

# ASSOCIATION BETWEEN EARLY CHILDHOOD CARIES AND NUTRITIONAL STATUS IN CHILDREN IN A PERUVIAN SOCIAL PROGRAM. A CROSS-SECTIONAL STUDY

Asociación entre caries de la primera infancia y estado nutricional en niños de un programa social peruano. Un estudio transversal

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## ABSTRACT

**Introduction:** Early childhood caries is still very prevalent, mainly in developing countries, and it is related to the quality of life of children due to early tooth loss.

**Objective:** The study objective was to determine the association between dental caries and its clinical consequences on nutritional status in children of the “Vaso de Leche (Glass of Milk)” social program, in Puno City, Peru, during the year 2020.

**Materials and Methods:** An observational, descriptive-correlational, cross-sectional study; the sample consisted of 740 children between 1 and 5 years old who met the selection criteria; the clinical consequences of untreated dental caries were evaluated using the PUFA index and the prevalence of caries with def-t; the nutritional status was determined by the weight and height of the child according to protocols (NTS No. 357 - MINSA /2017/ DGIESP); the data were analyzed with the SPSS-v25 program, the association between variables was evaluated with the chi-square test, Mann-Whitney U test and Spearman's Rho test, considering significance at a  $p$ -value  $<0.05$ .

**Results:** No significant relationship was found when dental caries was evaluated with the nutritional condition ( $p < 0.05$ ). However, when the def-t index values were related to the nutritional condition of the children, a significant difference was found ( $p < 0.05$ ). There was no significant difference with the PUFA index ( $p > 0.05$ ).

**Conclusions:** There is no association between early childhood caries and nutritional status in children aged between 3 and 5 years; however, a significant relationship was found between the values of the def-t index and the nutritional status of the children.

**Keywords:** Dental caries; Nutritional status; Overweight; Child, preschool; Thinness; Body Mass Index.

## RESUMEN

**Introducción:** La caries infantil temprana sigue siendo muy prevalente, principalmente en los países en desarrollo, y está relacionada con la calidad de vida de los niños debido a la pérdida temprana de dientes

**Objetivo:** El objetivo del estudio fue determinar la asociación entre la caries dental y sus consecuencias clínicas sobre el estado nutricional en niños del programa social “Vaso de Leche”, en la ciudad de Puno, Perú, durante el año 2020.

**Materiales y Métodos:** Estudio observacional, estudio descriptivo-correlacional, transversal; la muestra estuvo conformada por 740 niños entre 1 y 5 años que cumplieron con los criterios de selección, se evaluaron las consecuencias clínicas de la caries dental no tratada mediante el índice PUFA y la prevalencia de caries con d-t; el estado nutricional se determinó mediante el peso y talla del niño según protocolos (NTS N°357 - MINSA/2017/DGIESP); los datos se analizaron con el programa SPSS-v25, la asociación entre variables se evaluó con el chi; -cuadrado, U de Mann-Whitney y Rho de Spearman, considerando significancia a un valor de  $p < 0,05$ .

**Resultado:** No se encontró relación significativa cuando se evaluó la caries dental con la condición nutricional ( $p < 0,05$ ). Sin embargo, cuando los valores del índice d-t se relacionaron con la condición nutricional de los niños, se encontró una diferencia significativa ( $p < 0,05$ ). No hubo diferencia significativa con el índice PUFA ( $p > 0,05$ ).

**Conclusión:** No existe asociación entre caries de la primera infancia y el estado nutricional en niños de 3 a 5 años; sin embargo, se encontró una relación significativa entre los valores del índice d-t y el estado nutricional de los niños.

