



## ORIGINAL ARTICLE

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## Occlusal and cephalometric characteristics of anterior open-bite among Colombian 5-10 years old school children.

**Abstract:** Objective. The aim of this study was to determine occlusal and skeletal characteristics of anterior open bite (AOB) according to sex and socioeconomic status (SES) in school children in the municipality of Pasto, Colombia. Methodology. A cross-sectional study was carried out involving 384 children between 5 and 10 years of age. A clinical assessment was performed to evaluate AOB, and information regarding socio-demographic variables, such as sex and SES according to Colombian standards, was obtained. Standardized lateral cephalograms and cast models were taken from participating subjects. A statistical analysis was performed using frequencies, percentages, t-student, ANOVA, Mann-Whitney and Kruskal-Wallis tests. Results. Prevalence of AOB was 8.1%, showing a significant difference according to SES. The most common Angle's classification was Class II with 70.6% in the right molars, and 58.8% in the left molars, according to occlusal characteristics. Statistically significant differences were observed in the ratio of posterior and anterior facial height (PFH:AFH) ( $p=0.050$ ) according to sex. The distance between the upper first molar and palatal plane (U6-PP) ( $p=0.028$ ), the Overbite ( $p=0.032$ ) and Gonial° ( $p=0.033$ ) values showed statistically significant differences according to SES in vertical skeletal measures. The 64.7% of AOB were of dental origin. Conclusion. Results suggest variations in some vertical skeletal measures according to sex and SES in children with AOB. Since a high percentage of AOB is caused by dental factors, preventive programs are required to control this condition.

**Keywords:** Anterior open bite, Children, Malocclusion, Prevalence, Socioeconomic status.

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### INTRODUCTION.

Anterior open bite (AOB) is defined as the lack of contact between anterior teeth.<sup>1-3</sup> Prevalence of this condition in the population is variable. A presence of 18% has been observed in Italian preschool children of 3 to 5 years of age,<sup>4</sup> while a prevalence of 2.7% has been reported in subjects aged 8 to 16 years in Colombia.<sup>5</sup>

Overbite,<sup>6</sup> and a dental<sup>7</sup> and skeletal<sup>8</sup> Class II are characteristic in people with AOB. Individuals with AOB have a cranio-facial morphology characterized by a small anterior cranial base, long lower anterior facial height, obtuse gonial° angle, short posterior facial height, anterior upward tilting of maxilla, posterior downward tilting of maxilla,<sup>9</sup> among others. Likewise, people with

AOB may show variations according to sex due to differences in skeletal growth and development, particularly of the jaw.<sup>10-12</sup>

In the municipality of Pasto, Colombia, 65% of the population has low socioeconomic status.<sup>13</sup> Population aged 7 to 15 years represents the 57.6%.<sup>14</sup> AOB has been associated with non-nutritive sucking habits.<sup>15</sup> These habits persist due to boredom, stress, anxiety, hyperactivity, disabilities and hunger,<sup>16</sup> among others. Consequently, some kind of relationship between a state of malnutrition and growth in the diagnosis of AOB in children may be expected. In addition, AOB produces occlusal, functional and aesthetic problems<sup>17</sup> that affect the normal emotional development of children.

The aim of this study was to determine occlusal and skeletal characteristics of AOB according to sex and socioeconomic status in school children aged 5 to 10 years in the municipality of Pasto, Colombia.

## MATERIALS AND METHODS.

### Design and Population

A cross-sectional study was carried out. A simple random probability sampling with 95% confidence and 5% error was performed. Given that the prevalence of AOB in this age group in the city was unknown, an *a priori* prevalence of 50% was estimated. The target population was 87,308 children aged 5 to 10 years, according to data obtained from the 2005 municipal census. The estimated sample size was 384 subjects.

Children of both sexes aged 5 to 10 years, with deciduous or mixed dentition, and whose parents had signed the informed consent, were included in the study. Children with severe dental caries causing premature loss of teeth or affecting the clinical measurement of AOB, with physical or psychological disabilities that prevented dental examination, under corrective or preventive orthodontic treatment, or those who have exceeded the number of annual radiographs according to the permissible levels of radiation for each person (1mSv) were excluded

from the study.

