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ORIGINAL ARTICLE

Prevalence of early childhood caries in non-fluoridated rural areas of Chile.

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Abstract: Introduction: Early Childhood Caries (ECC) is a serious public health concern worldwide, especially in communities without water fluoridation. Objective: To determine the prevalence of ECC in 2 and 3 year old children attending rural daycare centers without access to water fluoridation. Methods: A cross-sectional study at community level was performed during 2012. The eligible population was composed of 2 and 3 year-old children from rural daycare centers located in non-fluoridated areas in regions La Araucanía, Los Ríos, and Los Lagos, Chile. Four calibrated examiners (ICC=0.83) measured the prevalence of dental caries based on criteria proposed by the WHO. Data were analyzed using chi-square test, t-test and logistic regression models. Results: The study sample consisted of 587 children; two-year-olds accounted for 53.32%, and 52.47% were female. Prevalence of ECC was 51.62% with a mean dmft index of 2.53. Region de la Araucanía had the highest ECC prevalence (52.79%). Variables that showed association were age, OHI-S and type of health insurance coverage ($p<0.05$). Conclusion: A high prevalence of ECC was found in areas with a non-fluoridated water supply.

Keywords: *Dental caries, Prevalence, Epidemiology, Preschooler.*
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INTRODUCTION.

Early Childhood Caries (ECC) is a severe and specific type of caries. It has a multifactorial character and affects deciduous teeth in infants and preschoolers.[1] Although its global prevalence has declined in recent decades, ECC continues to be a serious public health problem in some populations. This is especially true in developing countries and at-risk communities in developed countries, such as immigrant populations, ethnic minorities or in rural areas. ECC prevalence may reach 72% in preschoolers among these populations.[2]

A report issued by the Chilean Ministry of Health in 2007 informed a caries prevalence of 17% at 2 years of age, and 48% at 4 years in the Metropolitan region.[3] A recent oral health study conducted in preschoolers in the south of Chile reported a prevalence of 20.3% in 2-year-olds and 52.7% in 4-year-olds.[4] The study also revealed more severe ECC in children of lower socioeconomic status, a factor widely analyzed in the literature.[2,5-7]

Higher caries prevalence has been reported in rural preschoolers in previous studies, establishing an association between caries and the condition of rurality.[8-10] Several factors that may contribute to these results have been identified, and include financial cost, difficulty accessing dental care due to distance and parental neglect.[8,11]

In Chile, information is scarce regarding prevalence of ECC in preschool children living in rural areas. However, rural people account for a significant sector of the population in regions such as La Araucanía and Los Lagos, averaging 32.3% and 31.1%, respectively; both regions have higher percentage of rural population than the average 13.4% estimated at a national level.[12]

In addition, evidence shows that water fluoridation significantly reduces inequality in oral health. This is achieved by reducing the proportion of children with caries and the number of teeth affected by them. Water fluoridation results in an increase of caries-free children and adolescents by 15,4%.[13]

In Chile, fluoridation of drinking water is one of the main strategies for the prevention and control of dental caries, covering 70% of the total population. Concentration of fluoride has been adjusted to optimum levels for the prevention of dental caries. However, there are still some people without access to fluoridated water, particularly in rural areas. In response, the School Feeding Program (PAE, for its acronym in Spanish) provides fluoridated milk to schoolchildren living in rural areas. Previous studies have shown that this measure has been effective in decreasing the caries index in deciduous teeth and that there is no significant statistical difference in the bioavailability of fluoride in saliva and biofilm between the intake of fluoridated water and fluoridated milk.[14] Despite these measures, there are still differences in the prevalence of caries in children according to level of rurality, demonstrating the multifactorial nature of this disease.

The aim of this study was to determine the prevalence of ECC in 2 and 3 year old children attending rural daycare centers without access to fluoridated water in the regions of La Araucanía, Los Ríos, and Los Lagos, Chile.

MATERIALS AND METHODS.

Study design and context

A cross-sectional study was conducted at community level between March and June 2012 in children attending JUNJI and INTEGRA rural daycare centers without access to fluoridated drinking water in the regions of La Araucanía, Los Ríos and Los Lagos, Chile.

JUNJI and INTEGRA rural daycare centers provide care to children under 6 years of age, mainly of low socioeconomic status. Their objective is to expand preschool educational coverage and provide daily free meals to all enrolled children.

Although in Chile there is public dental coverage for the rural population, access is restricted due to distance, unpaved rural roads, poor public transportation and/or lack of economic resources.

This study was prepared according to the STROBE recommendations.[15] It is part of FONIS Project No. SA11I2054 and was approved by the Ethics Committee of the Health Service of Araucanía Sur, Chile (Resolution No. 1473).

