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Article

Prevalence of malocclusion and non-physiological oral habits in primary school Children from Ercilla, Chile.

Prevalencia de maloclusión y hábitos bucales no fisiológicos en niños de primaria de Ercilla, Chile.

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Abstract: Introduction: Dentomaxillary Anomalies (DMA) affect the growth and morphology of the stomatognathic system of individuals, representing a public health problem. Few studies have described its prevalence among vulnerable populations in Chile. The aim of the study was to explore the prevalence of DMA and its association to non-physiological habits (NFH) and sociodemographic characteristics among primary school children living in Ercilla, Chile. **Material and Methods:** A convenience sample of 327 primary school students from six schools in Ercilla, were assessed through an intraoral and extraoral evaluation. Overjet, overbite, molar relationship, presence of DMAs, and NFHs were measured. Descriptive statistics, analysis of association between DMAs and studied factors, and logistic regression models were done and odds ratio with 95% confidence intervals presented. **Results:** A total of 61.5% of students presented at least one DMA. Chi-square test showed no significant association between DMA prevalence and NHFs, however, after adjusting for sociodemographic factors, children with NFH were 1.69 (95%CI 1.02-2.78) times more likely to have DMAs. Gender and area of residence were not significantly associated with DMAs. **Conclusion:** In children from Ercilla, DMAs were associated with NFHs, however, sociodemographic characteristics did not have a significant role in the presence of DMA, suggesting that sociodemographic factors might not strongly influence orthodontic needs among children from this geographical area.

Keywords: Malocclusion; dentition; children; rural population; habits; epidemiology.

Resumen: Introducción: Las anomalías dentomaxilares (ADM) afectan el crecimiento y la morfología del sistema estomatognático de los individuos, lo que representa un problema de salud pública. Pocos estudios han descrito su prevalencia en poblaciones vulnerables en Chile. El objetivo del estudio fue explorar la prevalencia de ADM y su asociación con hábitos no fisiológicos (HNF) y características sociodemográficas en niños de escuela primaria que viven en Ercilla, Chile. **Material y Métodos:** Se evaluó una muestra de

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conveniencia de 327 estudiantes de educación básica de seis escuelas de Ercilla mediante una evaluación intraoral y extraoral. Se midieron el resalte, la sobremordida, la relación molar, la presencia de DMA y HNF. Se realizó estadística descriptiva, análisis de asociación entre ADMs y los factores estudiados, y modelos de regresión logística y se presentaron odds ratio con intervalos de confianza del 95%. **Resultados:** El 61,5% de los alumnos presentó al menos una ADM. La prueba de chi-cuadrado no mostró una asociación significativa entre la prevalencia de ADM y HNF, sin embargo, después de ajustar de acuerdo a factores sociodemográficos, los niños con HNF tenían 1,69 (IC del 95%: 1,02 a 2,78) veces más probabilidades de tener ADMs. El género y el área de residencia no se asociaron significativamente con las ADMs. **Conclusión:** En los niños de Ercilla, las DMA se asociaron con NFH, sin embargo, las características sociodemográficas no tuvieron un papel significativo en la presencia de DMA, lo que sugiere que los factores sociodemográficos podrían no influir fuertemente en las necesidades de ortodoncia entre los niños de esta área geográfica.

Palabra Clave: *Maloclusión; dentición; niño; población rural; hábitos; epidemiología.*

INTRODUCTION.

Dentomaxillary anomalies (DMA) are oral disorders that affect the masticatory function, craniofacial development, and facial features.[1] They appear as a result of alterations in the development of the different stomatognathic system structures[2] including bone, muscle, and/or teeth. This leads to deviations in the inter and intra maxillary relationships of teeth.[3,4]

Its aetiology is multifactorial and includes hereditary, congenital and environmental factors, abnormal pressures, presence of non-physiological habits, and factors that directly affect the dental substance. The World Health Organisation (WHO) estimates that malocclusions are the third most prevalent oral health problem worldwide after dental caries and periodontal disease affecting 50% of the world's population.[5,6]

A global systematic review in mixed and permanent dentition found that the overall prevalence of horizontal and vertical malocclusions was 25.49% and 26.91% respectively. The authors reported a higher prevalence of class III in permanent dentition compared to mixed dentition. In the same study, the highest prevalence of class II in permanent dentition was reported in Europe. While the prevalence of class II, III, and open bite malocclusions in mixed dentition occurred mainly in Europe (31.95%), Asia (5.76%) and Africa (8.3%)[7] respectively.

