



CLINICAL RESEARCH:

Association Between Access to Oral Health Information and Use of Fluoride Toothpaste with at Least 1000 PPM in Peruvian Children

Asociación entre el acceso a información de salud bucal y uso de pastas dentales fluoradas con mínimo 1000 ppm en niños peruanos menores de 12 años de edad

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ABSTRACT: Oral health education is assumed to improve knowledge and behaviors regarding fluoride toothpaste use. However, dental caries prevention requires comprehensive strategies that integrate dental examinations, provision of fluoride toothpaste, and preventive treatments. To analyze the association between access to oral health information and the use of fluoride toothpaste with a concentration of ≥ 1000 ppm in Peruvian children under 12 years of age. A cross-sectional analysis was conducted using nationally representative 2023 ENDES data, including 23,613 children. Independent variables were access to oral health information and its provider; the dependent variable was fluoride toothpaste use (≥ 1000 ppm). Covariates included wealth index, natural region, health insurance, altitude, area and place of residence, age, and sex. Multilevel Poisson regression estimated prevalence ratios (PR) and 95% confidence intervals (CI). In bivariate analyses, appropriate fluoride toothpaste use was significantly associated with information provider ($p < 0.001$), natural region ($p < 0.001$), altitude ($p < 0.001$), wealth index ($p < 0.001$), age ($p < 0.001$), area ($p = 0.030$), and place of residence ($p = 0.041$). Children living in the coastal region, at lower altitudes, from wealthier households, and older age groups had higher prevalence of use. However, in multivariate analysis, access to oral health information was not significantly associated with appropriate fluoride toothpaste use (coef.: -0.01 ; PR: 1.00; 95% CI: 0.97–1.04; $p = 0.808$). Access to oral health information was not linked to fluoride toothpaste use ≥ 1000 ppm among Peruvian children under 12 years, while geographic and socioeconomic factors played a significant role. Educational strategies alone may be inadequate without tackling structural barriers. Strengthening

regulations, aligning policies with clinical guidelines, and ensuring equitable access are crucial. This first 2023 ENDES-based analysis offers valuable national evidence to guide targeted interventions and oral health policy.

KEYWORDS: Oral health; Health education; Child; Dentifrices; Health disparities; Social determinants; Fluoride use.

RESUMEN: La educación en salud bucal suele considerarse una estrategia clave para mejorar los conocimientos y comportamientos relacionados con el uso de pasta dental con flúor; sin embargo, la prevención de la caries dental requiere enfoques integrales que incluyan evaluaciones odontológicas, provisión de dentífricos adecuados y tratamientos preventivos. El objetivo fue analizar la asociación entre el acceso a información en salud bucal y el uso de pasta dental con una concentración de flúor ≥ 1000 ppm en niños peruanos menores de 12 años. Se realizó un estudio transversal utilizando datos representativos a nivel nacional de la ENDES 2023, que incluyó a 23,613 niños. Se evaluó el acceso a información en salud bucal y su proveedor como variables independientes, y el uso de pasta dental con flúor ≥ 1000 ppm como variable dependiente. Se empleó regresión de Poisson multinivel para estimar razones de prevalencia e intervalos de confianza al 95%, ajustando por factores sociodemográficos y geográficos. En los análisis bivariados, el uso adecuado de pasta dental con flúor se asoció con variables socioeconómicas y geográficas; sin embargo, en el análisis multivariado, el acceso a información en salud bucal no mostró una asociación significativa con el uso de pasta dental fluorada ≥ 1000 ppm. En conclusión, el acceso a información en salud bucal no se asoció con el uso adecuado de pasta dental con flúor, mientras que los factores geográficos y socioeconómicos fueron determinantes, lo que evidencia la necesidad de fortalecer la regulación y garantizar un acceso equitativo a dentífricos fluorados.

PALABRAS CLAVE: Salud bucal; Educación en salud; Niño; Dentífricos; Desigualdades en salud; Determinantes sociales de la salud; Fluoruros.

INTRODUCTION

Oral health is essential for overall well-being, contributing to the prevention of various diseases (1). Among the essential products for adequate oral hygiene, toothpaste stands out due to its fluoride content, the effectiveness of which in preventing caries has been widely supported by scientific evidence. It has been demonstrated that using toothpaste containing at least 1000 parts per million (ppm) of fluoride significantly reduces the risk of caries compared to fluoride-free toothpastes (2,3). The Ministry of Health of Peru recommends using toothpaste with fluoride concentrations between 1000 and 1500 ppm from

the eruption of the first tooth (4). To maximize benefits, it is recommended to use toothpaste at least twice a day. However, concentrations above 1500 ppm should be evaluated cautiously due to the potential risk of excessive ingestion (5).