Participants

All children aged 2 and 3 years attending rural daycare centers without a fluoridated water supply were included in the study. Only daycare centers with more than 10 enrolled children were considered. Children with disabilities, systemic disease, on chronic medication and from daycare centers that had participated in the pilot preventive program with fluoride varnish "Sembrando Sonrisas" (*Sowing smiles*) were excluded from the study.

Convenience sampling was performed, reaching 10% of the potential eligible children in each region. The data sources for the identification of participants were JUNJI and INTEGRA.

Variables

The main variable of interest was the presence of ECC, established according to criteria proposed by the WHO in the Oral Health Survey Basic Methods for epidemiological studies.[16] The association variables were sex, age, type of health insurance coverage, geographical region, access to dental care and oral hygiene.

The type of health insurance coverage was determined following parameters established by the Chilean National Health Fund (FONASA, for its acronym in Spanish), which classifies its beneficiaries in different categories according to their income. A: Homeless, indigent or extremely poor people; B: People with a monthly taxable income less than or equal to CLP 250,000 (USD$370); C: People with a monthly taxable income greater than CLP 250,000 (USD$370) and less than or equal to CLP 365,000 (USD$545); D: People with a monthly taxable income greater than CLP 365,000 (USD$545).[17]

Access to dental care was defined as the distance to the nearest dental health care center. This was categorized as easy access (<25km) or difficult access (≥25km). Oral hygiene was

determined using the Greene and Vermillion's Simplified Oral Hygiene Index (OHI-S).[16]

Measurement and data sources

Children were examined by four researchers previously calibrated in a pilot test (intraclass correlation coefficient: 0.830, 95% CI 0.759-0.901).

Examinations were carried out on stretchers placed in rooms especially equipped and adapted for the study in each daycare center. Researchers used a dental clinic chart specifically designed for the study, which included demographic, socioeconomic and clinical background information.

In order to facilitate the detection of caries, cleaning with a dental brush or gauze was performed according to the age and degree of cooperation of the children before examination and after plaque measurement.

Statistical analysis

The bivariate association between ECC and covariates was determined using chi-square test for the dichotomous response variable "presence of caries". For the continuous response variables "dmft index", a t-test test for non-homogeneous variances was used. A multivariate analysis was performed using a logistic regression model that included the variables with statistical significance of from the bivariate analysis. For all cases a level of significance of $p<0.05$ was considered statiscally significant. Variables with missing data were not analyzed. STATA 12 (Stata Corp LP, USA) was used.

RESULTS.

Out of the 5841 children of 2 and 3 years of age from rural daycare centers in the three studied regions, 589 met the eligibility criteria. Sampling corresponded to 313 2-year-olds and 274 3-year-olds, 52.47% female (Figure 1). Response rate was 99.16%. The majority (79.73%) belonged to the most vulnerable stratum of the population corresponding to FONASA category A. The 60.99% belonged to La Araucanía, a 25.89% to Los Lagos and the remaining 13.12% to Los Ríos. A 21.98% lived in a rural area located at least 25 kilometers from the nearest urban center with a dental care. The prevalence of ECC according to covariates is shown in Table 1. The bivariate analysis between ECC and the rest of the covariates is shown in Table 2.

The multivariate analysis estimated an OR of 2.05 (CI95% 1.46-2.90) for oral hygiene, an OR of 1.92 (CI95% 1.37-2.70) for age and an OR of 1.86 (CI 95% 1.21-2.84) for type of health insurance, all of them statistically significant ($p<0.01$).

Figure 1. Participant recruitment flow chart.

