Prevalence of Malocclusion and Dental Caries Among Aymara Children in Colchane, Chile

Prevalencia de Maloclusión y Caries Dental en Niños Aymaras de Colchane, Chile

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SEGEUR, S. K.; FUENTES, K. F.; SABANDO, F. V.; DONAIRE, A. F. & VÁSQUEZ, H. A. Prevalence of malocclusion and dental caries among aymara children in colchane, Chile. *Int. J. Odontostomat., 14(2)*:191-197, 2020.

ABSTRACT: Describe the prevalence of malocclusions, dental caries and the need for orthodontic treatment according to the Index of Orthodontic Treatment Need (IOTN) among Aymara schoolchildren, Indian group has lived in the highlands of the Andes Mountains. 76 Aymara schoolchildren between 5 and 15 years old in Colchane, Chile, where a cross-sectional study was conducted. DMFT/dmft index, Dental component (DHC) of IOTN and demographics were determined. Frequencies and mean (SD) were calculated. Bivariate analyses were conducted using Fisher's exact to test the association between sex and stage of dentition ($p<0.05$). Stata version 14 was used for all analyses. Among the 76 participants, 47.4 % (N=36) were male. Participants were on average 9.96 years old (SD=2.5). Over half presented dental caries (61.8 %, n=47) and 36.8 % (N=28) had missing teeth due to caries. The DMFT index was 2.1 (SD=1.9). The most frequent biotype was brachyfacial 88.2 % (N=67). Malocclusion was observed in 81.6 % (N=62) of participants. Class I, was the most frequent (67 %, N=51) malocclusion in the different stages of dentition. The most prevalent treatment need was grade 4 and 5 "need treatment" of the IOTN, observed in 71 % (N=54) of the sample with significant differences according to the stage of dentition ($p<0.05$). In this study, a high prevalence of malocclusion and a high percentage of dental caries was observed in Aymara children.

KEY WORDS: Aymara, malocclusion, caries, orthodontics, index of treatment need.

INTRODUCTION

Malocclusions or dentomaxillary disharmonies are defined as deviations from the normal relationships between teeth and jaws. Specifically, malocclusions are clinically significant variations from the normal fluctuation of growth and morphology of the oral structure (Moyers, 1992), which, in most cases, is the result of a relative discrepancy between teeth and bone size or from a inharmoniousness in the development of the maxillary bone (Barranchina, 1988).

Occlusion expression is the result of genetic and environmental components. The etiology of malocclusion is complex and variable, however, the genetic contribution, specifically the effect of population admixture, has been observed in relation to the development of oral pathologies such as caries and periodontal disease, which are also related to social determinants such as poverty (Farsi & Salama, 1997; Marmot & Bell, 2011). On the other hand, the effect of oral habits could be a potential agent for the development of a malocclusion, which could have a greater or lesser effect on the structures of the stomatognathic system depending on frequency, duration and intensity (Farsi & Salama; Chevitarese *et al*., 2002; Marmot & Bell).

In Chile, the prevalence of malocclusions varies from 65 % to 72.6 % in children between 5 and 15 years of age. However, prevalence of malocclusions and dental anomalies depends on ethnic group, age-range, and diagnosis criteria (Burgos, 2014).

Since pre-Columbian times, the Aymara American Indian group has lived in the highlands of the Andes Mountains. Contemporarily, this includes cities in towns in the north of Chile. One such town is Colchane, a rural community located 3700 meters above sea level, neighboring Bolivia, in the Tarapacá region. Colchane has a population of 1,728, 85 % of whom identify as belonging to a Native American group, 87.6 % Aymara (Instituto Nacional de Estadísticas, 2017). According to the National Socioeconomic Characterization Survey (Casen Survey) (Ministerio de Desarrollo Social y Familia, 2017), Colchane is one of the poorest communities of Chile, according to Casen Survey (Ministerio de Desarrollo Social y Familia). The incidence of multidimensional poverty in Chile is 20.7 % and 24.9 % in the Tarapacá region where Colchane is located (Instituto Nacional de Estadísticas; Ministerio de Desarrollo Social y Familia). Thus, this group is a good model for observing the impact of the environmental factors and ethnic influences in oral pathologies including malocclusion, dental caries, and oral habits.