Fluoride is crucial for oral health, although both insufficient fluoride exposure and excessive intake can lead to adverse effects (6). Some experts indicate that despite the risk of fluorosis, its benefits in preventing caries might outweigh this risk (7). Regular fluoride use strengthens tooth enamel, making demineralization more difficult and promoting remineralization (3). In childhood, fluoride contributes to the early development and

protection of permanent teeth (8). Additionally, reducing caries and other dental conditions lowers costs associated with restorative treatments (9).

Health education programs not only prevent diseases but also promote well-being and foster healthy behaviors. In dentistry, oral health education has been a fundamental pillar for many years, yielding successful results in various contexts, both in developing and developed countries. Its implementation spans diverse environments, such as schools, workplaces, and residential facilities for older adults, thus reaching different population groups. However, to achieve a sustained impact, these initiatives must be continuous and tailored to the needs of various groups, including families and teachers. This approach ensures not only the promotion of oral health but also the establishment of long-term preventive habits (10,11).

Evidence indicates that oral health education programs targeting children, parents, and educators strengthen understanding of the importance of using fluoride toothpaste. To reduce the incidence of caries, these approaches must be comprehensive, including dental examinations, provision of fluoride toothpaste, and preventive treatments (12,13). Nevertheless, it is often assumed that simply transferring knowledge automatically leads to better oral health practices, yet this relationship has not been conclusively established.

In Peru, programs exist to provide structured oral health education, but access to information is broader, coming not only from these programs but also through media, healthcare professionals, and other sources.

This study is particularly relevant as it utilizes nationally representative data from the 2023 ENDES, providing a comprehensive overview of the country's reality. The use of this recent dataset offers the advantage of reflecting the most current state of the problem, incorporating updated varia-

bles and context-specific conditions that may not have been captured in earlier surveys. These results are relevant because they can help reinforce preventive policies aimed at improving oral health among vulnerable populations. By analyzing 2023 ENDES data with multilevel modeling, this research provides novel evidence on the association—or lack thereof—between access to oral health information and the proper use of fluoride toothpaste in children under twelve years of age, offering broader and more generalizable insights than those obtained from localized or older studies in Peru or other Latin American countries.

MATERIALS AND METHODS

This cross-sectional study was based on the analysis of secondary data obtained from the 2023 Demographic and Family Health Survey (ENDES), which is a national survey with a two-stage, stratified, and independent probabilistic sampling design at the departmental level and by urban and rural areas, conducted by the National Institute of Statistics and Informatics (INEI) of Peru (14). The study population consisted of 143,486 records of children under twelve years of age nationwide, collected in the specified ENDES year. Inclusion criteria required complete data on all study variables, while exclusion criteria eliminated records with missing information. All records were individually verified, resulting in a final sample of 15,428 cases with complete data, specifically including those reporting the use of fluoride toothpaste containing at least 1000 ppm.

In this study, the independent variable was access to oral health information, derived from the "Health Survey" component of ENDES. This variable was constructed based on the following question: "In the last 12 months, meaning from ___ of last year to ___ of this year, have you received information on the care and hygiene of children's teeth, tongue, and mouth through a person or media source?" Conversely, the depen-

dent variable was the use of fluoride toothpaste with concentrations equal to or greater than 1000 ppm, also obtained from the same survey component. Measurement was based on the following instruction: "Could you please show me the toothbrush and toothpaste used by (NAME) to brush their teeth?" Fluoride concentration was verified solely through the interviewer's inspection of the product label, relying on the manufacturer's declaration. While this method may introduce measurement bias, it is consistent with approaches used in previous studies. The interviewer then recorded the corresponding code according to predefined ppm categories. Additionally, this study included other variables of interest, such as the source of oral health information, natural region, area and place of residence, altitude, wealth index, health insurance affiliation, as well as the sex and age of participants.

To conduct the research, the official INEI website (www.inei.gob.pe) was accessed, selecting the "Database" option, followed by "Microdata" and "Query by surveys." The Demographic and Family Health Survey (ENDES) corresponding to the year 2023 and the specific study period was located in this section. Subsequently, datasets from relevant modules according to the variables included in the study were downloaded. Once the data were obtained, the databases were integrated using Stata 18's merge command, which combines datasets based on common identifying variables. After consolidating the database, incomplete records were removed, and the data were then analyzed.

