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Occlusal traits of Primary School Children and early Orthodontic intervention

Prevalence and Factors Associated with Crossbites and Openbites

Soft Skills in Orthodontics

Orthodontic Treatment of Severe Anterior Crowding and Crossbite

Anterior Open Bite correction using Passive Self Ligating System: A Case Report

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# Prevalence and Factors Associated with Crossbites and Openbites in Primary School Children in the Ouagadougou City.

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## Abstract

*Background:* To determine the prevalence and factors associated with crossbite and dental open-bite among primary school students in Ouagadougou, Burkina Faso.

*Methods:* A cross-sectional descriptive and analytical study conducted in Ouagadougou schools. A questionnaire sent to the students' parents had provided information on the presence or not of non-nutritive sucking habits. For each student, the following data was collected: age, sex, type of dentition, molar Angle class, presence of a deviation of the incisor medline, openbite, crossbite,mouth breathing, atypical swallowing, non-nutritive sucking habit, and an orthodontic treatment history.

*Results:* This study examined 950 primary school students, including 51.6% girls and 48.4% boys. Students' with a mean age of 9.48 years ± 1.65 years. The posterior openbite was observed in 1% of the study population, the anterior openbite in 7.5%; the anterior crossbite in 3.7% and the posterior crossbite in 10.6% of the students. Anterior openbite and posterior crossbite were statistically associated with non-nutritive sucking habits and mouth breathing.

*Conclusion:* Anterior open bite and posterior crossbites were the most prevalent of the malocclusion pattern studied. A strong association was observed between the aforementioned and the practice of non-nutritive habits and mouth breathing. Early intervention of these habits is suggested to reduce the development of malocclusion. Dental open bites and crossbites affect some school students. Associated factors such as non-nutritive sucking habits, mouth breathing, and atypical swallowing should be timely managed to reduce the risk of dental malocclusions.

*Keywords:* prevalence, openbite, crossbite, associated factors, Burkina Faso.

ORIGINAL ARTICLE

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## Introduction

Facial dysmorphism and dental malocclusions are due to hereditary and / or local factors.[1,2,3] Local factors, such as oral habits, essentially depend on the neuromuscular situation.[4] Therapeutic intervention is particularly effective against local factors, when this is practiced timely as preventive or interceptive therapies. This therapeutic approach, in case of openbite and crossbite, changes the function and shape by acting on the three dimensions of the space and by utilizing the residual growth[4].

Anterior openbite remains a common malocclusion with prevalence ranging from 3 to 41% in primary dentition, from 1 to 15% in mixed dentition and from 2 to 5% in permanent dentition[1]. Crossbite is also due to a common aetiology with prevalence estimated to be between 8 and 25% in primary dentition.[5] Both malocclusions are often associated and seem to have common risk factors.[5,6,7,8]

On the one hand, these abnormalities are very progressive with an adverse aesthetic, psychological, and functional impact.[2] On the other hand, they can be difficult and very expensive to treat in adulthood. Considering the difficulty of accessing orthodontic treatment,[9,10] prevention and interception are becoming the preferred therapeutic means.

Therefore, the knowledge of the aetiological factors of openbites and crossbites is essential for the prevention, success, and stability of orthodontic treatment.[11,12]

This study aimed to describe the prevalence and factors associated with crossbites and dental open-bite in primary school students in the Ouagadougou City, Burkina Faso.

## Materials and Methods

This was a descriptive and analytical cross-sectional study conducted in schools, in the Ouagadougou City, Burkina Faso.

## Study Population and Sampling

Our study population included all the primary school students in Ouagadougou City i.e. 213,552 children. The city has 1,310 primary schools distributed in 19 Primary Education Constituencies.

We conducted a two-level sampling method. In the first level, we conducted a cluster survey, selecting one primary school per Primary Education Constituency. In a second step, a simple random survey was made based on the alphabetical list of students in each of the previously selected schools, while complying with a sampling fraction of 3. If a student refused to participate in the study, the next one on the list was selected.

Schwartz formula[13] was used to determine the sample size. From this formula, a minimum size of 384 pupils was established. Taking the cluster effect into account, the sample size was raised to 770 students. We estimated the probable losses of the self-administered questionnaires at most 30%, resulting in an enrollment of 1001 students for the survey.

Included in this study were primary school students from Ouagadougou City, aged between 7 and 12 years, who agreed to participate and whose parents signed an agreement in this respect.

Primary school students with a history of treatment or under current orthodontic treatment were excluded.