This study aims to describe the prevalence of malocclusions, dental caries and need of orthodontic treatment according to the DHC-IOTN among Aymara schoolchildren in Colchane, Chile.

MATERIAL AND METHOD

As part of a cross-sectional study to establish the prevalence of malocclusions and dental caries, a dental examination was conducted with children between 5 and 15 years old from Colchane. The IOTN and demographic information was also collected, and children were photographed. This study was approved by the Ethics Committees. Then, parents, teachers and children were consulted and consent for participation in the study requested. Study researchers confirmed that there was no Aymara social or political organization (e.g. Elders Council, Chief or Lonco) in the community of Colchane, which may have required researchers to request special permissions to conduct a study.

The sample size was calculated for a simple random sample of proportions from a finite population, with 95 % significance, 5 % accuracy and 65 % malocclusion prevalence (Burgos; Pincheira Garcés *et al*., 2016). The result was 75 students. Ninety-five children registered in pre-school and basic education (1st to 8th grade) from the 5 schools belonging to municipality of Colchane: Cariquima Primary School (7 students); Colchane Primary School (79 students), Enquelga Primary School (1 student), Mauque Primary School (1 student), Pisiga-Choque Primary School (7 students) were enrolled.

This study excluded children with cognitive or physical limitations who could not follow instructions, children who had previously received orthodontic treatment, those who reported using or having used fixed or removable dental appliances and children who were not Aymara (determined via self-identification or maternal or paternal surname).

In this study, the Index of Orthodontic Treatment Need (IOTN) was used to identify malocclusion and unmet treatment needs. The index has a Dental Health Component (DHC) for dental occlusion and alignment and an Aesthetic Component (AC) which the patient self-reports based on 10 standardized images. The DHC-IOTN was used to classify the need for orthodontic treatment in 5 categories Grade 1: No need; Grade 2: Mild, Grade 3: Borderline; Grade 4: In need and Grade 5: Extreme need (Brook & Shaw, 1989; Proffit, 2018). Before study enrollment, examiners were trained on the use of the diagnostic instrument, DHC-IOTN, clinical registry, and photographs Then, in a second phase, the examiners and an orthodontic specialist performed clinical diagnostics and applied the index to 5 students with similar characteristics as the study population. There was high concordance between examiners, with Kappa values of 0.85.

The clinical examination was conducted at the Primary Health Care Center of Colchane in a dental chair by a single examiner, with artificial light, 45º of chair inclination, sterile disposable mirror, water and air for drying. Clinical photographs were taken with a NikonÒ D500 camera, TamronÒ 60mm MACRO 1:1 lens, Macro Ring flash, ManfrottoÒ MT290 Xtra Carbon Fiber Tripod, ManfrottoÒ MH804 3-way Pan/Tilt Head. For the extraoral photos, the patients were placed in front of a white curtain with a true vertical positioner at 85 cm. from the camera. A profile picture was considered in Natural Head Position (NHP), where was applied Rickets and Spradley analysis for soft tissues and a frontal photo to evaluate facial biotype and both vertical and horizontal symmetry. Five intraoral photographs were taken per patient (Paredes *et al*., 2006).

For the model cast registrations was used a Rim Lock cuvette with Jeltrate Chromatic alginate

(DentsplayÒ). Using the model, the molar class was reviewed and compared with the molar class registered in the clinic. Additionally, the presence of dental alterations such as inclination, diastema, rotations of the teeth, alterations of the Spee curve, presence of compressions, overjet and overbite was evaluated.

Descriptive analysis was conducted using measures of central tendency and dispersion for quantitative variables and measures of frequencies for categorical variables. To evaluate the relationship between orthodontic index, age and sex we used Fisher´s exact test with a p<0.05 level of significance. All analyses were conducted in Stata v14.

RESULTS

Of the 95 primary schoolchildren from Colchane enrolled, 76 (80 %) completed the oral examination. Of the 19 (20 %) without oral examinations, 3 did not comply with the inclusion criteria (2 genetic disorders and 1 non-Aymara), 1 student was ill, 2 withdrew, 1 with interceptive orthodontic treatment, and 12 did not provide consent (1 student refusal, 9 parental refusals and 2 parents were unable to be contacted to sign consent).