For statistical analysis, a 95% confidence interval and a significance level of $p < 0.05$ were used. Descriptive analyses provided absolute and relative frequencies, followed by bivariate associations assessed with the Chi-square test. Using a nationally representative database allowed for a more accurate approximation of the country's

reality; however, it was necessary to account for the type of sampling applied in the study to ensure validity. Multivariate analysis was conducted with a multilevel Poisson regression model to estimate crude (PR) and adjusted prevalence ratios (aPR), which is particularly suitable for cross-sectional data as it avoids overestimating associations that could lead to misleading conclusions. Access to oral health information was the independent variable, and the use of fluoride toothpaste ≥ 1000 ppm was the dependent variable, with adjustments for covariates significant in bivariate analyses. Representative estimates were obtained using Stata's survey svy command, incorporating strata, primary sampling units, and sampling weights.

This study received approval from the Institutional Ethics Committee of Universidad Peruana Cayetano Heredia (CIE-UPCH) on July 19, 2024, under code SIDISI No. 214548. The database, published by the National Institute of Statistics and Informatics (INEI) in August 2024, corresponds to data collected during the second semester of 2023 and is publicly accessible through the official INEI website. All records are coded to ensure participant confidentiality and anonymity.

RESULTS

The results are summarized in two tables. Table 1 presents both descriptive and bivariate analyses, while Table 2 displays multivariate models. Although the full database includes approximately 143,000 records, the analysis was restricted to about 15,000 cases corresponding to the oral health module. This distinction is important, as ENDES encompasses a broad range of general health variables beyond oral health.

Overall, 86.20% of participants ($n=2135$) reported using fluoride toothpaste containing at least 1000 ppm, while 60.26% ($n=6139$) stated

they had received oral health information. The Ministry of Health (MINSA) was the main source of this information, reaching 58.10% of respondents (n=4911), followed by the private sector, which provided guidance to 27.30% (n=2303).

Bivariate analysis showed no significant association between the use of fluoride toothpaste and access to oral health information ($p=0.607$), health insurance affiliation ($p=0.975$), or sex ($p=0.071$). In contrast, several sociodemographic variables were significantly associated with toothpaste use, including the source of oral health information ($p<0.001$), natural region ($p<0.001$), area of residence ($p=0.030$), place of residence ($p=0.041$), altitude ($p<0.001$), wealth index ($p<0.001$), and age ($p<0.001$) (Table 1).

In the multivariate analysis, no association was found between access to oral health information and the use of fluoride toothpaste. In the unadjusted model (Model 1), the relationship was not statistically significant (coefficient: -0.01 ; PR: 0.99 ; 95% CI: $0.96-1.03$; $p=0.846$). This result remained unchanged in the fully adjusted model (Model 4), which controlled for sociodemographic variables that showed significant associations in the bivariate analysis (coefficient: -0.01 ; PR: 1.00 ; 95% CI: $0.97-1.04$; $p=0.808$) (Table 2).

Some results yielded p-values close to the significance threshold, suggesting possible trends; however, a conservative approach was adopted to minimize the risk of drawing misleading or erroneous conclusions.

Table 1. Use of Fluoride Toothpaste with 1000 ppm According to Access to Oral Health Information and Characteristics of Children Under 12 Years of Age in Peru, 2023.

	n	%	Use of fluoride toothpaste > 1000ppm				p*
			Yes		No		
			n	%	n	%	
			13293	86.20	2135	13.80	
Access to oral health information							
Yes	9289	60.26	7991	86.08	1298	13.92	0.607
No	6139	39.74	5302	86.38	837	13.62	
Source of oral health information							
Ministry of health	4911	58.10	612	87.55	4299	12.45	
Social security (EsSalud)	660	7.74	121	81.86	539	18.14	
Armed forces/Police forces	20	0.25	2	90.00	18	10.00	<0.001
Private sector	2303	27.30	355	84.44	1948	15.56	
Others	574	6.61	87	85.28	487	14.72	
Natural region							
Metropolitan Lima	1658	11.52	222	86.61	1436	13.39	
Rest of coast	4430	30.77	613	86.16	3817	13.84	
Highlands	4265	29.62	670	84.29	3595	15.71	<0.001
Jungle	4044	28.09	482	88.08	3562	11.92	
Area of residence							
Urban	10208	70.90	1455	85.75	8753	14.25	0.030
Rural	4189	29.10	532	87.30	3657	12.70	
Place of residence							
Capital	1658	11.52	222	86.61	1436	13.39	
City	4331	30.08	649	85.02	3682	14.98	
Town	4219	29.30	584	86.16	3635	13.84	0.041
Countryside	4189	29.10	532	87.30	3657	12.70	
Altitude							
Less than 2500 MAMSL	10824	75.18	1424	86.84	9400	13.16	<0.001
From 2500 MAMSL and above	3573	24.82	563	84.24	3010	15.76	
Wealth index							
Very poor	3830	26.60	430	88.77	3400	11.23	
Poor	3898	27.08	529	86.43	3369	13.57	
Medium	3006	20.88	458	84.76	2548	15.24	<0.001
Rich	2227	15.47	365	83.61	1862	16.39	
Very rich	1436	9.97	205	85.72	1231	14.28	
Health insurance coverage							
Yes	13695	88.55	1899	86.20	11796	13.80	0.975
No	1733	11.45	236	86.17	1497	13.83	
Sex							
Man	10454	70.39	1478	85.85	8976	14.15	0.071
Woman	4974	29.61	657	87.03	4317	12.97	
Age							
From 0 to 5 years old	6471	40.82	1390	78.36	5081	21.64	<0.001
From 6 to 11 years old	8957	59.18	745	91.61	8212	8.39	
Total	15428	100.00					