Subjects of the sample were randomly enrolled between July 2012 and July 2013 from three schools, selected by number of students, location and socioeconomic status (SES). Sample was organized with a sex ratio 1:1 and divided according to SES classification: low for 1 and 2, middle for 3 and 4, and high for 5 and 6. SES data of the participating students were confirmed by the administration at each school.

### Procedure

A form for data collection including socio-demographic variables, and occlusal characteristics of the subjects was designed.

AOB was measured between incisors or canines that showed a greater distance in an edge-to-edge position.<sup>18</sup> Two researchers were calibrated previously using photographs and models of patients from the Dental Clinic at Universidad Cooperativa de Colombia - Pasto. Kappa Index was obtained with 10% of the sample for the first and second measurement. Kappa values were 0.83 and 0.89 for the intra-observer variability, and 0.94 and 0.77 for inter-observer.

Dental examination was performed in a portable dental unit with a standardized light source. A lateral radiograph and study models with the same quality standards were taken from subjects with clinical AOB, and cephalometric measurements were made according to parameters proposed by Angle, Steiner, McNamara, Legan and Burstone.<sup>8,19</sup>

### Statistical analysis

A database was created using SPSS 22 (IBM, USA). Frequencies, percentages, means, medians, standard deviations were estimated and a comparison was made by sex and SES using the chi-square test. Assumptions for using parametric or nonparametric measurements were determined for each of the anteroposterior and vertical measurements (distribution of groups in an independent manner, normality tests such as Shapiro-Wilk and homoscedasticity tests such as Levene) in order to use mea-

surements such as t-student and ANOVA with the mean or Mann-Whitney and Kruskal Wallis tests with the median. Significance levels were set at  $p < 0.05$ .

### Ethical considerations

The present study was approved by the Ethics Committee of Health Sciences at Universidad Cooperativa de Colombia - Pasto (Act No. CECS06-12).

Informed consent was obtained in a parents' meeting after explaining the aim and scope of the study.

### RESULTS.

Characterization of the sample is described in Table 1. Prevalence of AOB was 31 cases (8.1%) (95% CI: 5.37–10.83).

There were no significant differences by age and sex. According to SES, there were 17 cases in low SES (13.4%) (95% CI: 9.99–16.8), 7 cases in middle SES (5.5%) (95%

CI: 3.22–7.78) and 7 cases in high SES (5) (5.4%) (95% CI: 3.14–7.66) ( $p = 0.027$ ).

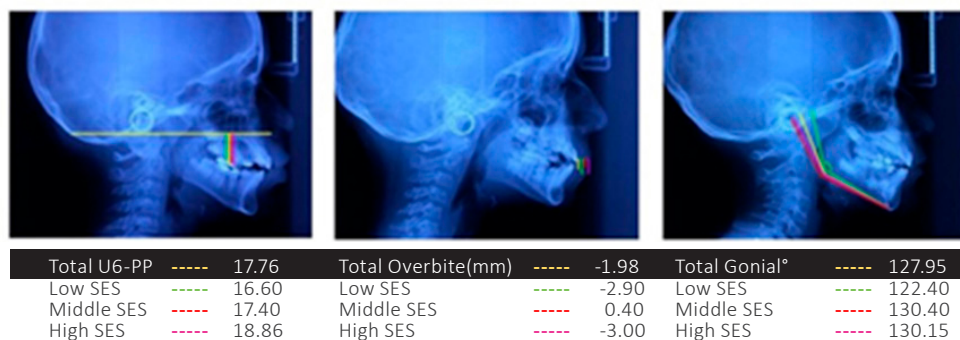
Of the 31 AOB cases, 17 completed examinations, of these 16 (94.1%) had mixed dentition. Right and left molar relationship in permanent dentition was Class II with 70.6% and 58.8%, respectively.

Table 2 shows occlusal characteristics of AOB by sex. Analysis was limited in relation to SES because the groups were small, although it was observed that 4 low SES subjects (57.1%) had decreased Overjet ( $p = 0.611$ ).

