Research Article

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Malocclusion relationship-Dental Aesthetics Index in need of orthodontic treatment in Angolan population

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Introduction

Orthodontics is based on the concept of ideal occlusion, so it is essential to have a notion, as complete as possible, of normal or ideal occlusion so that it is possible to correctly diagnose malocclusions. In normal occlusion defined by Angle, there is a molar relationship so that the mesiobuccal cusp of the maxillary first molar occludes in the buccal groove of the mandibular first molar and, in which the teeth are positioned in a slightly curved line of occlusion. This line of occlusion is divided into upper and lower [1].

By definition, any variation from normal occlusion is called malocclusion, and is therefore a state where there is a deviation from ideal occlusion [2-5]. However, malocclusion is not easily measured by patients, as the perception of the various types and severities of malocclusions is highly subjective and perceived in a qualitative rather than quantitative way. Thus, the use of a valid instrument to objectively assess the criteria and recommend and prioritize orthodontic treatment to the patient, such as occlusal indices, becomes essential [6, 7].

Several indices have been validated and accepted as useful tools to objectively measure malocclusions and orthodontic treatment needs [8-13]. Among the various indices, the index applied in this investigation is the Dental Aesthetics Index (DAI), an occlusal index that allows malocclusion to be grouped into groups according to the level and priority of orthodontic treatment required. It relates the clinical and aesthetic components mathematically, arriving at a score that reflects the severity of the malocclusion [14, 15].

Several studies suggest that the DAI can be universally applied, without the need for modifications or adaptations, to different ethnic or cultural scenarios [16, 17]. This investigation intends to assess whether the Angolan population has occlusion conditions that are percentage equivalent to other countries. Considering the previous hypothesis, this study aimed to determine the prevalence of malocclusion and the need for orthodontic treatment in young Angolans of black race through DAI.

Material and Methods

To carry out this study, the opinion of the Ethics Committee of the Instituto Superior Politécnico de Benguela was requested, which was favorable. The population studied was randomly obtained, having as inclusion criteria: age between 12 and 14 years old, black race, collaborating person and public-school student, with no previous or current history of corrective orthodontic treatment, duly signed informed consent by those responsible. A sample of 160 children was obtained. The index applied was the DAI, evaluating its 10 occlusal characteristics: absence of incisor, canine and premolar, crowding in the incisor region, spacing in the incisor region, interincisal diastema, anterior maxillary misalignment, anterior mandibular misalignment, anterior maxillary overjet, anterior mandibular overjet, anterior vertical open bite and molar relationship. Equation for calculating the DAI (Visible missing teeth x 6) + (Crowding) + (Spacing) + (Diastema x 3) + (Anterior maxillary misalignment) + (Anterior mandibular misalignment) + (Anterior maxillary overjet x 4) + (mandibular overjet anterior x 4) + (Anterior vertical open bite x 4) + (Anteroposterior molar relationship x 3) + 13. The assessment of the DAI allows, in this way, to categorize the severity of the malocclusion of each subject in: normal or malocclusion slight occlusion (cutoff 3-25); defined malocclusion (cutoff 26-30); severe malocclusion (cutoff 31-35) and very severe or disabling malocclusion (cutoff ≥36). The DAI also makes it possible to make a dichotomous categorization of individuals, using cut-off points, into "not needing treatment" (cut-off point 3-30) and "in need of treatment" (cut-off point ≥ 31) [15, 18, 21].

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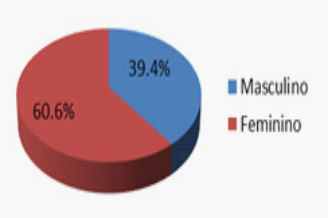
The collection of data necessary for this investigation was based on direct observation by two researchers previously calibrated for the index. Initially in a clinical setting to assess the difficulty of interpreting the index, and later, after being calibrated, a second experimental phase took place, in the schoolyards, with good natural lighting conditions. In this phase, 13 adolescents were examined, seven females and six males between 12 and 14 years of age, whose parents consented through the Free and Informed Consent Term and after guaranteed confidentiality. At the end of the experimental period, the proposed investigation was started. For data collection, a form was prepared based on the Dental Aesthetics Index (DAI), in order to individually assess its 10 components.