n: Absolute frequency. %: Relative frequency.
p: Statistical significance. * Chi-square test.

Table 2. Association Between the Use of Fluoride Toothpaste with 1000 ppm and Access to Oral Health Information Among Children Under 12 Years of Age in Peru, 2023.

Variables	Use of fluoride toothpaste > 1000ppm							
	Unadjusted model				Adjusted model 4			
	Coefficient	PR	95%CI	p	Coefficient	PR	95%CI	p
Model 1: Acceso a información de salud bucal								
Access to oral health information								
No	Ref.				Ref.			
Yes	-0.01	0.99	0.96-1.03	0.846	-0.01	1.00	0.97-1.04	0.808
Source of oral health information								
Ministry of health	Ref.				Ref.			
Social security (EsSalud)	-0.07	0.93	0.85-1.03	0.156	-0.06	0.95	0.86-1.04	0.262
Armed forces/Police forces	0.03	1.03	0.65-1.36	0.907	0.04	1.04	0.65-1.67	0.862
Private sector	-0.04	0.96	0.91-1.02	0.200	-0.02	0.98	0.92-1.04	0.511
Others	-0.03	0.97	0.88-1.07	0.597	-0.020	0.98	0.88-1.08	0.635
Variance	0.09				0.22			
Intra-class correlation (ICC %)	0.02				0.05			
p	<0.001				<0.001			
Model 2: Geographic characteristics								
Natural region								
Metropolitan Lima	Ref.							
Rest of coastal regions	-0.01	0.99	0.94-1.06	0.867	-	-	-	-
Highlands	-0.03	0.97	0.92-1.03	0.385	-	-	-	-
Jungle	0.02	1.02	0.96-1.08	0.590	-	-	-	-
Area of residence								
Urban	Ref.							
Rural	0.02	1.02	0.98-1.06	0.362	-	-	-	-
Place of residence								
Capital	Ref.							
Small city	-0.02	0.98	0.92-1.04	0.550	-	-	-	-
Town	-0.01	0.99	0.94-1.06	0.867	-	-	-	-
Countryside	0.01	1.01	0.95-1.07	0.799	-	-	-	-
Altitude								
Less than 2500 MAMSL	Ref.							
2500 meters or more above mean sea level	-0.03	0.97	0.93-1.01	0.147	-	-	-	-
Variance	0.09							
Intra-class correlation (ICC %)	0.87							
p	<0.001							
Model 3: Sociodemographic characteristics								
Wealth index								
Very poor	Ref.							
Poor	-0.03	0.97	0.93-1.02	0.271	-	-	-	-
Middle	-0.05	0.95	0.91-1.01	0.078	-	-	-	-
Rich	-0.06	0.94	0.89-0.99	0.038	-	-	-	-
Very rich	-0.03	0.97	0.90-1.03	0.293	-	-	-	-

Variables	Use of fluoride toothpaste > 1000ppm							
	Unadjusted model				Adjusted model 4			
	Coefficient	PR	95%CI	p	Coefficient	PR	95%CI	p
Health insurance coverage								
Yes	Ref.							
No	-0.01	0.99	0.95-1.06	0.991	-	-	-	-
Sex								
Man	Ref.							
Woman	0.01	1.01	0.98-1.05	0.487	-	-	-	-
Age								
0 to 5 years old	Ref.							
6 to 11 years old	0.16	1.17	1.13-1.21	<0.001	-	-	-	-
Variance	0.12	1.25						
Intra-class correlation (ICC %)	0.01	0.23						
p	<0.001	<0.001						

PR: Prevalence Ratio. aPR: Adjusted Prevalence Ratio; 95% CI: 95% Confidence Interval; p: Statistical significance; ICC: Intra-class Correlation Coefficient (similarity within cluster). a: Adjusted by natural region, area of residence, place of residence, altitude, wealth index and age.