**Palabras Clave:** Caries dental; Estado nutricional; Sobrepeso; Preescolar; Delgadez; Índice de Masa Corporal.

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## INTRODUCTION

Early childhood caries continues to be a public health problem worldwide, manifesting as progressive damage with demineralization of the enamel and is caused by commensal bacteria in the oral cavity.<sup>1</sup> It is one of the most common chronic childhood diseases characterized by at least one tooth with cavitated or non-cavitated caries lesion, repaired or lost by caries in children under 6 years old.<sup>2-4</sup>

It is caused by the interrelation between an altered oral microbiome and a diet rich in fermentable carbohydrates for a certain period.<sup>1</sup> This oral dysbiosis favors the proliferation of bacteria that secrete organic acids as a product of their metabolism, which causes the demineralization of tooth enamel.<sup>3</sup>

The prevalence of early childhood caries has been increasing in several countries of the world,<sup>5</sup> even more so being the most common childhood disease in developing countries,<sup>6</sup> with overall rates ranging up to 98% among 4-year-old children.<sup>2</sup> National or regional children's programs do not address caries prevention, and it is still not prioritized in many countries, with even a very limited ratio of dentists for each population.<sup>7</sup> The prevalence of caries in early childhood is related to age, economic level, frequency of sugar consumption, oral treatment behavior, and parental evaluation of children's oral health.<sup>8</sup>

In Peru, the prevalence of caries is 59.1% in children under 72 months and 85.6% in school-age children.<sup>9</sup> Therefore, it is among the countries with the highest prevalence of untreated early childhood caries, mainly due to high sugar consumption in early ages and poor access to health services for the poorest populations.<sup>10</sup>

The DMFT/def-t index is used to evaluate the experience of caries in permanent and deciduous dentition; however, this index does not record the

clinical consequences of untreated dental caries, such as pulp involvement, dental abscess, fistula, and an ulcer.<sup>11</sup>

These consequences may cause pain, discomfort, and infections that affect the quality of life of children.<sup>12-14</sup> Currently, not treated caries are more frequent than in the past.<sup>15</sup> Monse *et al.*,<sup>16</sup> developed the PUFA/pufa index which complements the classic caries evaluation indexes, providing relevant information for epidemiological studies and health planning that intervenes in reducing the incidence of pulp-affected teeth.

This index records the presence of severely decayed teeth with visible pulp involvement (P/p), ulceration of tooth fragments (U/u), fistula (F/f), and abscess (A/a); the information from this index added to the data on sociodemographic conditions facilitates the search for effective intervention strategies to improve children's oral health.<sup>16</sup> The relationship between dental caries and malnutrition is not clear. Some studies have shown association between early childhood caries and malnutrition nutritional status.<sup>3,17,18</sup> Overweight children had a higher prevalence of early childhood caries<sup>3</sup> and children who have a lower degree of food diversity were diagnosed with early childhood caries.<sup>19</sup>

In addition, children with pulp cavities are at greater risk for having a body mass index below normal, dental pain produces reduced food intake, affects sleep quality and the release of cytokines that would explain the association between these variables.<sup>20,21</sup> The association of early childhood caries with nutritional status below ideal weight or underweight is shown in children from families with low economic income.<sup>22,23</sup>

Therefore, this study was carried out with the purpose of evaluating the relationship between early childhood caries and nutritional status in children from a Peruvian social program.

## MATERIALS AND METHODS

### Method, type, and design

This study corresponds to the deductive-hypothetical method, descriptive type with an analytical and transversal component.

### Sample Selection

A total of 740 children between 1 and 5 years old from the social program “*Vaso de Leche (Glass of Milk)*” in the city of Puno (Peru). They were selected considering the inclusion criteria, the sampling was non-probabilistic for convenience, excluding children with special needs and those whose parents refused to participate.

### Inclusion criteria

- Children whose mothers are registered in the registry of beneficiaries of the Puno 2020 Glass of Milk program.
- Parents who agreed to give written informed consent for the study.
- Children and parents who reside in the city of Puno.
- Children between 1 and 5 years who have agreed to participate.

### Data collection

The data collection procedure followed the steps described below:

#### Age and sex data

- Data collection was compiled using a structured questionnaire, applied to the parents and the sheets provided by the social program.

#### Early childhood caries

- The quantitative method of structured observation was used. For this purpose, the assessment of early childhood caries was performed by two pediatric dentists and a final-year dentistry student. These personnel were previously trained to measure the def-*t* (decayed-extracted-filled) indexes. Intra-examiner agreement was assessed by re-examining 10% of the sample 10 days after

the first examination (inter-examiner Kappa 0.79).

$$t = (d+e+f)/n$$

Where: **d**= decayed, **e** = extracted and **f**= filled due to caries, **n** = deciduous teeth.