Table 3 shows anteroposterior measurements; there were no statistically significant differences by sex and SES. However, there was a difference in vertical measurements in PFH: AFH ( $p = 0.050$ ), which was higher in men. In Figure 1 and Table 4, significant differences with respect to SES are observed.

They would not be affected by age according to the mean

**Figure 1.** Cephalograms of subjects with AOB according to U6-PP, overbite and gonial° measurements by SES.



**Table 1.** Sociodemographic characteristics of 384 children aged 5 to 10 years of different educational institutions in Pasto, Colombia.

Age		Low SES (1 y 2) n=127		Middle SES (3 y 4) n=128		High SES (5) n=129	
		Males n=60(%)	Females n=67(%)	Males n=67(%)	Females n=61(%)	Males n=74(%)	Female n=55(%)
5	14.8	16.7	4.5	9.0	13.1	27.0	18.2
6	16.1	8.3	14.9	11.9	11.5	23.0	27.3
7	19.8	30.0	23.9	16.4	6.6	17.5	25.5
8	17.2	15.0	22.4	16.4	26.2	12.2	10.8
9	16.1	11.7	14.9	29.9	27.8	6.8	5.5
10	15.9	18.3	19.4	16.4	14.8	13.5	12.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

of each group (low SES  $\bar{x}$ =7.60±1.673 and md=8, middle:  $\bar{x}$ =8.00±0.707 and md=8; high:  $\bar{x}$ =8.71±1.704 and md=9). In high SES the mean of the U6-PP measurement was decreased (18.86mm±1.22) (p=0.028), just as the Overbite

in the middle SES (0.40mm±1.79) (p=0.032) and gonial° angle in the low SES (122.40°±4.41) (p=0.033).

Eleven subjects (64.7%) had dental AOB, 1 subject (5.9%) skeletal, and 5 (29.4%) had dental and skeletal.

**Table 2.** Occlusal characteristics in study models of 17 cases with AOB according to sex.

Variables		Cases (n=17) %	Males (n=9) %	Females (n=8) %	p <sup>a</sup>
Right Canine Relationship. Deciduous teeth	N/A	58.8	44.4	75.0	0.196
	Class I	17.6	11.1	25.0	
	Class II	11.8	22.2	-	
	Class III	11.8	22.2	-	
Left Canine Relationship. Deciduous teeth	N/A	35.3	-	75.0	0.007
	Class I	29.4	33.3	25.0	
	Class II	23.5	44.4	-	
	Class III	11.8	22.2	-	
Right Canine Relationship. Permanent teeth	N/A	88.2	100.0	75.0	0.110
	Class I	-	-	-	
	Class II	11.8	-	25.0	
	Class III	-	-	-	
Left Canine Relationship. Permanent teeth	N/A	76.5	88.9	62.5	0.373
	Class I	-	-	-	
	Class II	17.6	11.1	25.0	
	Class III	5.9	-	12.5	
Right Molar relationship. Permanent teeth	N/A	5.9	-	12.5	0.152
	Class I	5.9	11.1	-	
	Class II	70.6	55.6	87.5	
	Class III	17.6	33.3	-	
Left Molar relationship. Permanent teeth	N/A	11.8	-	25.0	0.232
	Class I	11.8	22.2	-	
	Class II	58.8	55.6	62.5	
	Class III	17.6	22.2	12.5	
Overjet	Normal (1-2mm)	29.4	22.3	37.5	0.667
	Increased (>2mm)	35.3	44.4	25.0	
	Decreased (<1mm)	35.3	33.3	37.5	
Overbite	Normal (3-4mm)	-	-	-	N/A
	Increased (>4mm)	-	-	-	
	Decreased (<3mm)	100.0	100.0	100.0	

<sup>a</sup> Obtained from the Chi-square test for categorical variables.