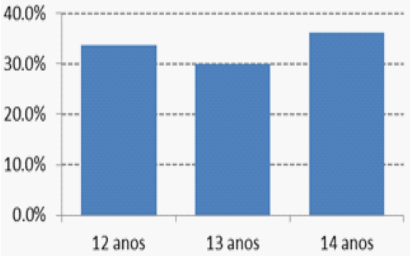
The criteria defined by the World Health Organization (WHO 1997) 19 were used to calculate the referred system. Sterile CPI (Community Periodontal Index) probes, disposable wooden spatulas, surgical masks, gloves, caps and gowns were used by the observers and pens to fill in the observation forms. This research study follows the parameters of a cross-sectional observational study with the collected data submitted to statistical analysis using the chi-square and Fisher's test, with a significance level of $\alpha \leq 0.05$. Statistical analysis was performed using SPSS® (Statistical Package for the Social Sciences) version 22.0.

Results

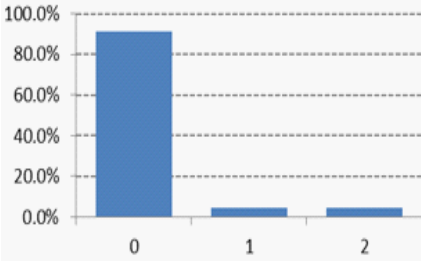
A total of 160 children participated in the study, most of which were female n=97, (60.6%) vs n=63 (39.4%), between 12 and 14 years old (Graphs 1 and 2) respectively. The percentage of children who had no incisors, canines and/or premolars was 91.2% (Graph 3). In the anterior crowding, 66.3% of the children did not present this dental characteristic. Of those who had crowding, 16.3% had it in one region and 17.4% in both regions, upper and lower (Graph 4). Spacing in the incisor region was observed in 33.8% of the subjects, with 19.4% in both regions and 14.4% in one region (Graph 5). The presence of interincisal diastema was present in 42.5% of the children (Graph 6). Anterior maxillary misalignment was not present in 85.0% of the children (Graph 7). Anterior mandibular misalignment was not present in 81.3% (Graph 8). Anterior maxillary overjet was present in 70.0% of the children (Graph 9). Anterior mandibular overjet occurred in only 2.5% of subjects (Graph 10). The anterior vertical open bite occurred in 40.6% of the children (Graph 11). As for the molar relationship, 75.6% were normal, 17.5% had a half-cuspid relationship and 6.9% had a single cusp (Graph 12). After categorizing the DAI index, 62.5% of the children had normal occlusion, 11.3% defined malocclusion, 4.3% severe malocclusion and 21.9% very severe malocclusion (Graph 13). The results of gender and age parameters for each DAI component are shown in (Tables 1 and 2), respectively. However, the differences in the results obtained are not statistically significant. The DAI varied between a minimum of 13 and a maximum of 63 points, with an average of 26.43 (SD=11.17) as shown in (Table 3). In (Graph 14), it is possible to observe the results of the DAI index obtained in the Angolan population and in the studies developed by other countries.



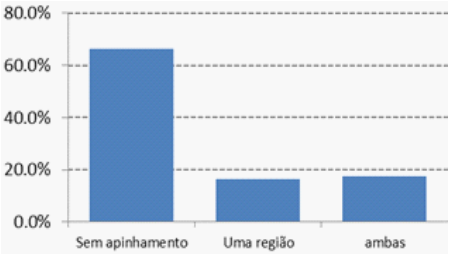
Graph 1: *Characterization of the sample by gender.*



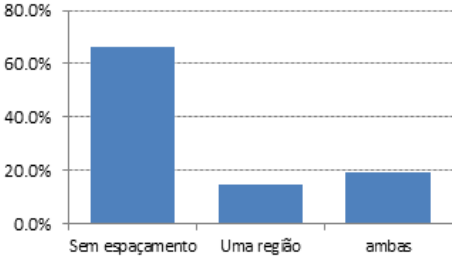
Graph 2: *Characterization of the sample by age.*



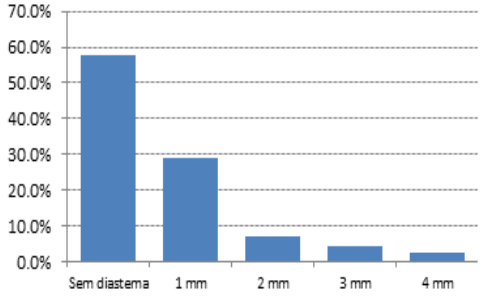
Graph 3: *Representation of the results obtained from the dental absence component.*