The indexes were assessed in the child in the same session, in an environment with natural light and biosafety elements. The number of teeth (def-*t*) was evaluated according to the criteria of the World Health Organization (WHO).<sup>24</sup> Then, a visual assessment was made to determine whether the deciduous tooth (teeth) had visible pulp involvement (p), ulcerations in the marginal or papillary gingiva caused by the sharp tips of a decayed tooth, or root segment (u), presence of fistula (f) and abscesses (a) due to infections of dental origin.<sup>16</sup>

### Nutritional status

- The nutritional status was determined by the weight and height of the child according to protocols referred to in the technical health standard for the control of growth and development of girls and boys under five years of age (NTS No. 357 - MINSa /2017/ DGIESP). According to Table 01 of Annex B of the said norm, the children obtained a value for their nutritional status.<sup>24</sup>

The normal cutoff was established for scores between +2 SD and -2 SD (SD = standard deviation). In this sense, children with weight/age (W/E) ratios below -2 SD were considered low weight and similarly for the height/age (W/E) ratio. On the other hand, overweight was established as the situation in which the ratio P/E (weight/age) was located above +2 SD.

### Statistical Analysis

The data collected were processed in the SPSS v. 25.0 (IBM, USA) statistical program, calculating absolute and relative frequencies of the characteristics related to early childhood caries

and the child’s nutritional status. For quantitative variables, mean values were calculated. Chi-square, Mann-Whitney U, and Spearman’s Rho statistical tests were used to compare the study variables at a significance level of 5%.

### Ethical Considerations

The research process and results were approved by the Institutional Research Ethics Committee of the office of the Vice Rectorate for Research of the National University of the Altiplano.

The parents or legal representatives of the children who participated in the study were informed and signed a voluntary consent, and

the children, an informed assent, when possible. The procedures followed the guidelines of the Declaration of Helsinki and the Peruvian General Health Law (Law 268429). The information obtained was handled confidentially, ensuring the anonymity of each participant using identification coding.

## RESULTS

Out of 740 children examined, 51.8% were female, 48.2% were male, 50.4% were 2 years old, only 8.9% had no dental caries, 47% had normal nu-

**Table 1.** Early childhood caries, nutritional status, and dental infectious processes in children aged 1 to 5 years.

VARIABLE		FREQUENCY (NUMBER)	PERCENTAGE (%)
Gender	Male	357	48.2
	Female	383	51.8
Age	1 year	19	2.6
	2 years	373	50.4
	3 years	189	25.5
	4 years	155	20.9
	5 years	4	0.5
Dental caries	Yes	674	91.1
	No	66	8.9
Nutritional Status	Normal	384	47
	Underweight	31	4.2
	Short stature	240	32.4
	Overweight	121	16.4
PUFA	Pulp exposure	317	42.8
	Ulceration and/or fenestration	6	8.9
	Fistula	207	28
	Abscess	398	53.8
<b>TOTAL</b>		<b>740</b>	<b>100</b>

**Table 2.** Dental caries, def-t, pufa, and mean age of the children included in the study.

VARIABLE	MEAN	STANDARD DEVIATION
Age	2.66	0.852
Dental caries	6.86	4.043
Def-t	7.36	4.423
PUFA	3.38	3.744

**Table 3.** Dental caries and nutritional status according to sex and age in children of a Peruvian social program.

VARIABLES		DENTAL CARIES				p-value*	NUTRITIONAL STATUS								p-value*
		YES		NO			NORMAL		UNDER-WEIGHT		SHORT STATURE		OVER WEIGHT		
		n	%	n	%		n	%	n	%	n	%	n	%	
Gender	Masculine	321	89.9	36	10.1	0.304*	156	43.7	14	3.9	123	34.5	64	17.9	0.063**
	Female	353	92.2	30	7.8		192	50.1	17	4.4	117	30.5	57	14.9	
Age	1 to 2 years	326	83.2	66	16.8	0.000*	201	51.3	21	5.4	108	27.6	62	15.8	0.007***
	3 to 5 years	348	100	0	0		147	42.2	10	2.9	132	37.9	59	17	

\*Chi-square test, \*\*U-Mann-Whitney test, \*\*\*Kruskal-Wallis

**Table 4.** def-t and pufa index according to sex, age, and nutritional status in children in a Peruvian social program.