Among the 76 participants, 47.4 % (N=36) were male and 52.6 % (N=40) female. The average age was

Table I. Experiences of oral health of children Aymara of the of Colchane commune.

	Total %(N)	Man %(N)	Woman %(N)	p Value [a]
Dentoalveolar trauma (TDA)				
No	89.5 (68)	39.5 (30)	50.0 (38)	0.140
Yes	10.5 (8)	7.9 (6)	2.6 (2)	
Number of bad habits				
None	42.1 (32)	18.4 (14)	23.7 (18)	0.790
One	39.5 (30)	21.1 (16)	18.4 (14)	
>2	18.4 (14)	7.9 (6)	10.5 (8)	
Oral habit				
None	42.1 (32)	18.4 (14)	23.7 (18)	0.990
Mouth breathing	17.1 (13)	9.2 (7)	7.9 (6)	
Lingual interposition	19.7 (15)	9.2 (7)	10.5 (8)	
Other (Onychophagia and	13.2 (10)	6.6 (5	6.6 (5)	
Mouth breathing/Interposition	7.9 (6)	4.0 (3)	4.0 (3)	
Hygiene index (surfaces with	1.3 (1)	0	1.32 (1)	0.053
5-20%	32.9 (25)	10.5 (8)	22.4 (17)	
21-49%	65.8 (50)	36.8 (28)	29.0 (22)	
>50%				
Dental caries				
No	38.2 (29)	19.7 (15)	18.4 (14)	0.359
Yes	61.8 (47)	27.6 (21)	34.2 (26)	
Missing teeth				
No	63.2 (48)	30.3 (23)	32.9 (25)	0.545
Yes	36.8 (28)	17.1 (13)	19.7 (15)	
Dental alterations				
None	89.5 (68)	42.1 (32)	47.4 (36)	0.133
Number	1.3 (1)	0	1.3 (1)	
Eruption process	3.95 (3)	3.95 (3)	0	
Both	2.6 (2)	0	2.6 (2)	
Without registration	2.6 (2)	1.32 (1)	1.3 (1)	
Alteration permanent first molar				
None	86.8 (66)	38.2 (29)	48.7 (37)	0.273
Destruction >50% the crown	6.6 (5)	5.3 (4)	1.3 (1)	
Missing	5.3 (4)	2.6 (2)	2.6 (2)	
Without registration	1.3 (1)	1.3 (1)	0	

a p<0.05; Fisher's exact test

9.96 (s.d. 2.5). The majority (85.5 %, N=65) reported no health issues, with 14.5 % reporting items such as ophthalmological problems, headaches, epilepsy, and minor surgeries, among others.

The average age for children with temporary dentition was 5.3 (SD= 0.57) years old, mixed dentition at first and second phase was 7.6 and 10.5 years, respectively, and 12.8 years for permanent dentition.

In the sample, 10.5 % of students had a history of Dento Alveolar Trauma, with no significant difference by sex (p>0.05). Poor oral habits were identified in 58 % of children; the most common oral habit was lingual interposition or atypical swallowing 19.7 % (N =15), followed by mouth breathing 17.1 % (N=13). No habit significantly differed by sex (p>0.05). For the Silness and Loe hygiene index, the category containing more than 50 % of the sites with biofilm was the most frequent 65.8 % (N=50) (Table I).

Dental caries was observed in 61.8 % (N=47) of children and 36.8 % (N=28) presented missing teeth due to caries. No significant differences were observed by sex (p>0.05). The most frequent dental alteration (4 %) related to the eruption process, and 4 children were missing the first permanent molar (Table II).

In the analysis of caries with DMFT/dmft, an average of 5.3 (SD=2.9) teeth with caries were observed in primary dentition and 7.2 (SD = 3.8) in the first stage of mixed dentition. In the case of DMFT with mixed dentition, the second stage contained 1.1 (SD= 1.6) and 2.1 (SD=1.9) in the case of the definitive dentition stage with a median of 2 (Table II).