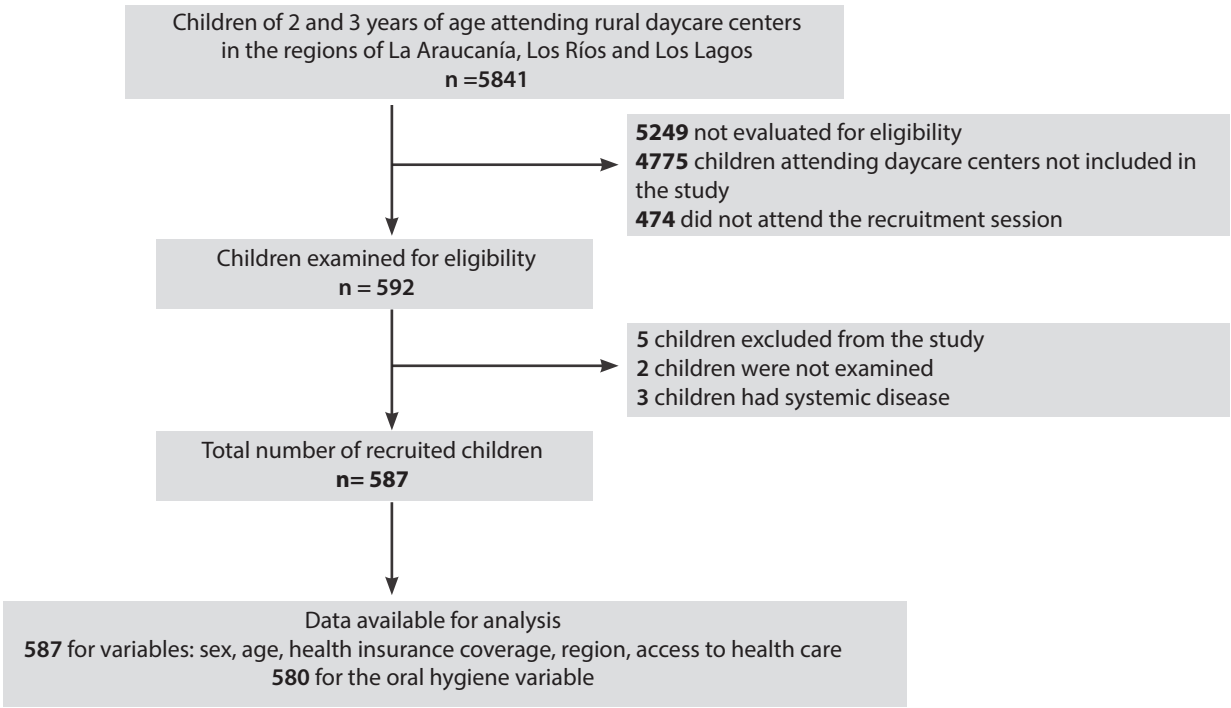

Table 1. Prevalence de ECC according to sex, region, distance and oral hygiene.

Variable		Total	Absence of ECC n (%)	Presence of ECC n (%)	p Value
Total		587	284 (48.38%)	303 (51.62%)	
Sex	Male	279	131 (46.95%)	148 (53.05%)	0.510
	Female	308	153 (49.68%)	155 (50.32%)	
Age	2 years	313	179 (57.19%)	134 (42.81%)	<0.001
	3 years	274	105 (38.32%)	169 (61.68%)	
Health insurance coverage	Fonasa A	468	211 (54.09%)	257 (54.91%)	0.002
	Fonasa B-C-D-Isapre	119	73 (61.34%)	46 (38.66%)	
Region	Araucanía	358	169 (47.21%)	189 (52.79 %)	0.502
	Los Lagos	152	73 (48.03%)	79 (51.97%)	
	Los Ríos	77	42 (54.55%)	35 (45.45%)	
Access to health care	Less than 25 km	458	226 (49.34%)	232 (50.66%)	0.379
	25 or more km	129	58 (44.96%)	71 (55.04%)	
Oral Hygiene Index	Good or Fair	327	186 (56.88%)	141 (43.12%)	<0.001
	Poor	253	95 (37.55%)	158 (62.45%)	

Table 2. Mean dmft according to sex, age, oral hygiene, region and distance.

Variable		Mean dmft (SD)	p Value
Total		2.53 (3.48)	
Sex	Male	2.55 (3.45)	0.902
	Female	2.51 (3.50)	
Age	2 years or less	1.81 (2.95)	<0.00
	More than 2 years	3.35 (3.83)	
Health insurance coverage	Fonasa A	2.72 (3.57)	0.007
	Fonasa B-C-D-Isapre	1.77 (2.99)	
Region	Araucanía	2.55 (3.40)	0.653
	Los Lagos	2.65 (3.65)	
	Los Ríos	2.21 (3.50)	
Access to health care	Less than 25 km	2.45 (3.43)	0.293
	25 or more km	2.81 (3.65)	
Oral Hygiene Index	Good or Fair	1.65 (2.50)	<0.00
	Poor	3.67 (4.18)	

DISCUSSION.

The present study showed a high prevalence of ECC in children living in rural areas without fluoridated drinking water in the three regions evaluated. These figures are of concern due to the early age of occurrence, the rapid progression of the lesion through the tissues and the high probability of developing new caries lesions as age increases.[2,18,19]

Epidemiological studies conducted in rural areas without access to fluoridated water are scarce and the prevalence of ECC reported in countries with similar sociodemographic

characteristics is diverse. Masumo *et al.*[21] found prevalences of 3.7% and 17.6% in the rural areas of Manyara and Kampala, respectively. However, concentrations of fluoride differed, 3.0ppm in Manyara and 0.3ppm in Kampala. Warren *et al.*[22] reported a prevalence of 14.43% in infants aged from 6 to 24 months in the state of Iowa, USA. Dogar *et al.*[8] found a prevalence of 34% in children aged from 2 to 4 years in rural areas with suboptimal levels of fluoride in water (0.3 to 0.9ppm). Silva *et al.*[11] found an ECC prevalence of 65% in the 0 to 3 years age group, a result that is similar to the findings of this study. However, the location where the study was conducted did not have access to health care.

