.7)	10 (9.8)	5 (4.9)
Monthly income	< 1000 ETB	103 (47.7)	60 (27.8)	15 (6.9)	10 (4.6)	10 (4.6)	43 (19.9)	30 (13.9)	9 (4.2)	19 (8.8)
	1000–2500 ETB	55 (40.7)	57 (42.2)	53 (39.3)	14 (10.4)	5 (3.7)	28 (20.7)	4 (3.0)	1 (0.7)	9 (6.7)
	> 2500 ETB	55 (44.0)	50 (40.0)	34 (27.2)	5 (4.0)	5 (4.0)	27 (21.6)	5 (4.0)	5 (4.0)	5 (4.0)
Breathing pattern	Mouth	79 (50.6)	49 (31.4)	19 (12.2)	10 (6.4)	5 (3.2)	29 (18.6)	25 (11.8)	5 (3.2)	18 (11.5)
	Nose	104 (49.1)	63 (29.7)	49 (23.1)	10 (4.7)	5 (2.4)	49 (23.1)	5 (2.4)	5 (2.4)	10 (4.7)

Abbreviation: ETB, Ethiopian Birr.

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Table 4 Prevalence of Different Malocclusion with the Possible Risk Factor for Children (12–18 Years)

Sociodemographic Characteristics		Class I with No Minor Discrepancy (n (%))	Class-I with Minor Discrepancy (n (%))	Lower Anterior Crowding (n (%))	Anterior Cross-Bite (n (%))	Posterior Cross-Bite (n (%))	Anterior Open Bite (n (%))	Class-2 Sub-1 (n (%))	Class-2 Sub-2 (n (%))	Angle Class-3 (n (%))
Maternal educational level	Illiterate	129 (39.7)	44 (81.5)	15 (27.8)	5 (9.3)	0 (0.0)	10 (18.5)	10 (18.5)	5 (9.3)	0 (0.0)
	5–8	10 (41.7)	20 (83.3)	9 (37.5)	0 (0.0)	0 (0.0)	15 (62.5)	0 (0.0)	0 (0.0)	0 (0.0)
	9–12	25 (52.1)	34 (70.8)	5 (10.4)	0 (0.0)	0 (0.0)	5 (10.4)	0 (0.0)	5 (10.4)	0 (0.0)
	College/ University	20 (80.0)	20 (80.0)	5 (20.0)	0 (0.0)	0 (0.0)	5 (20.0)	5 (20.0)	0 (0.0)	0 (0.0)
Exclusive breastfeeding	Yes	40 (67.8)	14 (23.7)	0 (0.0)	0 (0.0)	0 (0.0)	5 (8.5)	0 (0.0)	5 (8.5)	0 (0.0)
Bottle feeding	Yes	40 (74.1)	9 (16.7)	0 (0.0)	0 (0.0)	0 (0.0)	5 (9.3)	0 (0.0)	5 (9.3)	0 (0.0)
History of thump sucking	Yes	10 (41.7)	9 (37.5)	0 (0.0)	0 (0.0)	0 (0.0)	5 (20.8)	0 (0.0)	5 (20.8)	0 (0.0)

found 21.6% of the study participants had an anterior open bite. This value corresponds with previous studies done in Tanzania (16.1%),[25] and Kenya.[46]

Only 3.8% of the participants had a posterior cross-bite, this result is similar to a study done in Brazil, where 3.1% of the participants had functional posterior crossbite and 7% of the pacifier users had posterior cross-bite.[48] However, this result is low compared with a study done in Turkey (51.0%).[49] The difference might be due to racial and age differences between the studies.

The prevalence of class-II malocclusion was 10.9 of which, 8.4% had class -II subdivision 1, and 2.5% had class-II subdivision 2, which is relatively similar to the global prevalence in African populations (5.1%).[20] This result is high compared with a study done in Nigeria (1.7%)[45] and Tanzania (4.4%).[25] However, a study done in urban Libya showed 21.9% of the participants had class-II subdivision 1 malocclusion.[43]

The Global distribution of malocclusion traits found that class-III malocclusion was the least prevalent condition in the Africans, which supports the present study where only 8% of the participants had developed a class-III malocclusion.[20] Meanwhile, a systematic review done in Iran showed only 5.5% of the patients in Iran had a class-III relation.[39] However, a study done in Sudan found 58.7%[40] of the study participants had class-III malocclusion. This difference might be the study done in Sudan includes Down syndrome patients who are more prone to jaw development problems.