Concerning the craniofacial characteristics of the students, the most frequent biotype was brachyfacial 88.2 % (N=67). The straight profile was found in 50 % of children and the convex profile in 46.6 %. Horizontal and vertical asymmetry was observed in 35.5 % (N=27) and 47.4 % (N=36), respectively, with no difference by sex (p>0.05).

Regarding soft tissue diagnosis, there was a significant sex difference for the Spradley analysis. For diagnosis values of upper lip, the most frequent was the norm for both men and women with 59 % (N=44). There were significant differences in the diagnosis of protruded upper lip by sex, with a higher prevalence of protrusion in men compared to women (27.6 %, N=21 vs 14.5 %, N=11) (p<0.05). In relation to the diagnosis of the lower lip, the highest percentage was 80.3 % (N=61), with significant differences by where 7.9 % (N=6) of men presented this condition versus women (N=0, p<0.05). For Spradley's analysis, the mandibular retrusion was greater among females with 30.3 % (N=23) compared to males with 18.4 % (N=14). Finally, in the Ricketts analysis, the predominant characteristic was lower labial protrusion with 59 % (N=45), with no significant difference by sex.

According to the characteristics of the malocclusion, Class I was the most frequent in the different stages of dentition 67 % (N=51). The highest frequency of Class III in mixed dentition second phase had a frequency of 9 % (N=7). The overjet was the most frequent characteristic, observed in 53.6 % (N=37) of the sample and increased overjet had a frequency of 37.7 % (N=26). Overbite was observed in 79.4 % (N=54) of the sample. The canine relationship was observable in 88 % of the students and the most frequent corresponded to the mesiocclusion on the right side and distocclusion on the left side 43 % and 46 %, respectively. Crossbite was observed in 36.5 % of the students. The deviation of the lower middle line was observed in 63 % of the students, with the deviation of the middle line to the left being the most frequent with 39.5 % (Table III).

Finally, according to the DHC-IOTN, 71 % (N=54) had a need for treatment (grade 4 and 5), with no difference by sex (p>0.05). Significant differences were observed according to the stage of dentition (p<0.05). By DHC-IOTN need treatment was observed an average of 10 years (Tables IV and V).

Table II. Caries index dmft/ DMFT across type of dentition of children Aymara of Colchane commune.

Stage	N	dmft Mean (s.d.)	Median	N	DMFT Mean (s.d.)	Median
Temporary	3	5.3 (2.89)	7		0	0
Mixed 1st phase	23	7.2 (3.82)	8	19	0.47 (0.77)	0
Mixed 2nd phase	20	2.9 (1.94)	2	32	1.1 (1.64)	0
Definitive	11	5.5 (4.3)	6	18	2.1 (1.91)	2

Table III. Characteristics of malocclusion of children Aymara of Colchane commune.