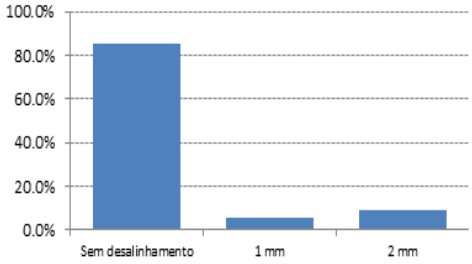
Graph 4: *Representation of the results obtained from the crowding component*



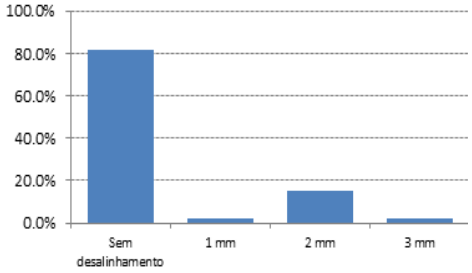
Graph 5: *Representation of the results obtained from the spacing component.*



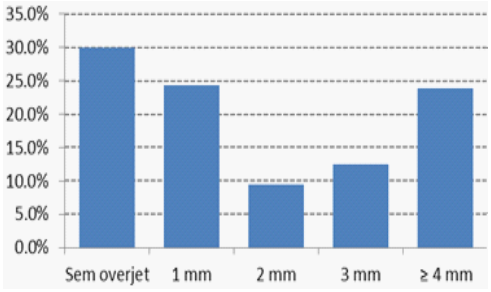
Graph 6: *Representation of the results obtained from the interincisive diastema component.*



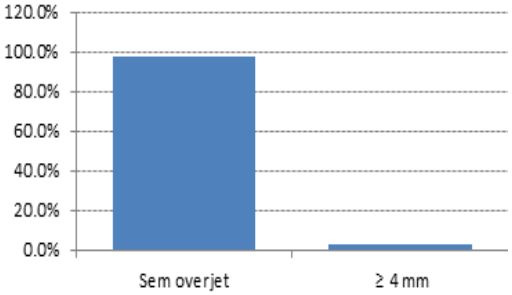
Graph 7: *Representation of the results obtained from the anterior maxillary misalignment component.*



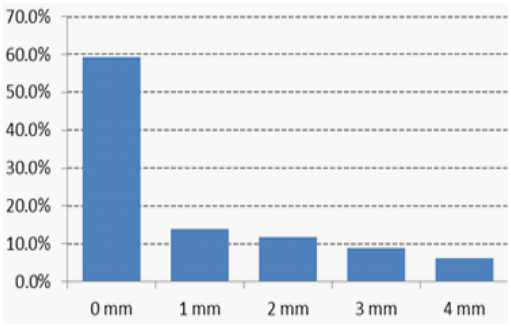
Graph 8: *Representation of the results obtained from the anterior mandibular misalignment component.*



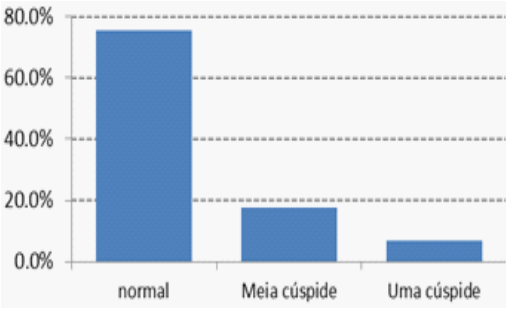
Graph 9: *Representation of the results obtained from the maxillary overjet component.*



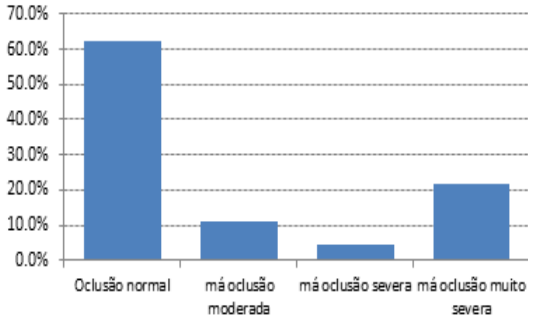
Graph 10: *Representation of the results obtained from the mandibular overjet component.*



