Open Access Library Journal
2024, Volume 11, e11876
ISSN Online: 2333-9721
ISSN Print: 2333-9705

Prevalence of Orthodontic Malocclusions among Adolescents: A National Survey

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How to cite this paper: Lahcen, O., Hiba, K. and Ikrame, D. (2024) Prevalence of Orthodontic Malocclusions among Adolescents: A National Survey. *Open Access Library Journal*, **11**: e11876.
https://doi.org/10.4236/oalib.1111876

Received: June 27, 2024
Accepted: August 10, 2024
Published: August 13, 2024

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Abstract

The aim of our study is to determine the prevalence of orthodontic anomalies among high-school teenagers in Morocco and to establish possible associations between various malocclusions and the variables sex, age and socio-economic level. We studied the prevalence on a sample which was randomly selected and which included 7865 students from sixteen secondary schools in Morocco, of different socio-economic levels, including 4332 girls and 3533 boys. The results have shown that approximately 34.45% had normal occlusion and 65.55% had at least one malocclusion. In fact, 32.47% of the examined pupils had class 2 malocclusions (division 1: 24.35%; division 2: 8.12%) and 10.33% had class 3 malocclusions. 56.36% of the sample had a normal overbite, 30.51% an overbite ≥ 3 mm while only 13.12% had an overbite ≤ 2 mm. Dental crowding was the most frequent with a percentage of 57.22%, whereas, the results regarding the midline diastemas showed that 12.84% of the subjects had diastemas. The values of anterior and posterior crossbites were respectively 14.93% and 9.22%. Therefore, Moroccan adolescents have a high need in terms of orthodontic care.

Subject Areas

Dentistry

Keywords

Malocclusions, Prevalence, Adolescents

1. Introduction

Malocclusion is defined as an abnormality of the teeth or inter-arch relationships that are not correct compared to normal. It results in abnormal tooth

growth, which considerably disrupts the muscular function of the jaws. Although malocclusion is not very serious, it is considered a public health problem. It can adversely affect the individual through psychosocial problems linked to altered dentofacial aesthetics, as well as disrupted oral functions such as chewing, swallowing, phonation, occlusal trauma and periodontal disease. [1]

We distinguish skeletal anomalies which concern the bone bases and are generally linked to the growth mechanism, alveolar anomalies which develop during the phenomenon of teething or secondary to a functional disorder, and dental anomalies which can concern number, shape, volume, eruption, situation or position.

Orthodontic anomalies can be expressed in the three reference planes: vertical median sagittal plane, frontal plane perpendicular to the first, and horizontal plane perpendicular to the sagittal plane. [2]

The epidemiology of malocclusion and the assessment of orthodontic treatment needs are of national importance in many countries and have therefore been included in many national-level surveys. Few studies have focused on the age group between 14 - 20 years old.

Our investigation is part of a research policy of the dentofacial orthopedics service of the dental consultation and treatment center (CCTD) in Casablanca, it is a national epidemiological study on orthodontic malocclusions among high school students in the Kingdom.

Professor Ousehal's team has already carried out similar work in the cities of Casablanca, Agadir, Marrakech, El Jadida, Beni Mellal, Kenitra and Tangier.

This work aims to:

- Determine the prevalence of orthodontic anomalies in a population of high school students in Morocco.
- Draw up possible associations between the different malocclusions and entirely random variables, by their nature and distribution (age, sex and socio-economic level).
- Compare the results to those of other similar studies.

2. Materials and Methods

This is a nationwide study combining cross-sectional descriptive surveys already carried out in the following cities: Kenitra, El Jadida, Casablanca, Beni Mellal, Tangier, Agadir and Marrakech.

The data was collected between September 2021 and November 2022.