	Temporary %(N)	Mixed 1st phase %(N)	Mixed 2nd phase %(N)	Definitive %(N)	Total %(N)
Vertical					
Overjet					
Norm (0-3mm)	4.4(3)	17.4(12)	17.4(12)	14.5(10)	53.6(37)
Negative (<0 mm)	0	4.4(3)	4.4(3)	0	8.7(6)
Increase (>3,1mm)	0	2.9(2)	23.2(16)	11.6(8)	37.7(26)
Overbite					
Norm (0-3,5mm)	4.4(3)	20.6(14)	38.2(26)	16.2(11)	79.4(54)
Open bite (<0mm)	0	2.9(2)	1.5(1)	2.9(2)	7.4(5)
Deep bite (>3,6mm)	0	0	5.9(4)	7.4(5)	13.2(9)
Sagittal					
Right molar class					
I	0	15.79(12)	19.7(15)	17.1(13)	52.6(40)
II	0	9.2(7)	9.2(7)	0	18.4(14)
III	0	2.6(2)	13.2(10)	3.95(3)	19.7(15)
Left molar class					
I	0	9.2(7)	18.4(14)	14.5(11)	42.1(32)
II	0	10.5(8)	6.6(5)	2.6(2)	19.7(15)
III	0	7.9(6)	14.5(11)	3.95(3)	26.3(20)
Right canine relationship					
Normocclusion	0	2.6(2)	3.95(3)	1.3(1)	7.9(6)
Distocclusion	3.95(3)	13.2(10)	14.5(11)	11.8(9)	43.4(33)
Mesioocclusion	0	9.2(7)	18.4(14)	9.2(7)	36.8(28)
Not evaluable	0	5.3(4)	5.3(4)	1.3(1)	11.8(9)
Left canine relationship					
Normocclusion	0	3.95(3)	3.95(3)	2.6(2)	10.5(8)
Distocclusion	1.3(1)	13.2(10)	7.9(6)	10.5(8)	32.9(25)
Mesiocclusion	2.6(2)	9.2(7)	23.7(18)	10.5(8)	46.1(35)
Not evaluable	0	3.95(3)	6.6(5)	0	10.5(8)
Transverse					
Crossbite					
None	3.95(3)	19.7(15)	26.3(20)	14.5(11)	64.4(49)
Left	0	1.3(1)	9.2(7)	2.6(2)	13.2(10)
Right	0	3.95(3)	1.3(1)	3.95(3)	9.2(7)
Both	0	5.3(4)	5.3(4)	2.6(2)	13.2(10)
Middle line deviation					
None	1.3(1)	15.8(12)	13.2(10)	6.6(5)	36.7(28)
Left	2.6(2)	7.9(6))	19.7(15)	9.2(7)	39.5(30)
Right	0	6.6(5	9.2(7)	7.9(6)	23.7(18)
Scisor bite					
No	3.95(3)	30.3(23)	42.1(32)	21.1(16)	97.4(74)
Yes	0	0	0	2.6(2)	2.6(2)

Table IV. DHC-IOTN according to teething stage of children Aymara of Colchane commune.

DHC-IOTN	Temporary % (N)	Mixed 1st phase % (N)	Mixed 2nd phase %(N)	Definitive % (N)	p Value [a]
1 (None)	1.3 (1)	9.2 (7)	3.95 (3)	3.95 (3)	0.008
2 (Little)	1.3 (1)	0	0	2.6 (2)	
3 (Bordeline need)	1.3 (1)	1.3 (1)	2.6 (2)	1.3 (1)	
4 (Need treatment)	0	13.2 (10)	15.8 (12)	13.2 (10)	
5 (Need treatment)	0	6.6 (5)	19.7 (15)	2.6 (2)	

a $p < 0.05$; Fisher's exact test

Table V. DHC-IOTN and mean age children Aymara of Colchane commune.

DHC-IOTN	N	Mean Age	S.D.	Median	Min- Max
1 (None)	14	9.3	2.49	9	6-13
2 (Little)	3	10.7	4.93	13	5-14
3 (Bordeline need)	5	8.6	2.88	10	5-11
4 (Need treatment)	32	10.2	2.43	10	6-15
5 (Need treatment)	22	10.2	2.22	10,5	6-14

DISCUSSION

More than 40 years has passed since the oral health and oral morphologic characteristics of Aymara children has been studied. In this study, a high prevalence of malocclusion and a high percentage of dental caries was observed in the Aymara children evaluated.

The prevalence of malocclusion in Aymara children was 81.6 % (N=62) and the DHC-IOTN reached 71 %. One possible explanation for the high DHC-IOTN values is the high prevalence of dental caries, which could be associated with environment factors and high levels of poverty. However, the influence of changes in lifestyles among the Aymara (e.g., nutritional factors and availability of processed food) could also explain the high levels of oral damage, however, these aspects were not addressed in the current study.

A systematic review showed that the space of the dental arch decreases after premature loss of the first temporary molars (Kaklamanos et al., 2017). The high prevalence of loss of temporary teeth is associated with low socioeconomic groups (Sweeney et al., 1999). Levin et al. (2010) showed a clear social gradient in the prevalence of dental caries among children according to the level of neighborhood deprivation. In Colchane, two out of every five children had missing teeth.