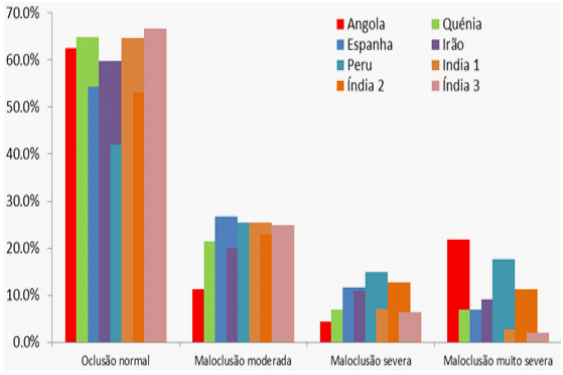
Graph 11: *Representation of the results obtained from the open bite component.*



Graph 12: *Representation of the results obtained from the molar relationship component.*



Graph 13: *Representative of the results on the categorization of the DAI regarding malocclusion.*



Graph 14: *Comparison of DAI by country.*

Table 1: *Representation of the results obtained from the DAI components by gender.*

DAI Components		Male		Female		Total	
		n	fr	n	fr	N	F
Absences	0 teeth	55	87,3%	91	93,8%	146	91,2%
	1 tooth	5	7,9%	2	2,1%	7	4,4%
	2 teeth	3	4,8%	4	4,1%	7	4,4%
Crowding	No crowding	44	69,8%	62	63,9%	106	66,2%
	One region	7	11,1%	19	19,6%	26	16,3%
	Both regions	12	19,0%	16	16,5%	28	17,5%
Spacing	No spacing	41	65,1%	65	67,0%	106	66,2%
	One region	6	9,5%	17	17,5%	23	14,4%
	Both regions	16	25,4%	15	15,5%	31	19,4%
Diastema	No diastema	34	54,0%	58	59,8%	92	57,5%
	1mm	16	25,4%	30	30,9%	46	28,8%
	2mm	5	7,9%	6	6,2%	11	6,9%
	3mm	5	7,9%	2	2,1%	7	4,3%
	4mm	3	4,8%	1	1,0%	4	2,5%
Anterior maxillary misalignment	No misalignment	54	85,7%	82	84,5%	136	85,0%
	1mm	5	7,9%	4	4,1%	9	5,6%
	2mm	4	6,3%	11	11,3%	15	9,4%
Anterior mandibular misalignment	No misalignment	53	84,1%	77	79,4%	130	81,2%
	1mm	0	0,0%	3	3,1%	3	1,9%
	2mm	8	12,7%	16	16,5%	24	15,0%
	3mm	2	3,2%	1	1,0%	3	1,9%
Overjet maxillary	no overjet	21	33,3%	27	27,8%	48	30,0%
	1mm	14	22,2%	25	25,8%	39	24,4%
	2mm	6	9,5%	9	9,3%	15	9,4%
	3mm	9	14,3%	11	11,3%	20	12,4%
	≥4mm	13	20,6%	25	25,8%	38	23,8%
Overjet mandibular	no overjet	63	100%	94	96,9%	157	98,1%
	≥4mm	0	0%	3	3,1%	3	1,9%
Molar relationship	Normal	43	68,3%	78	80,4%	121	75,6%
	Half cusp	13	20,6%	15	15,5%	28	17,5%
	one cusp	7	11,1%	4	4,1%	11	6,9%
Open bite	0	37	58,7%	58	59,8%	95	59,4%
	1mm	9	14,3%	13	13,4%	22	13,7%
	2mm	7	11,1%	12	12,4%	19	11,9%
	3mm	6	9,5%	8	8,2%	14	8,8%
	≥4mm	4	6,3%	6	6,2%	10	6,2%
Occlusion	Normal occlusion	35	55,6%	65	67,0%	100	62,5%
	Defined malocclusion	10	15,9%	8	8,2%	18	11,2%
	Severe malocclusion	4	6,3%	3	3,1%	7	4,4%
	Very severe malocclusion	14	22,2%	21	21,6%	35	21,9%

Table 2: *Representation of the results obtained from the components of the DAI by age.*