**Table 3.** Anteroposterior dental and skeletal cephalometric measurements of cases with AOB according to sex and SES.

Anteroposterior cephalometric variables	Total (n=17)	Males (n=9)	Females (n=8)	p <sup>a</sup>	Low SES (n=5)	Middle SES (n=5)	High SES (n=7)	p <sup>a</sup>
	$\bar{X}$ (SD)	$\bar{X}$ (SD)	$\bar{X}$ (SD)		$\bar{X}$ (SD)	$\bar{X}$ (SD)	$\bar{X}$ (SD)	
U1-PP°	110.39 (6.11)	108.5(5.05)	112.5(6.82)	0.186	109.10(5.99)	108.10(5.38)	112.93(6.57)	0.367
L1-MP°	94.35(7.01)	94.56(5.84)	94.13(8.56)	0.904	95.40(3.37)	92.40(10.84)	95.00(7.01)	0.779
U1 to L1°	121.09(8.46)	122.67(8.68)	119.32(8.42)	0.432	127.00(4.70)	116.30(9.46)	120.29(8.23)	0.125
Overjet	2.45(1.78)	2.67(1.57)	2.19(2.07)	0.595	2.80(1.96)	2.20(1.93)	2.36(1.80)	0.871
SNA°	83.45(5.23)	85.06(6.05)	81.63 (3.68)	0.185	84.70(6.67)	82.00(1.59)	83.58(6.20)	0.739
SNB°	78.45(4.18)	80.39(4.28)	76.25(2.96)	0.153 <sup>b</sup>	80.50(4.88)	76.80(0.84)	78.15(4.94)	0.431 <sup>b</sup>
ANB°	6.06(2.73)	5.78(1.65)	6.38(3.71)	1.000 <sup>b</sup>	6.20(1.79)	5.20(1.93)	6.57(3.78)	0.699 <sup>b</sup>
MxUL	73.56(4.62)	75.23(3.84)	71.69(4.94)	0.118	72.60(4.51)	73.80(4.39)	74.08(5.42)	0.870
MdUL	91.71(4.87)	93.78(4.00)	89.38(4.93)	0.060	92.60(3.65)	92.00(5.39)	90.86(5.79)	0.838
Difference MdUL-MxUL	18.74(5.06)	18.56(4.22)	18.94(6.16)	0.882	20.00(3.40)	18.20(5.07)	18.22(6.43)	0.821

Sex: <sup>a</sup> Obtained from the t-test and <sup>b</sup> Obtained from the Mann-Whitney U test for independent and continuous variables.  
SES: <sup>a</sup> Obtained from ANOVA and <sup>b</sup> Derived from the Kruskal-Wallis test for independent and continuous variables.