Our sample is made up of sixteen public high schools drawn at random from the global list of public high schools in Morocco distributed according to decentralized territorial organization. Three high schools in Kenitra: Lycée Mohammed 5, Lycée Elmassira and Lycée Ibn Sina, two from El Jadida: Lycée Abou Chouaib Doukkali and Lycée Ibn Khaldoun, two from Casablanca: Lycée Ibn Chohaid and Lycée Prince Moulay Abdellah, one from Beni Mellal: Lycée Hassan II, three from Tangiers: Lycée Mohamed Ben Abdelkrim Khattabi, Lycée

Zainab Nafzaouiya and Lycée Ibn zohr, two high schools in Agadir: Lycée Anoual and Lycée Youssef Ben Tachfine and three high schools in Marrakech: Lycée Hassan II, Lycée El Koutoubia and Lycée Kadi Ayad in Marrakech.

All students who benefited, or who had benefited from subsequent orthodontic treatment, those who refused to participate in the study as well as those who were absent during the survey period were excluded from this study. Verbal consent was obtained from the students.

Thus, our final sample is composed of 7865 students.

2.1. Questionnaire

A three-part questionnaire was drawn up to collect the data required for the survey.

First part: was devoted to the identification of each student examined.

Second part: was reserved for the collection of socio-demographic information, namely, age and sex, occupation of both parents, place and type of dwelling and socio-economic level.

Third part: focused on occlusal relationships in the three senses of space.

2.2. Variables Studied: (Table 1)

Socio-demographic variables:

Age: a quantitative variable indicated in the number of completed years.

Gender: a qualitative variable used to distinguish men from women. We have mentioned the female sex by the letter F and the male sex by the letter M.

The socio-economic level: a qualitative variable expressing according to a scale (1-low, 2-medium, 3-high) the socio-economic level of the student.

Clinical variables:

Sagittal occlusion: Class 1, Class 2 (Class 2 division 1 and Class 2 division 2) and Class 3.

Table 1. Variables studied and study methods.

Variable	Method of study
Sagittal occlusion	Based on Angle's classification.
Overbite	A value of 2 mm is considered normal. >2 mm is considered increased, less than 2 mm is considered decreased.
Crowding	Misalignment or incorrect relation between the teeth.
Median Diastema	A space greater than 1 mm between the upper central incisors.
Crossbite	When maxillary teeth are in palatal position relative to the mandibular teeth.
Socio-economic level	Based on parents' occupation, type and location of residence.
Sex	Female gender is mentioned by the letter F and the male by the letter M.
Age	Two age groups have been identified, <18 y/>18 y

Vertical occlusion: A value of 2 mm is considered normal, overbite and open bite.

Anterior crossbite or ACA and posterior crossbite or ACP.

Dental crowding and median diastema.

2.3. Survey Conduct

The surveys were conducted by two experimented practitioners who collected socio-economic and clinical data from the participants. Epidemiological data were obtained through a two-stage process. Initially, a questionnaire was administered to gather information on the age and socio-economic status of the respondents. Subsequently, an oral examination was performed to diagnose the type of dental occlusion in each patient.

The oral examinations were conducted with patients seated on a chair, using disposable gloves and a tongue depressor under natural daylight. Patients were instructed to open their mouths for a thorough intraoral examination, followed by clenching their teeth to assess occlusion based on Angle's classification criteria. The examination focused on the occlusion of the canines and molars to determine the anteroposterior diagnosis of malocclusion. Full retraction of the cheeks was performed to obtain a clear lateral view of Class I, Class II (divisions 1 and 2), and Class III occlusions.

All collected data were systematically recorded on a dedicated epidemiological sheet. At the conclusion of the consultation, each patient received their clinical diagnosis and information regarding their occlusal issues. Patients were also provided with therapeutic advice, motivation for oral hygiene, and preventive measures against dental caries. Additionally, they were informed about the risks and dangers associated with unqualified dental treatments, particularly in orthodontics.

Following the compilation of survey results, the prevalence of orthodontic malocclusions among adolescents was calculated on a national scale.

2.4. Statistical Analysis

Statistical analysis was carried out using Epi Info statistical software version 7.0 to assess the prevalence of malocclusions by age and sex.

Frequency measures were calculated to estimate possible relationships between malocclusion and age, gender, and socioeconomic status.

The Pearson or Chi^2 test was used to evaluate the statistical significance between the variables.

A significance threshold was set at a value of $p < 0.05$.