## Data Collection

Data was collected through two steps:

The first part targeted parents and included an informed consent form to request the child's participation in the study and a questionnaire to collect information on the presence or not of non-nutritive biting or sucking habits, involving fingers, nails, tongue, cheeks, lips or objects (clothes, pens, etc.) among the 1001 selected students.

The second part consisted of the clinical examination of the students by an orthodontist assisted by a final year dental student who filled out the sheets. These sheets were modeled on the method of recording occlusal anomalies developed by the World Health Organization and the International Dental Federation.[14] An interview was conducted followed by an oral examination. In addition, the socio-demographic and clinical characteristics of each child: age, sex, type of dentition (mixed or permanent), molar angle Class (class I, class II or class III) were recorded. Also the presence of midline discrepancies, of a dental openbite, of a crossbite, or the existence of mouth breathing, atypical swallowing (lingual interposition between the dental arches) or a non-nutritive sucking habit were reported.

## Data Analysis

Data was manually counted. EPI INFO version 7.1.3.3 was used to enter data. The statistical analysis was performed with Stata version 15. The error margin was 5% and the confidence interval was 95%. The Pearson Chi square test was used to check the association between variables and an association was considered statistically significant when $p \leq 0.05$. The odds ratio enabled us to see the level of dependence between variables. The study was authorized under N ° 2018/157 MENA / RCEN / DREPPNF. Confidentiality requirements were met throughout the study and the results are presented in tabular and textual form.

## Results

Excluded from the study were 34 students whose consent forms were not returned, 7 students with partially completed forms and 9 who declined participation in the study. A total of 950 primary school students were included in the final sample. The sample comprised 51.6% girls (490 girls) and 48.4% boys (460 boys). The students' mean age was 9.48 years with a standard deviation of 1.65 years.

Most of the students (see Table 1) had mixed dentition (80.5%) with molar Angle class I (92%). Anterior open bite (Table 2) was noticed in almost the same ratio in both genders. Among the 71 students with anterior open bite, most were in mixed dentition (90.1%). Many reported the use of pacifiers (80.5%). We also noticed (Table 2) that more than half of the patients with anterior open bite also had atypical swallowing (57.8%). The posterior crossbite, which was observed in 10.6% of the study population (Table 3), was more prevalent in mixed dentition (80.2%).

**Table 1: Students' Clinical Characteristics n=950**

| Characteristic | Pattern | Number | Rate (%) |
|---|---|---|---|
| Teeth | Mixed | 765 | (80.5) |
| | Permanent | 185 | (19.5) |
| Molar Angle class | I | 864 | (92.0) |
| | II | 34 | (03.6) |
| | III | 41 | (04.4) |
| Anterior openbite | Yes | 71 | (7.5) |
| | No | 879 | (92.5) |
| Lateral openbite | Yes | 10 | (1.0) |
| | No | 940 | (99.0) |
| Anterior crossbite | Yes | 34 | (3.6) |
| | No | 916 | (96.4) |
| Posterior crossbite | Yes | 101 | (10.6) |
| | No | 849 | (84.4) |
| Incisor median deviation | Yes | 262 | (27.6) |
| | No | 688 | (72.4) |
| Sucking habit | Yes | 111 | (11.7) |
| | No | 839 | (88.3) |
| Mouth breathing | Yes | 51 | (05.4) |
| | No | 899 | (94.6) |
| A typical swallowing | Yes | 66 | (07.0) |
| | No | 884 | (93.0) |

**1. Rate of the anterior openbite**

**Table 2: Distribution of students with anterior bite n=71**

| Variable | Patterns | Number | Rate |
|---|---|---|---|
| Gender | Boy | 36 | (50.7) |
| | Girl | 35 | (49.3) |
| Teeth | Mixed | 63 | (90.1) |
| | Permanent | 7 | (9.8) |
| Molar Angle class | Class I | 67 | (94.4) |
| | Class II | 1 | (1.4) |
| | Class III | 3 | (4.2) |
| Incisor median deviation | No | 62 | (87.3) |
| | Yes | 9 | (12.7) |
| Posterior crossbite | No | 61 | (85.9) |
| | Yes | 10 | (14.0) |
| Pacifier sucking | No | 61 | (85.9) |
| | Yes | 10 | (14.1) |
| Finger sucking | No | 36 | (50.7) |
| | Yes | 35 | (49.3) |
| Tongue sucking | No | 53 | (74.6) |
| | Yes | 18 | (25.4) |
| Cheek/lip sucking | No | 50 | (70.4) |
| | Yes | 21 | (29.6) |
| Sucking of other things (pen/clothes) | No | 65 | (91.1) |
| | Yes | 6 | (8.5) |
| Mouth breathing | No | 57 | (80.3) |
| | Yes | 14 | (19.7) |
| Atypical swallowing | No | 30 | (42.2) |
| | Yes | 41 | (57.8) |