**Table 4.** Vertical dental and skeletal cephalometric measurements of cases with AOB according to sex and SES.

Vertical cephalometric variables	Total (n=17)	Males (n=9)	Females (n=8)	p <sup>a</sup>	Low SES (n=5)	Middle SES (n=5)	High SES (n=7)	p <sup>a</sup>
	$\bar{X}$ (SD)	$\bar{X}$ (SD)	$\bar{X}$ (SD)		$\bar{X}$ (SD)	$\bar{X}$ (SD)	$\bar{X}$ (SD)	
U1-PP	24.21(2.82)	23.84(2.07)	24.63(3.59)	0.579	23.40(2.51)	25.40(2.71)	23.93(3.20)	0.532
U6-PP	17.76(1.61)	17.22(1.57)	18.38(1.51)	1.000 <sup>b</sup>	16.60(0.90)	17.40(1.82)	18.86(1.22)	0.028 <sup>b</sup>
L1-MP	32.53(2.07)	32.89(2.03)	32.13(2.17)	0.464	32.00(2.00)	32.80(1.79)	32.71(2.50)	0.811
L6-MP	25.18(1.40)	25.62(1.22)	24.69(1.49)	0.180	25.70(1.49)	25.00(1.00)	24.93(1.65)	0.633
Overbite	-1.98(2.53)	-2.00(2.10)	-1.94(3.10)	0.961	-2.90(2.82)	0.40(1.79)	-3.00(1.74)	0.032
UFH	41.86(3.29)	40.95(3.45)	40.75(3.33)	0.908	40.70(2.30)	39.60(3.79)	41.86(3.29)	0.529
LFH	54.24(3.58)	54.67(3.28)	53.75(4.07)	0.614	53.80(4.87)	55.40(1.52)	53.71(3.91)	0.714
UFH:LFH	1.32(0.26)	1.29(0.28)	1.34(0.26)	1.000 <sup>b</sup>	1.36(0.094)	1.35(0.37)	1.25(0.28)	0.506 <sup>b</sup>
PFH	60.76(5.94)	63.00(5.39)	58.25(5.80)	0.131 <sup>b</sup>	62.20(2.49)	59.80(6.50)	60.43(7.68)	0.770 <sup>b</sup>
AFH	96.29(5.35)	96.56(4.31)	96.00(6.64)	0.839	96.40(7.31)	95.60(4.73)	96.71(5.03)	0.945
PFH:AFH	0.63(0.05)	0.65(0.04)	0.61(0.05)	0.050 <sup>b</sup>	0.65(0.04)	0.62(0.05)	0.62 (0.06)	0.538 <sup>b</sup>
Ba-SN°	126.48(6.84)	127.06(3.03)	125.82(9.77)	0.637 <sup>b</sup>	126.70(5.50)	129.80(3.12)	123.93(9.01)	0.360 <sup>b</sup>
SN-GoGn°	34.15(4.32)	32.50(3.85)	36.00(4.28)	0.096	30.80(3.90)	34.80(2.17)	36.08(4.73)	0.098
Gonial°	127.95(5.94)	128.06(6.88)	127.82(5.15)	0.936	122.40(4.41)	130.40(5.32)	130.15(5.09)	0.033
ABPI-MP°	70.80(5.09)	71.00(5.62)	70.57(4.80)	1.000 <sup>b</sup>	73.90(2.25)	68.80(6.02)	70.00(5.42)	0.330 <sup>b</sup>
FH-PP°	-2.45(5.09)	-2.78(5.61)	-2.07(4.77)	0.782	-1.40(5.69)	-5.20(5.27)	-1.22(4.46)	0.375
OP-MP°	14.65(3.93)	13.67(2.74)	15.75(4.90)	0.288	13.60(3.21)	12.60(3.58)	16.86(3.94)	0.138
ODI ABPI-MP minus FH-PP	68.12(7.08)	68.3(8.47)	68.00(5.71)	0.951	71.70(7.35)	63.60(2.61)	68.79(8.06)	0.190

Sex: <sup>a</sup> Obtained from the t-test and <sup>b</sup> Obtained from the Mann-Whitney U test for independent and continuous variables.  
SES: <sup>a</sup> Obtained from ANOVA and <sup>b</sup> Derived from the Kruskal-Wallis test for independent and continuous variables.

## DISCUSSION.

In this study, an 8.1% prevalence of clinically diagnosed AOB was observed. This value was lower than that reported by Silvestrini-Biavati *et al.*<sup>4</sup> of 18% in preschool children of 3 to 5 years in Italy and Mafla *et al.*<sup>20</sup> of 18.9% in Colombian adolescents of 13 to 16 years. Although, it was slightly higher than Aliaga-Del Castillo *et al.*<sup>21</sup> of 5% in children and adolescents aged 2 to 18 years, who were residents of the villages and native communities in the Ucayali jungle of Peru.

Interestingly, there was a statistically significant difference according to socioeconomic status, as it was 13.4% in the low stratum, and 5.5% and 5.4% in the middle and high strata, respectively. This variation may be due to malnutrition, which can result in the appearance of habits such as thumb-sucking<sup>16</sup> or late exfoliation. The latter condition may sometimes cause the teeth to be placed in abnormal positions creating different occlusal patterns that do not follow the normal skeletal development and growth. Although it is possible to determine the specific etiological factors of these cases, factors involved in skeletal anterior open bite will be particularly complex to determine.<sup>22</sup>

It was observed that the right and left molar relationship in the permanent dentition was mostly Class II with 70.6% and 58.8%, respectively. Results show an increased ANB° angle average, which means a Class II skeletal malocclusion. Additionally, this relationship could occur independently of AOB, so a greater frequency of this classification would be expected in comparison with Class III, as reported in other studies carried out in subjects without AOB.<sup>20,23</sup>

Sex and SES differences occurred in some vertical measurements in subjects with AOB. It is evident that the measurement PFH: AFH was higher in men than women. The general characteristics of AOB are related to an anterior facial height increased with respect to the posterior, manifested as an elongation of the lower third of the face, referred to as "long face syndrome".<sup>24</sup> Probably this could be caused by differences in normal craniofacial growth and development between males and females.