3. Results

Our overall sample of 11 high schools included 7865 students, 55.08% of whom were female. 75.46% of students belonged to the age group ≤ 18 years old compared to 24.54% who were part of the age group > 18 years old. (**Table 2**)

Regarding the distribution of the sample according to socio-economic level, 23.75% of female students belong to the low level, 26.4% to the medium level and 4.9% belong to the high level while 19.6% of male students belong to the low level, 22% to the medium level and 3.32% belong to the high level. (Table 3)

However, 34.45% of the students had a normal occlusion, 19.68% of whom were female, while 65.55% had malocclusion, 35.05% of whom were also female. It would seem that there is no significant association between malocclusions and gender (P = 0.785). (Table 4)

Table 2. Distribution of the total sample by age group according to gender.

Age (Years)	F		M		Total	
	Number	%	Number	%	Number	%
−18 ans	3446	43.81	2489	31.65	5935	75.46
+18 ans	886	11.27	1044	13.27	1930	24.54
Total	4332	55.08	3533	44.92	7865	100

Table 3. Distribution of the sample according to socio-economic level by sex and age.

		Socio-economic level						
		Low		Medium		High		Total
		Number	%	Number	%	Number	%	Number
Sex	F	1868	23.75	2076	26.4	387	4.9	4331
	M	1542	19.6	1731	22	261	3.32	3534
	Total	3410	43.35	3807	48.4	648	8.22	7865

Table 4. Sample distribution by occlusion and gender.

	État occlusal				
	Normal occlusion		Malocclusion		Number
	N	(%)	N	(%)	
F	1548	19.68	2757	35.05	4305
M	1162	14.77	2398	30.5	3560
Total	2710	34.45	5155	65.55	7865
	$X^2 = 3.644$. P = 0.785 (NS)				

For the distribution of sagittal malocclusions, 57.2% of students had a class I of which 31.6% are female, 24.35% a class 2 division 1 of which 12.59% are female, 8.12% a class 2 division 2 of which 4.27% are female and 10.33% had a class 3 of which 5.2% are female. The statistical correlation between sagittal malocclusions and the sex variable is not significant (P = 0.235). (Table 5)

Concerning vertical malocclusions, 56.36% of students had a normal overbite, 24.59% of whom were male, 30.51% had an increased overbite, 14.35% of whom

were male, and 13.12% had a reduced overbite, 5.99% of whom were male. The correlation between vertical malocclusions and the gender variable is not significant (P = 0.342). (Table 6)

In terms of dental crowding, 57.22% of students, including 30.72% of females, had a dental crowding. While 12.84% had a median diastema of which 6.65% were female. It would appear that there is no significant association between the median diastema variable and the gender variable (P = 0.212), nor between the crowding variable and the gender variable (P = 0.241). (Table 7)

Table 5. prevalence of sagittal malocclusions by gender.

	F		M		Total	
	Number	%	Number	%	Number	%
Classe 1	2485	31.6	2013	25.59	4498	57.2
Classe 2 div 1	990	12.59	722	9.18	1915	24.35
Classe 2 div 2	336	4.27	303	3.85	639	8.12
Classe 3	409	5.2	404	5.13	813	10.33
$X^2 = 3.634$. P = 0.235 (NS)						

Table 6. Prevalence of vertical malocclusions according to sex.

	F		M		Total	
	Number	%	Number	%	Number	%
Normal	2499	31.77	1934	24.59	4433	56.36
Increased	1271	16.16	1129	14.35	2400	30.51
Reduced	561	7.13	471	5.99	1032	13.12
$X^2 = 5.933$. P = 0.342 (NS)						

Table 7. Prevalence of dental crowding and median diastema according to sex.

	F		M		Total	
	Number	%	Number	%	Number	%
Crowding (+)	2416	30.72	2084	26.5	4500	57.22
Crowding (−)	1927	24.5	1438	18.28	3365	42.78
$X^2 = 3.587$. P = 0.241 (NS)						
Diastema (+)	523	6.65	487	6.19	1010	12.84
Diastema (−)	3808	48.42	3047	38.74	6855	87.16
$X^2 = 3.467$. P = 0.212 (NS)						

14.93% of students had an anterior crossbite with 7.74% being female and 7.18% being male. As for the posterior crossbite, it was found in 9.22% with a female predominance with a percentage of 5.31%. The statistical correlation be-

tween the variables anterior crossbite and sex (P = 0.169) and between posterior crossbite and sex (P = 0.478) is not significant. (Table 8)

Table 8. Prevalence of anterior and posterior crossbites by gender.