Components DAI		age 12 years		13 years		14 years		Total	
		n	fr	n	fr	n	fr	N	F
Absences	0 teeth	48	88,9%	44	91,7%	54	93,1%	146	91,2%
	1 tooth	3	5,6%	2	4,2%	2	3,4%	7	4,4%
	2 teeth	3	5,6%	2	4,2%	2	3,4%	7	4,4%
Crowd-ing	No crowding	34	21,2%	31	64,6%	41	70,7%	106	66,2%
	One region	11	20,4%	8	16,7%	7	12,1%	26	16,3%
	Both regions	9	16,7%	9	18,8%	10	17,2%	28	17,5%
spac-ing	No spacing	36	66,7%	30	62,5%	40	69,0%	106	66,2%
	One region	9	16,7%	8	16,7%	6	10,3%	23	14,4%
	Both regions	9	16,7%	10	20,8%	12	20,7%	31	19,4%
Diastema	No diastema	32	59,3%	27	56,2%	33	56,9%	92	57,5%
	1mm	15	27,8%	15	31,2%	16	27,6%	46	28,8%
	2mm	3	5,6%	3	6,2%	5	8,6%	11	6,9%
	3mm	3	5,6%	2	4,2%	2	3,4%	7	4,3%
	4mm	1	1,9%	1	2,1%	2	3,4%	4	2,5%
Maxillary misalign-ment ante-rior	No misalignment	48	88,9%	38	79,2%	50	86,2%	136	85,0%
	1mm	3	5,6%	3	6,2%	3	5,2%	9	5,6%
	2mm	3	5,6%	7	14,6%	5	3,1%	15	9,4%
Anterior mandibu-lar mis-alignment	No misalignment	45	83,3%	38	79,2%	47	81,0%	130	81,2%
	1mm	1	1,9%	1	2,1%	1	1,7%	3	1,9%
	2mm	7	13,0%	8	16,7%	9	15,5%	24	15,0%
	3mm	1	1,9%	1	2,1%	1	1,7%	3	1,9%
Overjet maxil-lary	no overjet	18	33,3%	13	27,1%	17	29,3%	48	30,0%
	1mm	13	24,1%	11	22,9%	15	25,9%	39	24,4%
	2mm	3	5,6%	5	10,4%	7	12,1%	15	9,4%
	3mm	9	16,7%	5	10,4%	6	10,3%	20	12,4%
	≥4mm	11	20,4%	14	29,2%	13	22,4%	38	23,8%
Overjet man-dibular	no overjet	53	98,1%	46	97,9%	57	98,3%	157	98,1%
	≥4mm	1	1,9%	1	2,1%	1	1,7%	3	1,9%
Molar rela-tion-ship	Normal	39	72,2%	39	81,2%	43	74,1%	121	75,6%
	Half cusp	10	18,5%	6	12,5%	12	20,7%	28	17,5%
	one cusp	5	9,3%	3	6,2%	3	5,2%	11	6,9%
Open bite	0	32	59,3%	28	58,3%	35	60,3%	95	59,4%
	1mm	7	13,0%	6	12,5%	9	15,5%	22	13,7%
	2mm	8	14,8%	4	8,3%	7	12,1%	19	11,9%
	3mm	5	9,3%	6	12,5%	3	5,2%	14	8,8%
	≥4mm	2	3,7%	4	8,3%	4	6,9%	10	6,2%

Table 3: *Minimum, maximum and average value of DAI categorization.*

	N	Minimum	Maximum	Average	Standard deviation
DAI	160	13	63	26,43	11,17

Discussion

The use of DAI index has been applied globally for its' simplicity of application, validity and for being easy to use, allowing comparations between different cultures and ethnic groups, however, it has limitations [16]. One of the limitations pointed to DAI is the fact that it does not account for occlusal anomalies such as: crossbites, impacted teeth, midline deviations, overbites and absent molars. Although the presence or absence of diastema between the teeth and crowding are accounted for, this index does not allow distinctions between various degrees of dentomaxillary discrepancy and is therefore a limitation [20].

The age range was chosen because the DAI index lose validity in individuals with deciduous dentition, and according to Anita et al. (2013), the malocclusions are totally manifested during these ages and, because, at advanced ages, the prevalence of tooth loss is higher [18].