In Chile, a study of 12-15 years-olds in Viña del Mar Municipality showed a 63% DMA prevalence.[8] However, there are cities where higher proportions have been reported: in Frutillar, 96.2% of a sample of children 6-15 years of age had DMA,[9] and in Temuco 82% of children aged 8-14 years had one or more DMA in transversal, sagittal or vertical plane.[10]

Among DMA etiological factors are the persistence of non-physiological habits and dysfunctions during the first years of life.[11] These dysfunctions can interfere with occlusion and normal facial or cranial development.[12] The influence of these habits in the subject depends, among other factors, on cell resistance, the facial pattern of the child, and other factors directly linked to the habit such as intensity, frequency, and time of habit practice.[13] Among the non-physiological habits that can be observed in the clinical evaluation, it is included the use of pacifier or bottle, thumb sucking, tongue thrusting, mouth-breathing, and nose-mouth-breathing.[14]

Studies reveal the presence of a wide range of oral habits in children; which vary according to population, race, and geographic location; and there is support that their presence is influenced by factors such as gender, diet, age, socioeconomic level, and education.[15]

Few studies have been carried out to determine the prevalence of DMA in children and adolescents in rural areas or belonging to indigenous populations. In this context, it is important to know the distribution of malocclusions in this population group due to the particular sociodemographic characteristics that define them and habits they might have.[16]

Ercilla Municipality is located in the province of Malleco in the region of La Araucania, in Chile. It is characterized by its rurality, where 64.2% of the population live in rural areas and 35.8% in urban areas.[17] There are 10 public educational establishments in Ercilla, 8 located in rural areas with a total of 481 students, and 2 in urban areas with a total of 431 students. According to the data from the 2017 Census *(http:/www.Results.censo2017.cl/Region?R=R09)*, the average schooling years of the household head was 7.7 years and 53% of its inhabitants declared that they had aboriginal ancestry.[18]

In this context, the objective of this study was to explore the prevalence of DMA and its association to non-physiological habits and sociodemographic characteristics among primary school children living in Ercilla, Chile.

MATERIALS AND METHODS.

A cross-sectional study based on secondary data from a preventive intervention programme was carried out using a convenience sample of 5-to-11-year-old children. The sample consisted of all students from first to fifth year of six primary schools in Ercilla selected to participate in an DMA prevention project conducted between August 2017 and November 2018. The prevention project consisted of the following three stages:

1) Diagnosis (September-October 2017);

2) Dental trainer delivery (October 2017);

3) Six check-ups, at 15 days (November 2017), 1 month (December 2017), 4 months (March 2018), 6 months (May 2018), 9 months (August 2018) and one year after the intervention (November 2018). The sample size was determined by the total enrolment of the selected establishments.

From ten primary schools in Ercilla, six were chosen according to their availability by the Ercilla Municipal Department of Education; of these, four were located in rural areas and two in urban areas. All students from these six schools with written informed consent were included in the study. Students with orthodontic treatment before or at the time of the study, with severe craniofacial anomalies or those who did not accept the clinical examination were excluded from the project and the study.

Written communication and informed consent forms were sent to each parent and/or guardian to be signed authorizing participation of their child in the study. The students thus authorized underwent an intraoral and extraoral examination. The examination was carried out on the premises of each participating school. For the selection of the examination space, the room had to be separated from the classroom and have ventilation and appropriate natural light. Also, the room had to have a desk, chairs, and a trash bin as well as drinking water in the educational establishment. For clinical examination latex gloves, masks, mouth-opener, breastplate, disposable paper towels, denatured ethanol at 70%, and caliper were used.