Similarly, the mean of the U6-PP measurement in children of high SES was slightly decreased, suggesting a diagnosis of infra-eruption of upper molar. This could be related to changes in patterns of eruption being delayed in many occasions or because of the premature loss of deciduous molars that modify the normal process of root resorption resulting in tooth impaction. A decreased Overbite was observed in middle-SES children. This condition could occur as a result of genetic factors, or particular functional habits such as tongue thrusting, atypical swallowing or mouth breathing. Also, the gonial° angle was decreased in low-SES children. This could be the result of delayed eruption of the first permanent molars,<sup>25</sup> or due to a late exfoliation related to malnutrition<sup>26</sup> reducing the size of this angle.

According to clinical, cephalometric and model analyses, the main classification observed was a dental AOB in 64.7%. If these results are consistent with cases that were not completed, it could be said that this type of bite could be preventable because its main cause may be related to non-nutritive oral habits.

According to clinical, model and cephalometric analyses, the main advantage of this study is reporting the prevalence and showing the occlusal and skeletal characteristics of subjects with AOB with different diagnostic methods. This is an advantage over other studies that are based solely on clinical evaluation. However, this design has limitations because it provides information in a specific given time and does not control risk factors to which participants could be exposed. This does not allow to establish causal relationships. Although in the first part of the study a probability sample was used, occlusal and skeletal analyses were affected because some mothers accepted to participate, but they did not take the children to perform study models and cephalometric evaluations. Total inclusion cases may alter and affect means and statistical significance, because small samples are unstable. Therefore, it is recommended to design studies with larger samples because they increase statistical significance and reflect the characteristics of the population more accurately.

## CONCLUSION.

Prevalence of anterior open bite was 8.1%, similar to the range reported in the literature. Class II molar relationship in permanent teeth was observed. There were variations in the vertical skeletal measurements according to sex and SES. The 64.7% of AOB was of dental origin, consequently it is necessary to develop preventive programs for managing AOB.

## Características oclusales y esqueléticas de mordida abierta anterior en escolares colombianos de 5 a 10 años.

**Resumen:** El objetivo de este estudio fue determinar las características oclusales y esqueléticas de mordida abierta anterior (MAA) según sexo y nivel socioeconómico en escolares de Pasto, Colombia. Metodología. Se diseñó un estudio transversal con la participación de 384 niños entre 5 y 10 años. Se realizó una valoración clínica para evaluar la MAA y se obtuvo información sobre variables socio-demográficas como edad, sexo y estrato socioeconómico (ESE) basado en los parámetros de Colombia. A los participantes se les tomó cefalometrías laterales estandarizadas y modelos de estudio de yeso. Se hizo un análisis estadístico usando frecuencias, porcentajes, t-student, ANOVA, Mann-Whitney y Kruskal-Wallis. Resultados. La prevalencia de MAA fue 8,1% y existió una diferencia significativa según

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ESE. La clasificación de Angle más común fue la Clase II para el molar derecho en 70,6% e izquierdo: en 58,8% de acuerdo a las características oclusales. Diferencias estadísticamente significativas fueron observadas en la razón entre la altura facial posterior y anterior (PFH: AFH) según sexo ( $p=0,05$ ). Los valores de la distancia entre el primer molar superior y el plano palatino (U6-PP) ( $p=0,028$ ), el Overbite ( $p=0,032$ ) y Gonial° ( $p=0,033$ ) tuvieron una diferencia estadísticamente significativa con respecto al ESE en las medidas esqueléticas verticales. El 64,7% de MAA fueron de origen dental. Conclusión. Los resultados sugieren variaciones en algunas medidas esqueléticas verticales según sexo y ESE. Debido a que existe un alto porcentaje de MAA dental, se requieren programas preventivos para controlar esta condición.

**Palabras clave:** *Mordida abierta anterior, Niños, Maloclusión, Prevalencia, Nivel socioeconómico.*

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