	F		M		Total	
	Number	%	Number	%	Number	%
ACA (+)	609	7.74	565	7.18	1174	14.93
ACA (−)	3695	46.98	2881	36.63	6691	85.07
$X^2 = 4.236$. P = 0.169 (NS)						
ACP (+)	418	5.31	307	3.9	725	9.22
ACP (−)	3913	49.75	3260	41.45	7173	91.2
$X^2 = 2.456$. P = 0.478 (NS)						

4. Discussion

Our work is a national cross-sectional descriptive epidemiological survey whose objective was to calculate the prevalence of malocclusions in a population from several regions of the kingdom, none of whom had received orthodontic or interceptive treatment or corrective measures.

Our sample is composed of 7865 students, including 4332 girls and 3533 boys.

This is a large sample size; the results can therefore be extrapolated.

Based on our results, the kingdom is characterized by an average rate of malocclusions reaching 65.55%. Among sagittal malocclusions, class 1 was the most frequent among students with a rate of 57.2%. 56.36% of students examined had a normal overbite, while 57.22% had dental crowding.

Other anomalies were less commun in our sample such as median diastema (12.84% of students), anterior crossbite (14.93% of students) and posterior crossbite (9.22% of students).

Regarding malocclusion, our results do not agree with those of the study carried out by Nesreen A. Salim [3] on a population of Syrian refugee children and adolescents where she noted a malocclusion rate of 83.8%.

Fundagul Bilgic [4] also found a rate of malocclusion reaching 89.9% in the Turkish population.

In Saudi Arabia, Jaddah, the prevalence of malocclusion among students aged 14 to 18 years old was 88% [5]. Also, in China, Shanghai, the prevalence was 83.5% among adolescents aged 11 - 15 years. [6]

However, a study carried out in 2016 in Chili on a population of adolescents aged between 14 and 18 years old showed a malocclusion rate similar to ours (64%) [7].

Other authors have found a lower prevalence, including Lombardo's study. G and AL [8] which revealed a global prevalence of malocclusion of 56%, the highest prevalence was in Africa (81%) and Europe (72%), followed by America

(53%) and Asia (48%). In Karachi, Pakistan, the overall prevalence of malocclusion in adolescents was 57.4%. [9]

In Iran, the prevalence of malocclusion among students aged 14 to 18 was only 23.70% [10].

Regarding the sagittal malocclusions, class 1 was the most frequent; followed by class 2 and then class 3 in all the regions studied. With the respective prevalence of (57.2%, 32.47% (division 1: 24.35%; division 2: 8.12%), 10.33%)

The study by Lombardo. G and AL [8] revealed that the worldwide prevalence of sagittal malocclusions affecting the permanent dentition was: class 1: 55.5%, class 2: 24.7% and class 3: 10.7 %.

A similar prevalence was reported in the study of L. De Ridder [11] in children and adolescents which showed values of class 1: 51.9%, class 2: 23.8% and class 3: 6.5%. The study by Nesreen A. Salim [3] among Syrian refugee children and adolescents showed a rate of class 1: 52.6%, class 2: 24.2% and class 3: 7%. Ravi Kumar Gudipaneni's study [12] carried out on a sample of Saudis revealed that 52.80% of cases are in class 1; 31.80% in class 2 and 15.40% of cases in class 3.

Concerning the study achieved in Karachi, Pakistan, the highest prevalence of malocclusion was class 1 malocclusion (43.0%), followed by class 2 (10.8%) and class 3 (1.4%) [9].

However, the study by Karla Alvarado in Puerto Rico [13], carried out on a population aged 13 to 18 years, does not share the same results as ours, with a prevalence of class 3 increased compared to that of class 2 (73% of cases in class 1; 7.10% in class 2 and 19.40% in class 3).