The data of each student was collected through an individual clinical file in Excel format. The variables collected were: school area (urban/rural), age, gender, mm of overjet (OJ) and overbite (OB), molar class (type I, II or III), and type of dentition: deciduous, mixed, or permanent. Also presence of non-physiological habits including atypical swallowing, mouth-breathing, nose-and-mouth-breathing, and tongue thrust. The prevalence of DMAs were recorded and categorised using the classification by Zhou *et al*.,[4] Sagittal DMAs defined were anterior crossbite, edge-to-edge occlusion and increased overjet (>3mm.). Vertical DMAs included open bite, and increased overbite (>3 mm.). No transversal DMAs were included in the study as they were not measured during the clinical examinations in the prevention project. Three dentists carried out the clinical examinations. Previously, a meeting to discuss the diagnostic criteria was done to calibrate the dentists at the beginning of the project. Eight visits were made to each school during one year as part of the prevention project; of these eight visits, one was destined to the presentation and coordination of activities with the school, in addition to the delivery of the informed consent form, and another visit was exclusively intended to carry out the diagnosis and data collection.

Statistical analysis was carried out using STATA statistical software version 15.1. Descriptive statistics by gender were done. Then, association tests (chi-square, chi-square test-for-trend and Fisher exact test) between overall DMA prevalence, and each type of DMA with sociodemographic characteristics, oral variables, and non-physiological habits were done. A p-value<0.05 was considered to be evidence of a significant association between analysed variables. Afterwards, logistic regression models were carried out for overall DMA prevalence and significant DMAs adjusted for sociodemographic variables. Odds ratios (OR), 95% confidence intervals (95%CI) and p-values were reported.

Figure 1. Flowchart of sample population size.

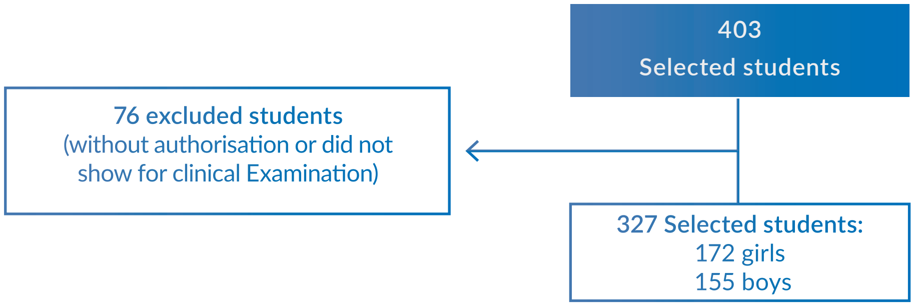

Table 1. Distribution of sociodemographic and oral characteristics, and non-physiological habits among 5-11 year-old children from Ercilla, Chile.

Categorical Variables		Gender			
		Boys		Girls	
		N	%	N	%
Age	5-8 year-olds	99	50.25	98	49.75
	9-11 year-olds	57	43.85	73	56.15
Area	Urban	76	47.80	83	52.20
	Rural	80	47.62	88	52.38
Type of dentition	Deciduous	0	0.00	3	100.00
	Mixed	147	48.84	154	51.16
	Permanent	9	39.13	14	60.87
Occlusion	I class	114	49.35	117	50.65
	II class	20	40.82	29	59.18
	III class	22	50.00	22	50.00
	Not registered*	0	0.00	3	100
Overjet	Negative	30	48.39	32	51.61
	0 mm	3	50.00	3	50.00
	1 mm	15	45.45	18	54.55
	2-3 mm	72	45.28	87	54.72
	4-5 mm	29	0.88	28	49.12
	>5 mm	6	66.67	3	33.33
Overbite	Negative	3	27.27	8	72.73
	0 mm	3	50.00	3	50.00
	1 mm	25	49.02	26	50.98
	2-3 mm	65	45.77	77	54.23
	4-5 mm	45	48.39	48	51.61
	>5 mm	13	59.09	9	40.91
Non-physiological habit Prevalence	Yes	51	47.66	56	52.34
	No	105	47.73	115	52.27
Atypical swallowing	Yes	23	54.76	19	45.24
	No	133	46.67	152	53.33
Mouth-breathing	Yes	7	87.50	1	12.50
	No	149	46.71	170	53.29
Nose-and-mouth-breathing	Yes	24	46.15	28	53.85
	No	132	48.00	143	52.00
Tongue thrust	Yes	32	47.06	36	52.94
	No	124	47.88	135	52.12

*:Molar class was not measured in children with deciduous dentition

Table 2. Distribution of Dentomaxillary Anomalies among 5-11 year-old children from Ercilla, Chile.