VARIABLES		DEF-T						p-value*	PUFA						p-value*
		0-6		7-13		14-20			0-3		4-9		10-16		
		n	%	n	%	n	%		n	%	n	%	n	%	
Gender	Masculine	156	43.7	176	49.3	25	7	0.797*	206	57.7	123	34.5	28	7.8	0.922*
	Female	160	41.8	188	49.1	35	9.1		232	60.6	120	31.3	31	8.1	
Age	1-2 years	239	61	136	34.7	17	4.3	0.000**	265	67.6	109	27.8	18	4.6	0.000**
	3-5 years	77	22.1	228	65.5	43	12.4		173	49.7	134	38.5	41	11.8	
Nutritional status	Normal	173	49.7	146	42	29	8.3	0.019***	218	62.6	109	31.3	21	6.1	0.247***
	Underweight	11	35.5	19	61.3	1	3.2		16	51.6	15	48.4	0	0	
	Short stature	89	37.1	132	55	19	7.9		135	56.3	79	32.9	26	10.8	
	Overweight	43	35.5	67	55.4	11	9.1		69	57	40	33.1	12	9.9	

\*U-Mann-Whitney Testt. \*\*Sperman's Rho Test. \*\*\*Kruskal-Wallis.

**Table 5.** Relationship between caries and nutritional status in children from a Peruvian social program.

VARIABLES		NUTRITIONAL STATUS								p-value
		NORMAL		LOW WEIGHT		LOW WEIGHT		OVER WEIGHT		
		n	%	n	%	n	%	n	%	
Cavities	Yes	304	45.1	30	4.5	229	34	111	16.5	0.005
	No	44	66.7	1	1.5	11	16.7	10	15.2	
<b>Total</b>	<b>348</b>	<b>47</b>	<b>31</b>	<b>4.2</b>	<b>240</b>	<b>32.4</b>	<b>121</b>	<b>16.4</b>		

\*Chi-square test.

tritional status, and 42.8%, 8.9%, 28%, and 53.8% had teeth with pulp exposure, ulceration and/or fenestrations, fistula, and abscess, respectively (Table 1). The means for age, def-t index, PUFA index, and teeth with caries were  $2.66 \pm 0.85$ ,  $7.36 \pm 4.42$ ,  $3.38 \pm 3.74$ , and  $6.86 \pm 4.04$ , respectively

(Table 2). When dental caries was evaluated with nutritional status or with the combination of nutritional status and sex, no significant relationship was found. However, there was a significant relationship when dental caries and nutritional status were evaluated with age (Table 3).

When the def-t and PUFA index values were related to sex, it was not found significant difference. However, a significant difference was observed when these values were related to age. As for the def-t index, the status, and the PUFA index, significant and non-significant differences were found, respectively (Table 4).

The prevalence of dental caries in all nutritional states is high, however, when relating dental caries to nutritional status, it indicates that there is a statistically significant relationship ( $p = 0.005$ ), which indicates that dental caries increases when the nutritional status of the child is altered (Table 5)

## DISCUSSION

The evaluation of the children that make up the study sample, with the def-t index, showed that the severity of caries in early childhood was high, similar to that reported by other studies.<sup>1,25</sup> This study reports that the prevalence of caries and def-t values increases as the child's age increases (3 to 5 years old, 100%, while children under 3 years old, 83.2%).

These values coincide with those reported<sup>7</sup> by on caries prevalence in children aged 5 to 6 years (66.4%) and in children under 5 years (21.2%), possibly because age is a predictive factor of dental caries in deciduous dentition. It is also known that early childhood caries experience is associated with a high risk of disease progression due to the early incorporation of fermentable sugars in their daily diet and inadequate oral hygiene.<sup>26</sup> In this study, the highest prevalence of caries according to sex was 92.2% for the female sex and 89.9% for the male sex, however this difference was not statistically significant.