In this investigation, the first component of the DAI evaluated was dental absences, where 91.2% of the participants did not present any type of absence. These results are in line with the results obtained by Sanadhya et al. (2014) in India, where about 89.5% of the 947 children aged between 12 and 15 years did not have dental absences. Rwakatema et al. (2007) in Tanzania observed the prevalence of malocclusions and the need for orthodontic treatment in 289 children aged 12 to 15 years, determined that only about 5.1% and 6.9%, respectively, had absences. Muasya et al. (2013) in Kenya assessed patterns of malocclusion with DAI in 1382 children aged 12 to 15 years in which 94.9% had no absences. Slightly higher values were found by Bauman et al. (2018) in Brazil, where 5,539 children aged 12 years were observed with 96.8% without absences in the upper arch and 97.3% in the lower arch. Singh et al. (2019) in India obtained 98.8% and 96.7% of participants without absences in the upper and lower arch, respectively, of the 902 children observed aged between 12 and 15 years [20-24].

Evaluating crowding, this was not present in 66.3% of the children, a similar situation reported by other authors [20-24]. Evaluating the spacing, this was present in 33.8% of the children observed in this study, values in consonance found by other authors [20-23]. Another parameter evaluated in this investigation was the presence of interincisive diastema in which the percentage of children with this characteristic was much higher than those found in the studies [20-24]. Evaluating the anterior misalignment in the maxilla, in this investigation, only 15% of the children were observed, a situation opposite to the other studies that observed higher values [20-24]. The 6th DAI parameter assesses previous mandible misalignments, in this investigation 18.7% of the children observed presented this occlusal problem, a similar result found by Bauman et al. (2018), higher values were reported by other authors [20-24]. Maxillary overjet occurred in 70.0% of the children evaluated, most with 1mm (24.4%) or 4mm (23.9%). Sanadhya et al. (2014) found that 36.1% of the children had maxillary overjet of 1 mm and 12.7% of 4 mm. In the studies that analyzed only the highest overjet value, i.e., 4 mm, they found values slightly higher than those determined in this investigation [20-23]. Mandibular overjet in this investigation was present in only 2.7% of children, equally low percentages obtained in different studies [20-24].

The presence of anterior open bite in this investigation was observed in 40.6% of the children, a situation totally opposite to the other investigations, all with much lower values [20-24]. The last parameter of the DAI evaluates the molar relationship, in this investigation the normal molar relationship predominated, a situation also found in the studies mentioned above [20-24].

Analyzing the parameters of gender and age, the results obtained in this study as well as in the studies mentioned above did not present results with statistical significance, except in the analysis of the crowding regarding age in the investigation of Sanadhya et al. (2014), having been higher in individuals aged 12 years in one and in both regions (p=0.000). In the same study they determined that spacing, interincisive diastemas and anterior maxillary misalignment are less prevalent with advancing age, making it difficult to specify the relationship between their occurrence and age [20].

It should be noted that in the study developed by Singh et al. (2019), in the analysis of mandibular overjet there were no differences between the ages studied and in the open bite component they observed the same percentage in all ages except at 15 years where there was no open bite [24].

After categorizing the DAI index, the results obtained in this investigation determined that 62.5% of the children observed present normal occlusion so, without the need for treatment or slight need for treatment. In the distribution of malocclusions, 11.3% corresponded to defined malocclusion, with elective need for orthodontic treatment, 4.3% corresponded to severe malocclusion with a highly desirable need for orthodontic treatment and 21.9% of very severe malocclusion, and priority treatment was considered mandatory. According to other authors, the result obtained in normal occlusion is similar to those found in this investigation. Comparing malocclusion, most studies found slightly higher values for defined occlusion and severe occlusion and lower values of very severe malocclusion [20-24]. Analyzing the occlusion averages, it can be seen that Angola is statistically within the normal occlusion average of the countries analyzed and out of the average of malocclusions compared to these countries. (Table 4)

Table 4: *Comparison of the percentage of occlusion between Angola and other countries*

	Normal occlusion	Defined malocclusion	Severe malocclusion	Very severe malocclusion
Angola	62,5%	11,3%	4,3%	21,9%
Average countries	63,7% (8,4)	18,3% (7,3)	10,9% (6,5)	6,7% (3,8)

Conclusion

Taking into account the limitations of this study it was possible to conclude that 62.5% of the subjects have normal occlusion and the rest present malocclusion, requiring the latter for treatment. Compared to other countries, normal occlusion was similar, however, defined malocclusion and severe malocclusion were percentage lower and malocclusion far superior to other countries, demonstrating differences in malocclusion. Social factors of gender and age are not correlated with malocclusion.

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