Dentomaxillary anomalies (DMA)		Gender: Boys N	Boys %	Girls N	Girls %
DMA Presence	Yes	95	47.26	106	52.74
	No	61	48.41	65	1.59
Anterior crossbite	Yes	33	45.83	39	54.17
	No	123	48.24	132	51.76
Edge-to-edge occlusion	Yes	3	50.00	3	50.00
	No	151	47.34	168	52.66
Increased overjet	Yes	35	53.03	31	46.97
	No	120	46.15	140	53.85
Open bite	Yes	4	33.33	8	66.67
	No	152	48.25	163	51.75
Deep overbite	Yes	58	50.43	57	49.57
	No	96	45.71	114	54.29

Table 3. Association between sociodemographic factors and non-physiological habits with overall and specific prevalence of DMA.

Variables	DMA prevalence N (%)	p-value[1]	Anterior crossbite N (%)	*p*-value[1]	Edge-to-edge N (%)	*p*-value[3]	Increased Overjet N (%)	*p*-value[1]	Increased Overbite N (%)	*p*-value[1]	Open bite N (%)	*p*-value[3]
Age												
5-8 year-olds	113(57.4)	0.06	45 (22.8)	0.658	4 (2.1)	0.544	28 (14.3)	0.001	56 (28.7)	0.002	7 (3.55)	1.000
9-11 year-olds	88 (67.7)		27 (20.8)		2(1.5)		38 (29.2)		59 (45.4)		5 (3.85)	
Gender												
Boys	95 (60.9)	0.84	33 (21.2)	0.719	3(2.0)	0.607	35 (22.6)	0.318	58 (37.7)	0.415	4 (2.56)	0.385
Girls	106 (62.0)		39 (22.8)		3 (1.8)		31 (18.1)		57 (33.3)		8 (4.68)	
Area												
Urban	101 (63.5)	0.458	30 (18.9)	0.181	1 (0.6)	0.118	33 (20.8)	0.823	63 (39.6)	0.118	8 (5.03)	0.247
Rural	100 (59.5)		42 (25.0)		5 (3.0)		33 (19.8)		52 (31.3)		4 (2.38)	
Type of dentition												
Deciduous	0 (0.0)		0 (0.00)		0(0.0)		0 (0.0)		0 (0.00)		0 (0.00)	
Mixed	182 (60.5)	0.005[2]	65 (21.6)	0.209[2]	6 (2.0)	0.582[2]	58 (19.3)	0.05[2]	103 (34.5)	0.039[2]	11 (3.65)	0.777[2]
Permanent	19 (82.6)		7 (30.4)		0 (0.0)		8 (34.8)		12 (52.2)		1 (4.35)	
NFS prevalence												
Yes	128 (58.18)	0.08	31 (29.0)	0.034	2 (1.9)	0.636	26 (24.3)	0.203	26 (24.5)	0.004	12 (11.21)	<0.001
No	73 (68.22)		41 (18.6)		4 (1.8)		40 (18.3)		89 (40.6)		0 (0.00)	
Atypical swallowing												
Yes	30 (71.4)	0.155	11 (26.2)	0.485	1 (2.4)	0.558	11 (26.2)	0.304	8 (19.5)	0.023	10 (23.81)	<0.001
No	171 (60.0)		61 (21.4)		5(1.8)		55 (19.4)		107 (37.7)		2 (0.70)	
Mouth-breathing												
Yes	8 (100.0)	0.023	3 (37.5)	0.285	0(0.0)	0.860	5 (62.5)	0.003	3 (37.5)	0.899	1 (12.50)	0.261
No	193 (60.5)		69 (21.6)		6 (1.9)		61 (19.2)		112 (35.3)		11 (3.45)	
Nose-and-mouth-breathing												
Yes	31 (59.6)	0.765	12 (23.1)	0.841	1 (2.0)	0.644	10 (19.2)	0.843	12 (23.5)	0.054	3 (5.77)	0.414
No	170 (61.8)		60 (21.8)		5 (1.8)		56 (20.4)		103 (37.6)		9 (3.27)	
Tongue thrust												
Yes	46 (67.7)	0.239	22 (32.4)	0.021	0 (0.0)	0.247	14 (20.6)	0.937	13 (19.4)	0.002	11 (16.18)	<0.001
No	155 (59.9)		50 (19.3)		6 (2.3)		52 (20.2)		102 (39.5)		1 (0.39)	