The present study found that urban residents were 1.64 times at risk of developing malocclusion than rural residents which corresponds with a study done in India where a higher prevalence of class-III malocclusion was reported among urban residents.[50] However, a systematic review and meta-analysis in china did not find a significant difference in malocclusion between the urban and rural residents (RR = 0.99, [0.82–1.20]).[37]

A correlational study done in India revealed that mouth breathing had a statistically significant effect on the occurrence of malocclusion ((AOR=0.013, 95% CI: −6.807, −0.787),[36] which supports the present study where mouth breathers were 2.50 times at risk of developing malocclusion. Moreover, a study done in Italy on preschool children found a statistically significant association between mouth breathing and malocclusion ($p < 0.05$).[51]

The present study noted that male participants were more likely to suffer from malocclusion, which is similar to a study done in India[52] where class-II and malocclusion were high in boys. Moreover, Tang and Wei also reported

Table 5 Binary Logistic Regression Model to Determine the Association Between the Independent Variables and Malocclusion

Variable		Malocclusion		AOR	P-value
		Yes (n)	No (n)		
Sex	Male Female	148 115	95 118	1.6 (1.11, 2.3) 1	0.011
Age	12–34 35–49 ≥50	202 31 30	149 35 29	1.75 (0.82, 2.99) 0.81 (0.27, 1.63) 1	0.218
Marital status	Single Married Divorced	131 117 15	89 120 4	0.85(0.33, 2.72) 1.56 (0.61, 4.70) 1	0.09
Residency	Urban Rural	204 59	170 43	1.6465 (1.0577, 2.5632) 1	0.026
Monthly income	≤2500 ETB > 2500 ETB	193 70	158 55	1.2728 (1.0192, 1.5895) 1	0.023
Breathing pattern	Mouth Nose	160 106	79 131	2.503 (1.7259, 3.63) 1	<0.0001

Abbreviation: ETB, Ethiopian Birr.

a high prevalence of class-II and III malocclusions than females.[34] Moreover, participants within low socioeconomic status were 1.27 times at risk of developing malocclusion, which is in line with previous studies.[53–55] However, a study done in Turkey did not find a statistically significant relationship between socio-economic status and malocclusion.[56]

Limitation and Strength of the Study

The present study has some limitations. The first limitation was that risk factor was not explored for each different type of malocclusion. Secondly, most of the parents did not recall their child's habit for 12–18 children. Moreover, the findings in this study did not represent the general prevalence of malocclusion in the country due to the small sample size.

This is the first study in the area and gives epidemiologic data of malocclusion in Northwest Ethiopia. In this study, random sampling was used to decrease bias. Moreover, the findings of this study are useful for public health planning and hypothesis creation for future studies.

Conclusion

A significant amount of the study participants had malocclusion. Male gender, urban resident, low monthly income, and mouth breathing habits were independent factors for a malocclusion. Therefore, early attention to the development of the dentition and occlusion, and necessary functional correction during childhood are important to reduce its prevalence and lifelong adverse effect. Moreover, publicly financed orthodontic treatment should be scheduled and supplied to individuals in desperate need of orthodontic care.

Abbreviations

CI, confidence interval; IRB, Institutional Review Board; OR, odds ratio; WHO, World Health Organization; SD, standard deviation; SPSS, Statistical Package for the Social Science.

Data Sharing Statement

All the data obtained were included in the main manuscript.

Ethical Approval and Consent to Participate

The study was approved by the Institutional Review Board of the University of Gondar and complied with the Declaration of Helsinki Ethical Principles for Medical Research. Written consent was taken after the study participants were briefed for the aim of the study and written informed consent was obtained from parents or legal guardians for 12–18 years old children.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they do not have competing interests.

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