**2. Rate of posterior crossbite**

**Table 3: Distribution of students with posterior crossbite n=101**

| Variable | Patterns | Number | Rate |
|---|---|---|---|
| Gender | Boy | 55 | (54.5) |
| | Girl | 45 | (45.5) |
| Teeth | Mixed | 81 | (80.2) |
| | Permanent | 20 | (19.8) |
| Molar Angle class | Class I | 88 | (87.1) |
| | Class III | 11 | (10.9) |

| | | | |
|---|---|---|---|
| Incisor medial deviation | No | 90 | (89.1) |
| | Yes | 11 | (10.9) |
| Pacifier sucking | No | 80 | (79.2) |
| | Yes | 21 | (20.8) |
| Finger sucking | No | 83 | (82) |
| | Yes | 18 | (17.8) |
| Tongue sucking | No | 92 | (91.1) |
| | Yes | 9 | (8.9) |
| Cheek/ lip sucking | No | 79 | (72.2) |
| | Yes | 22 | (21.8) |
| Sucking of other things (pen/clothes) | No | 90 | (89.1) |
| | Yes | 11 | (10.9) |
| Mouth breathing | No | 67 | (66.3) |
| | Yes | 34 | (33.7) |
| Atypical swallowing | No | 90 | (89.1) |
| | Yes | 11 | (10.9) |

## 3. Factors associated with anterior open bite

**Table 4: Factors associated with anterior bite (n=950)**

| Variables | Patterns | OR | IC at 95% | P-value |
|---|---|---|---|---|
| Gender | Boy (Ref.) | 1 | | |
| | Girl | 0.96 | 0.59-1.56 | 0.87 |
| SNN habit | No (Ref.) | 1 | | |
| | Yes | 62.20 | 32.59-118.70 | 0.00 |
| Mouth breathing | No (Ref.) | 1 | | |
| | Yes | 5.58 | 2.85-10.93 | 0.00 |
| Atypical swallowing | No (Ref.) | 1 | | |
| | Yes | 46.68 | 25.20-86.46 | 0.00 |
| OCP | No (Ref.) | 1 | | |
| | Yes | 1.41 | 0.70-2.86 | 0.32 |

**4. Factors associated with posterior cross bite occlusion**

**Table 5: Factors associated with posterior cross bite occlusion (n=950)**

| Variables | Patterns | OR | IC at 95% | P-value |
|---|---|---|---|---|
| Gender | Boy (Ref) | 1 | | |
| | Girl | 0.76 | 0.50-1.15 | 0.20 |
| SNN habit | No (Ref) | 1 | | |
| | Yes | 8.51 | 5.34-13.56 | 0.00 |
| Mouth breathing | No (Ref) | 1 | | |
| | Yes | 24.83 | 13.18-46.78 | 0.00 |
| Atypical swallowing | No (Ref) | 1 | | |
| | Yes | 1.76 | 0.89-3.49 | 0.10 |

A statistically significant association was observed between anterior open bite and non-nutritive sucking habits, mouth breathing, and atypical swallowing (Tables 4). Primary school pupils with mouth breathing were 5 times more likely to have an anterior open bite compared to those who did not. Primary school pupils who had a non-nutritive sucking habit were 62 times more likely to have anterior open bite than those who did not. Regarding atypical swallowing, the risk was 47 times high.

Posterior crossbite was statistically associated with non-nutritive sucking patterns and mouth breathing (Table 5). Primary school pupils who had mouth breathing were 25 times more likely to develop a posterior crossbite than those who did not. Those who had non-nutritive sucking habits were 8 times more likely to develop posterior crossbite compared to those who did not.

## Discussion

Some transient dental malocclusions disappear in children when changing from primary to mixed dentition, sometimes without treatment. By choosing the age group of 7 to 12 years, we intended to avoid the abnormalities of occlusion in infancy which are transient. Anterior crossbites (3.7%) and lateral openbites (1%) were uncommon in our study; a larger sample size could have enabled a significant number of cases to determine their associated factors.