This coincides with another study that reports a prevalence in women of 42.88 versus 39.77 %,

because dental eruption in women is earlier than in men, so their teeth are more exposed to bacteria and fermentable sugars in the oral cavity.<sup>7</sup>

Caries is caused by the interaction of several factors such as oral dysbiosis, a diet with fermentable carbohydrates over a period, together with associated risk factors such as low socioeconomic status, the educational level of the mother,<sup>27</sup> cultural attitudes and non-exposure to fluoride.<sup>25</sup> The high prevalence of dental caries (91.1%) in this study may be due to the low awareness of dental health and the economic status of our population.

In the case of Puno, 42.5% of the population is poor; only 47.4% have access to basic services, and 63.2% of the children from 3 to 5 years old have access to basic regular educational services.<sup>28</sup> These factors have a positive influence on the prevalence of early childhood caries, and it is important to promote preventive programs and improve access to health services.

Likewise, 53.8% of children with abscesses indicate a high prevalence of untreated dental caries. The higher frequency of components "p" (pulpitis) and "a" (abscesses) coincides with what has been reported in other studies. The high presence of the PUFA index is due to inadequate access to health services and negative attitudes of parents and children towards oral health.<sup>6,29</sup>

Since the progression from caries to pulpitis and abscesses is mainly due to poor hygiene practices, oral inadequate eating habits, and low access to health services, which are characteristics of the population that attends this social support program in Puno.

Nutritional status was affected in 53% of the children, with a higher prevalence of short stature followed by overweight and underweight; these values are similar to other studies.<sup>3</sup> Nutritional



status impairment was associated with the experience of early childhood caries, similar to that shown by Rego *et al.*,<sup>23</sup> and it was confirmed that an imbalance in nutritional status (underweight or overweight) could be a risk factor for caries in children.<sup>30</sup>

The results reported in this study show no association between early childhood caries and nutritional status in children aged 1 to 5 years. However, when the def-t index values were related to the children's nutritional status, a significant difference was found ( $p < 0.05$ ), which became more evident as age increased.

### Limitations

The main limitation of the study is its cross-sectional design, the fact that the exposure and the outcome were evaluated simultaneously, did not allow us to conclude a cause-effect relationship in relation to time. Therefore, the results should be taken into account with moderation. However, despite this limitation, this study demonstrated that nutritional status in children under 5 years of age can be a risk factor for the presence of caries in early childhood.

On the other hand, social determinants of the child and parents that could have acted as confounding variables were not considered, since the sample of children belongs to a group that receives social food support, they account for their vulnerability, therefore that it would be necessary to study these variables because they are important.

## CONCLUSION

91.1% of the population presented dental infectious processes and of them the age group of two-year-old children present a higher prevalence with 50.4%, which means that at least one tooth has caries. In relation to untreated dental caries, dental abscess was the complication that most often occurred. Approximately half of the children studied presented a normal nutritional condition. However, a significant relationship between the def-t index values and the nutritional condition of the children was established, being more evident as age increased.

No association was found between early childhood caries and nutritional status in children aged 1 to 5 years; However, it is important to urgently implement oral health promotion and prevention programs that are sustainable and continuous within social programs.

## CONFLICT OF INTERESTS

There is no conflict of interest.

## ETHICS APPROVAL

Study was approved by the Institutional Research Ethics Committee of the office of the Vice Rectorate for Research of the National University of the Altiplano, (07-CIEI-UNA-PUNO).

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## AUTHORS' CONTRIBUTIONS

**Padilla-Cáceres T:** Conceptualization, methodology, analysis and interpretation of data and writing of the manuscript.

**Mamani-Cori V:** Conceptualization, data collection and writing of the manuscript.

**Caballero- Apaza L:** Methodology and writing of the manuscript.

**Cervantes-Alagón S:** Formal analysis, interpretation of statistical data and writing of the manuscript.

**Arbildo-Vega H:** Formal analysis, interpretation of statistical data and writing of the manuscript.

All authors gave their final approval and agreed to be responsible for all aspects of the work.

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## PEER REVIEW

This manuscript was evaluated by the editors of the journal and reviewed by at least two peers in a double-blind process.

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