1: Chi², **2:** Chi² test-for-trend, **3:** Fisher exact test. **NFS:** Non-physiological habits

Table 4. Logistic regression models for DMA prevalence, open bite, increased overbite and anterior crossbite according to prevalence of non-physiological habits adjusted for individual variables.

Variables		DMA prevalence		Open bite		Increased Overbite		Anterior crossbite	
		OR (95%CI)	*p*-value	OR (95%CI)	*p*-value	OR (95%CI)	*p*-value	OR (95%CI)	*p*-value
NFH Prevalence	No	Ref.	0.04	-- --*	-- --*	Ref.	0.013	Ref.	0.032
	Yes	1.69 (1.02-2.78)				0.51 (0.30-0.87)		1.82 (1.05-3.16)	
Age	5-8 year-olds	Ref.	0.03	Ref.	0.327	Ref.	0.008	Ref.	0.959
	9-11 year-olds	1.69 (1.05-2.72)		1.87 (0.53-6.59)		1.91 (1.18-3.07)		0.99 (0.57-1.71)	
Gender	Boys	Ref.	0.946	Ref.	0.317	Ref.	0.318	Ref.	0.723
	Girls	1.02 (0.65-1.60)		1.92 (0.53-6.94)		0.79 (0.49-1.26)		1.10 (0.65-1.87)	
Area	Urban	Ref.	0.575	Ref.	0.297	Ref.	0.098	Ref.	0.147
	Rural	0.88 (0.56-1.38)		0.51 (0.14-1.82)		0.67 (0.42-1.07)		1.48 (0.87-2.54)	

N*: A logistic model cannot be created because 100% of children with open bite had at least one non-physiological habit (model predicts outcome perfectly).

RESULTS.

From the 403 students enrolled in first to fifth grade in the six educational establishments under study, 327 (81.14% of the initial sample) were examined. The 76 unexamined students were not authorized by their parents to participate or did not show up for clinical evaluation (Figure 1). The average age of participants was 7.91 years. Of which 52.6% were female and 47.4% male.

Table 1 presents the descriptive statistics of the sample under study. The proportion of children according to their gender was similar in terms of age, area of residence and molar class. While most children had mixed dentition. Regarding NFH, 32.7% of children presented at least one (47.7% were boys and 52.3% girls). On the other hand, 61.5% of children had at least one DMA of which 47.3% were boys and 52.7% were girls (Table 2).

When exploring associations (Table 3), DMA prevalence was significantly associated only to a mouth-breathing habit. Having at least one NFH was significantly associated with anterior crossbite, increased overbite and open bite, while it was not significantly associated with overall DMA prevalence, edge-to-edge occlusion and increased overjet. Gender and area of residence were not significantly associated with DMAs, while significant differences in age were found among children with increased overjet and increased overbite.

The regression models adjusted for sociodemographic characteristics in Table 4 show that children with at least one non-physiological habit were 1.69 (95%CI 1.02-2.78) times more likely to have DMAs. More specifically children with at least one NFH were 1.82 (95%CI 1.05-3.16) times more likely to have anterior crossbite and 0.51 times (95%CI 0.30-0.87) less likely to present increased overbite. No model of open bite and overall non-physiological habit prevalence could be created as all children with open bite had at least one non-physiological habit (model predicted outcome perfectly).

DISCUSSION.

The study carried out showed that 61.5% of the students from first to fifth grade in the Ercilla Municipality presented DMA. No significant differences were found according to gender and residential area. The prevalence is lower to that reported in previous studies. In a study of adolescents between 13 and 15 years-old in Kerala, India, there was an 89.9% prevalence of DMA,[19] while in Frutillar 96.2% of children and adolescents between 6 and 15 years presented some type of malocclusion.[9]

On the other hand, a study in the Biobío region with adolescents 14-21 years belonging to the Mapuche ethnic group reported a 67.4% prevalence of malocclusions, these being mainly in permanent teeth.[16] The difference in prevalence by type of dentition can be explained due to the sample of students of older age in the study of Cartes-Velásquez.[16] and therefore with permanent dentition. Whereas the present study was conducted in younger children (5 to 11 years) characterized by mixed dentition and the exfoliation of the primary teeth.