In school-age children, nasal ventilation is often disrupted by allergic rhinitis resulting in emergency oral ventilation. In addition, there are dysfunctions during chewing, swallowing or phonation which cause dental joint disorders.[4,15]

Our study observed a higher prevalence of anterior open bite compared to Utomi et al,[10] who reported a prevalence of 6.7% after examination of 150 patients attending the Lagos University Teaching Hospital.

The prevalence of posterior crossbite would vary between 8 and 23% in both deciduous and mixed dentition in Caucasian children.[5] The low prevalence among African children may be explained by the fact that they are often breastfed for at least the first year of life. The prevalence of open bite decreases with age. Contrary to openbite, cross posterior occlusion tends to persist until permanent dentition once it sets.[5]

Gender was not significantly associated with open bite and posterior crossbite in our study. We found that boys had more non-nutritive sucking habits than girls. Some studies have shown that while malocclusions tend to increase in girls, from primary dentition to mixed dentition, it however tends to decrease in boys.[16] Girls would be more likely to have non-nutritive sucking habits than boys.

There is evidence of a direct link between non-nutritive sucking habits and malocclusions. In Senegal, Ngom et al[17] found a similar prevalence for

digit sucking of 16.50% in children aged 5-6 year-old. In Nigeria, a survey on the need for interceptive orthodontic treatments among 563 children aged 3 to 5 years by Onyeaso, et al[18]. reported a 12.5% prevalence rate of digitsucking. Warren et al.[19] found that 55% of children with a non-nutritive sucking habit had malocclusions in mixed dentition. Similarly, Lupi-Pégurier et al.[20] found that maxillary deformations occurred in 50% of children aged 6 to 12 years without sucking habits, against 78% with non-nutritive sucking habits.

Association between non-nutritive sucking habits and malocclusions have been reported. Indeed, during finger sucking, the jugular muscles and the sucked finger exert a force against the maxillary dentoalveolar structures which can cause a constriction of the maxillary arch in the transversal case. This causes a stretch in the sagittal position and interferes with the dental eruption in the vertical direction.[21] Thus, Al-Dawoody et al.[22] show that a child with a non-nutritive sucking habit is ten times more likely to develop an anterior openbite than a child without it. Yemitan et al.[23] added that finger sucking would be less responsible for posterior crossbite compared to pacifier sucking. This is because there is no impact on the mandibular inter-canine and inter-molar distances, contrary to maxillary widths. As for Bueno et al.[12], they found that children who had sucked their fingers for more than three years were 5 times more likely to develop posterior crossbite and 33 times more likely to have an openbite.

Oral breathing was significantly associated with anterior open bite and posterior crossbite in our study. A mouth breather is 3.86 times more likely to develop an anterior openbite and 5.67 times more to develop a posterior crossbite. Talmant[15] shows that breathing and the inherent behavior of soft tissues impact on craniofacial morphogenesis. Oral breathing can cause a high and narrow palate, posterior crossbite, labial weakness due to poor labial muscle development, and incisor protrusion.

Atypical swallowing was significantly associated with anterior openbite. Germa et al.[24] observed that atypical swallowing was more frequent in children with posterior crossbite than in others. This swallowing is very often associated with oral ventilation. It seems to be mostly due to the anterior openbite and less responsible for the anterior reverse occlusion. Considering all these various potential links, malocclusions occur due to all these lingual and labial behaviours at rest, as well as during their functions or dysfunctions.[25]

## Conclusion

This study has investigated the prevalence and factors associated with open bite and dental crossbite in children aged 7 to 12 years in Ouagadougou City. Anterior openbite was present in 7.5% of the children while posterior crossbite was found in 10.6%. Anterior crossbite and posterior open bite were less frequent, 3.7% and 1%, respectively. Non-nutritive sucking and mouth breathing were significantly associated with posterior crossbite. Anterior open bite was statistically associated with mouth breathing, non-nutritive sucking habits, and atypical swallowing. Non-nutritive sucking habits, atypical swallowing, and mouth breathing should be stopped at the early stage, ideally before transitioning to permanent dentition, to reduce the prevalence of malocclusions such as open bites and crossbites.

## Authors' Contributions

Ouédraogo Y[1], Sana AG[1], Garé JV[1], Beugré-Kouassi AML[2], Sonan K[2], Konsem T[1], Beugré JB[2].

contributed to conceptualization, study design, literature search, data collection, statistical analysis and manuscript preparation and manuscript review.
All authors approved the final copy of the manuscript

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## Conflict of Interest

None declared

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