Current research is insufficient to determine the real epidemiological status of this disease in Chile. Mariño & Onetto[23] compared the prevalence of caries in 3-year-old children from urban and rural populations, finding a prevalence of 41.5% in urban areas, and 62.3% in rural ones. Zaror *et al.*[10] found prevalences of 53% and 88% (urban/rural respectively) in children of 2 and 4 years of age in the municipality of Calbuco, Chile. Similarly to what was found in the present study, Uribe *et al.*[16] reported an ECC prevalence of 67.9% in a rural area of Los Ríos. These data differ considerably from the information provided by the Chilean Ministry of Health in 2007,[3] which reported a prevalence of 17% for the 2-year-old group and 48% for the 4-year-old group. These differences may be due to better access to health care and fluoridated water in urban sectors. Another important point to consider is the diagnostic criteria used, methods that include non-cavitated lesions increase the prevalence estimation of ECC.[10,23]

There were no statistically significant differences in ECC between male and female children, in agreement with Zaror *et al.*[10] and Mariño & Onetto.[23] However, Masumo *et al.*[21] showed that females consistently had more cavities than males in Malaysia. Although no statistically significant differences were found regarding distance to the nearest dental clinic, it is important to consider that the 25-km limit may be an obstacle for access to health care. There are other relevant factors, such as the frequency of public transportation and the availability of medical attention in the health center.

On the other hand, a statistically significant association was observed between ECC and OHI-S, similar to the findings reported by Warren *et al.*[22] The evidence is conclusive in establishing that the state of oral hygiene is critical for the development of ECC. Moreover, visible dental plaque is an important predictor of new carious lesions.[9,24,25] Another factor significantly associated with ECC was the type of health insurance coverage. The group categorized as FONASA A had a higher mean dmft index. Hoffmeister *et al.*[4] also significantly associated ECC with low socioeconomic status, but in an urban Chilean population. Global evidence confirms that socioeconomic status is a factor for ECC.[5,9,25,26]

One of the main limitations of this study lies in the non-probabilistic nature of the sampling and, consequently, generalization of results should be done with caution. Moreover, the sociodemographic and cultural characteristics of the rural population in southern Chile may differ from other regions. There were also differences between the number of children enrolled in the daycare centers and those who were actually present on the day of the examination. Another limitation is that the diagnosis of dental caries was based on criteria established by the WHO, which does not include non-cavitated lesions and may lead to an underdiagnosis of the disease. Although factors such as age, type of health insurance coverage and OHI-S showed a statistically significant association, it is important to bear in mind that cross-sectional designs do not allow causality to be established and should only be considered as exploratory. Findings should be confirmed with more appropriate methodological designs.

Information obtained from this research shows that children in rural areas without access to fluoridated water have oral health damage and should be treated by their respective health care services. The study also emphasizes the importance of preventive and educational measures that must begin during pregnancy.

CONCLUSION

Prevalence of ECC in non-fluoridated rural areas in the regions of La Araucanía, Los Ríos, and Los Lagos was 52.61%.

Prevalencia de caries temprana de la infancia en zonas rurales sin agua fluorada de Chile.

Resumen: Introducción: La Caries temprana de la infancia (CTI) constituye un serio problema de salud pública a nivel mundial, sobre todo en zonas rurales sin acceso a agua fluorada. Objetivo: Determinar la prevalencia de CTI en niños de 2 y 3 años que asisten a jardines infantiles sin acceso agua potable fluorada. Métodos: Se realizó un estudio de corte transversal a nivel comunitario durante el 2012. La población elegible fueron niños de 2 y 3 años asistentes a Jardines rurales de zonas no fluoradas de las regiones de La Araucanía, Los Ríos y Los Lagos. Cuatro examinadores calibrados (ICC= 0,83) determinaron la prevalencia de caries usando los criterios propuestos por la OMS. La información fue analizada utilizando el test chi cuadrado, la prueba t-test y modelos de regresión logística. Resultados: La muestra quedó constituida por 587 niños de los cuales el 53,32% tenían 2 años y el 52,47% eran mujeres. La prevalencia de CTI fue de 51,62% con un índice ceod promedio de 2,53. La región con más alta prevalencia fue la Araucanía con un 52,79%. La variables que mostraron asociación fueron edad, IHO-S y previsión (p<0,05). Conclusión: La prevalencia de CTI en las zonas rurales sin agua fluorada es alta.

Palabras clave: *Caries dental; prevalencia; epidemiologia, preescolar.*

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