On the other hand, in the Pakistani population, class 2 dominated sagittal malocclusions with a percentage of 58.80%, while class 1 represented only 29% [14].

Regarding the vertical anomalies, our investigation showed that 56.36% of the students examined had a normal overbite, 30.51% had an increased overbite and 13.12% had a reduced overbite.

The study by Lombardo. G and AL. [8] noted that the global prevalence of vertical malocclusions affecting the permanent dentition was: normal overbite: 49%, an increased overbite: 21% and a reduced overbite: 6%.

Similar results were also found in the study by Nesreen A. Salim [3] among Syrian refugee children and adolescents who showed that 33.3% of the sample presented a normal overbite, 31.2% an increased overbite and 29.5 % a reduced overbite,

In Saudi Arabia; the study by Yahya A. Alogaibi [5] showed that 61.5% had a normal overbite, 28.5% an increased overbite and 10% a reduced overbite.

In the study of Dhafer.A and AL in Najran City, Saudi Arabia, 14.7% had a reduced overbite and 21.22% had an increased overbite.[15]

Furthermore, increased overbite was observed in 13.2% of the sample, while 5.4% had reduced overbite in a study among adolescents in Karachi, Pakistan [9].

Regarding dental crowding, our survey recorded 57.22% of students having dental crowding. With a higher percentage of 69.26% in Casablanca.

Comparable values were reported in the study by Nesreen A. Salim [3] in Syrian refugee children and adolescents who reported a dental crowding in the maxilla of 56.6% and 61.84% in the mandible as well as that of Yahya A. Alogaibi *et al.* [5] who showed that 46% had crowding in the maxilla and 52% in the mandible.

On the other hand, Lombardo G. and AL. [8] noted that the global prevalence of dental crowding affecting the permanent dentition was only 39%. As well as Ferro R and AL. [16] in Italy showed that 30% of the cases examined presented dental crowding.

Another study achieved in, Shanghai, China revealed a prevalence of 44.8% of anterior crowding [6].

In Najram, Saudi Arabia dental crowding was observed in 34.69% of the samples. [15] while it was detected only in 2% of the sample in Karachi, Pakistan [9].

In our survey, only 12.84% of students had a median diastema.

Nesreen A. Salim's [3] study of Syrian refugee children and adolescents noted that 28.7% had a midline diastema in the maxilla and 18.5% in the mandible.

In Brazil, the prevalence of midline diastema was 19.50% [17] and 27.2% in Saudi Arabia. [12]

In Karachi, only 6% of the sample examined presented a diastema. [9]

It appears from our study that 14.93% of adolescents had an anterior crossbite, and 9.22% had a posterior crossbite.

Lutgart De Ridder's study [11] on children and adolescents showed that 7.8% had an anterior crossbite and 9% had a posterior crossbite.

In Saudi, the study by Yahya A. Alogaibi *et al.* [5] showed that 6% have an anterior crossbite and 25% have a posterior crossbite, while the study of Ravi Kumar [12] noted that only 4.8% of the sample had an anterior crossbite while 9.4% had a posterior crossbite.

In Shanghai, Jiaming Yin found that 10,1% of adolescents aged 11 - 15 years had an anterior crossbite and 5.7% had a posterior crossbite[6].

In Rabia.T's study in Pakistan, 2.6% of the sample had a posterior crossbite, while 3% had an anterior crossbite [9].

5. Conclusions

At the end of the present study, the prevalence of malocclusions in our population is quite high on a national scale, namely that 65.55% of adolescents have at least one malocclusion.

Dental crowding is the most common (57.2%), as well as class II which represents 32.47% and incisive overbite (30.51%).

The need for treatment therefore remains high on a national scale, but access to orthodontic treatment remains, in our opinion, still difficult, especially for populations with low or medium economic levels.

Raising awareness among young people about the importance of preventing their oral health and treating malocclusions is essential to improving oral health.

Dental health professionals must work together to provide quality orthodontic care and prevent malocclusion in young people.

Continued efforts are needed to improve the oral health of adolescents and reduce the prevalence of orthodontic malocclusions.

Conflicts of Interest

The authors declare no conflicts of interest.

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