Martins et al. (2019) studied 1612 adolescents aged between 11 and 14 years of age from public and private schools in Belo Horizonte, Brazil. Using the Dental Aesthetic Index and the Social Vulnerability Index to determine the degree of social vulnerability from adolescents, researchers found absence or minor malocclusion in 68.7 %. Malocclusion was associated with social vulnerability (PR=1.25;95 % CI=1.01-1.55). Thus, the authors concluded that the more socially vulne-

rable the adolescent, the worse indicators of malocclusion (Martins et al.). The Colchane community is one of poorest in Chile (Casen Survey) (Ministerio de Desarrollo Social y Familia). However, since 2009, there is one dentist in the Primary Care Center, thus children are able to participate in government preventive oral health programs, although the Aymara culture does not include dental visit.

The effect of social class on health outcomes has been observed across a wide spectrum of acute and chronic disease, including oral pathologies. Oral health surveys have revealed social gradients in edentulism, decay experience, periodontal disease, and trauma (Marmot & Bell).

In the study conducted by Sanabria-Castellanos et al. (2015), dental caries show stable scores (DMFT 2.4) from 1990, with a tendency toward lower scores in developed countries and higher scores in developing ones. In the Latin-American countries, inequalities present in different areas of these countries remain an important challenge (Sanabria-Castellanos et al.).

A study published by Palomino in 1978 was conducted among 429 Aymara and mestizo children and adults living in communities in Western Bolivia who lived in extreme environmental conditions. That sample had a lower prevalence of malocclusion than that observed in the present study (Palomino, 1978). Forty years ago, Palomino found a 56.5 % prevalence of malocclusion, in contrast with 81.6 % in our Colchane study. Additionally, they found a low frequency of dental anomalies such as tooth fusion or supernumerary teeth (3.09 %), in contrast with our study in Colchane where we found different type of dental anomalies in 10.5 % of our sample (Palomino).

Among children younger than 15 years old, 53.9 % did not have caries in compared with the Palomino study, to 38 % in our study. In the same Palomino study, the DMF index among 6 to 14 years old Aymara children was 0.88 (s.d.1.64) (Palomino), compared to 2.1 (SD=1.9) in the current study.

Future oral health interventions should consider the role of culture of the Native populations. It is important to rescue healthier habits of Native communities and work collaboratively in preventive public health actions.

ACKNOWLEDGEMENTS

SEGEUR, S. K.; FUENTES, K. F.; SABANDO, F. V.; DONAIRE, A. F. & VÁSQUEZ, H. A. Prevalencia de maloclusión y caries dental en niños Aymaras de Colchane, Chile. *Int. J. Odontostomat., 14(2)*:191-197, 2020.

RESUMEN: Describir la prevalencia de maloclusiones, caries dental y la necesidad de tratamiento de ortodoncia según el Índice de Necesidad de Tratamiento de Ortodoncia (IOTN), en escolares Aymaras, grupo indígena que vive en el altiplano de la Cordillera de los Andes. Estudio transversal de 76 escolares Aymaras de 5 a 15 años de Colchane, Chile. Se determinó el índice COPD/ceod, el componente dental (DHC) del IOTN y la demografía. Se calcularon las frecuencias y la media (DE). Se realizaron análisis bivariados utilizando el exacto de Fisher para probar la asociación entre el sexo y la etapa de la dentición (p<0,05). Se utilizó la versión 14 de Stata para todos los análisis. Entre los 76 participantes, 47,4 % (N = 36) eran hombres. Los participantes tenían un promedio de 9,96 años (DE = 2,5). Más de la mitad presentó caries dental (61,8 %, n = 47) y 36,8 % (N = 28) tenían dientes perdidos por caries. El índice DMFT fue 2,1 (DE = 1,9). El biotipo más frecuente fue el braquifacial 88,2 % (N = 67). Se observó maloclusión en el 81,6 % (N = 62) de los participantes. La Clase I fue la maloclusión más frecuente (67 %, N = 51) en las diferentes etapas de la dentición. La necesidad de tratamiento más prevalente fue la definida con los grados 4 y 5 de "necesidad de tratamiento" del IOTN, observada en el 71 % (N = 54) de la muestra con diferencias significativas según la etapa de la dentición (p <0,05). En este estudio, se observó una alta prevalencia de maloclusión y un alto porcentaje de caries dental en niños aymaras.

PALABRAS CLAVE: Aymara, maloclusión, caries, ortodoncia, índice de necesidad de tratamiento.

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