In the La Araucanía region, a study in children 8-14 years of age in the urban area of Temuco, showed that 82% had some type of dentomaxillary anomaly.[10] This is rather different from our results, and may be due to differences in the definition of malocclusion between studies and differences in habits between children according to their geographic and cultural characteristics. The ethnic population in Ercilla was 53%, while in Temuco was of 25%, being the predominant population Mapuche with 97.8 % and 97% representativeness respectively.[18] No significant differences according to gender and urban or rural area of residence was found in our study, and age was only associated with two specific DMAs.

A possible explanation could be that ethnicity, and its cultural component, could have a stronger influence in oral health status than rurality, gender or age, variables traditionally associated to a worse oral health status.[20]

Regarding the prevalence of non-physiological habits, this study showed that among Ercilla's primary school students, the prevalence was lower than in other studies, such as when compared with the results of Mendoza *et al*.,[21] carried out on a sample of Mexican population consisting of children from 2 to 15 years old about lingual interposition and mouth-breathing, which may be related to the sample age ranges. Also, when including such early ages it involves the greater use of devices such as pacifiers and/or bottles, which affect the physiological development of the orofacial apparatus and perpetuate or aggravate the presence of dentomaxillary disorders.[21]

The association test did not show a significant association between DMA prevalence and having at least one NFH, however, after adjusting for socio-demographic characteristics, the logistic regression models did show that children with NFH were more likely to have DMAs. In this sense, sociodemographic variables were confounding the effect of NFHs on DMAs and the logistic model could address this issue.

However, it is also important to mention that it is likely that other variables not included in the study may still confound the results. This could partially explain why the models predicted a lower likelihood of having increased overbite by children with NFHs or the perfect prediction of open bite. Another possible explanation could be a small sample size, which could also be related as to why increased overjet and edge-to-edge occlusion were nor significantly associated with NFHs.

Among the study limitations, as this is a secondary data analysis from a prevention project dataset which did not have research as primary purpose, there were limited available variables to include in the analysis. Other variables such as socioeconomic position, or a more specific index to assess orthodontic treatment need could have allowed a more thorough analysis. Also, the use of a convenience sample can lead to selection bias.

However, considering that this study is a first approximation to a population group rarely studied with a representative sample of a Municipality with a high indigenous (Mapuche) population, and that most children of the Municipality participated, this study can provide some insights of orthodontic need and the influence of sociodemographic characteristics among a Mapuche population.

In children from Ercilla, DMAs were associated with NFHs, however, sociodemographic characteristics did not have a significant role in the presence of DMA, suggesting that sociodemographic factors might not strongly influence orthodontic needs among children from this geographical area. The high prevalence of DMA in children in the Ercilla Municipality is a relevant aspect to consider in dental public health policies. The presence of malocclusions constitutes a highly prevalent public health problem worldwide, which becomes more important to address in populations in vulnerable conditions, such as those that inhabit rural areas and belong to indigenous population groups, factors that are associated with greater oral damage and fewer visits to the dentist.[22]

The prevalence of DMA is heterogeneous, and it varies between age groups and geographical areas, so characterizing the distribution of these conditions in each community is essential to implement prevention and early or corrective treatment measures, as well as methods and/or programs to identify early non-physiological habits that are important risk factors in the appearance and complication of the prognosis of DMA.

Conflict of interests: The authors declare a potential conflict of interest produced by the financing of the community project from which the data for this publication was obtained by private institutions. We inform that the writing of the article did not imply the participation of the aforementioned financing institutions, nor will the authors receive any form of financing from them as a result of this publication.

Ethics approval: This study did not need ethical approval by an ethics committee because it is based on secondary data obtained from a prevention project for dentomaxillary anomalies in a community setting. The project was approved by the Education department of the Municipality of Ercilla, the participating schools and the parents of the participating children.

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