DISCUSSION

The widespread use of fluoride toothpaste has substantially reduced dental caries over the past four decades, serving as an effective, economical, and socially accepted public health intervention for children and adolescents (15). Evidence shows that oral hygiene without fluoride offers no significant benefit in caries prevention (3). Nonetheless, the growing use of fluoride-free or insufficiently fluoridated toothpastes is concerning, potentially driven by variations in public health policies, cultural beliefs, and social perceptions (16).

In Peru, access to oral health information does not necessarily translate into the appropriate use of toothpaste with at least 1000 ppm fluoride. This study—the first to analyze 2023 ENDES data on the subject using multilevel modeling—found no significant association between receiving oral hygiene recommendations and correct toothpaste selection. These findings differ from those of

Curo-Valdivia *et al.*, who, over five years, reported a positive relationship between caregiver guidance and appropriate toothpaste use in children under 12 years (17). Such discrepancies may be due to differences in study period, sample characteristics, and analytical approach. International evidence similarly supports the positive influence of knowledge on oral health practices (18,19).

The present results challenge the assumption that expanding access to information alone ensures correct product use. They underscore the need for preventive strategies that integrate behavioral, cultural, and structural dimensions rather than relying solely on knowledge dissemination. In line with this, Lorenc *et al.* reported that interventions focusing on individuals may fail to reduce health inequities—and in some cases, exacerbate them—by overlooking differences in education and socioeconomic status (20). Likewise, Ghaffari *et al.*'s meta-analysis found that while education can improve attitudes and brushing habits within three months, high hetero-

geneity and limited impact on long-term practices or knowledge highlight the limitations of purely informational approaches (21).

This study identified geographical and sociodemographic variables as significant predictors of correct fluoride toothpaste use, suggesting that contextual factors may be more decisive than informational access. According to Nettle's framework, preventive health behaviors require time, energy, and financial resources, which may be deprioritized in socioeconomically vulnerable settings (22).

In this regard, despite the absence of an association between the main variables, significant associations were found with factors such as age, wealth index, natural region, and type of residence. These determinants are linked to structural conditions that must be addressed when designing and implementing preventive policies, ensuring that interventions are adapted to the specific needs of different population groups.

Peruvian research by Hernández and Azañedo (23) and by Carrizales and Quevedo (24) found strong associations between toothpaste use and variables such as age, wealth index, natural region, and type of residence. Similar patterns have been observed in Mexico (25) and Germany (26), where higher socioeconomic groups demonstrate earlier and more consistent adoption of recommended oral health practices for children.

Although no link was found between access to oral health information and correct toothpaste use, a critical barrier emerged: Peruvian regulations (as of March 2025) classify toothpastes with 1000–1500 ppm fluoride as “adult” products (27), whereas Ministry of Health clinical guidelines recommend these concentrations from the eruption of the first tooth (4). This misalignment fosters contradictory professional advice, complicates

policy implementation, and perpetuates misinformation—particularly given that many providers remain unaware of the regulatory context.

Harmonizing national regulations with evidence-based recommendations should be a priority for the Oral Health Directorate. Key actions include targeted provider training, clear and consistent public messaging, and ensuring the availability of adequately fluoridated toothpaste, especially in underserved communities.

Effective prevention must address both the risks of overexposure and the harms of insufficient fluoride use. Policies should guarantee equitable access to recommended toothpaste and be supported by culturally adapted interventions, community participation, and alignment with broader social protection measures. Future research should incorporate longitudinal designs, objective fluoride concentration testing, and clinical assessments to validate these findings and strengthen the evidence base for public health action.

CONCLUSION

Access to oral health information was not associated with the use of fluoride toothpaste ≥ 1000 ppm among Peruvian children under 12 years, while geographic and socioeconomic factors influenced its use. Current educational strategies alone may be insufficient without addressing structural and contextual barriers, particularly for vulnerable populations. Strengthening regulations, aligning policies with clinical guidelines, and ensuring equitable access are essential. This first analysis using 2023 ENDES data provides a comprehensive national perspective, offering key evidence to guide future interventions and policy. It should also be emphasized that improving the focus of preventive interventions is necessary to ensure that knowledge transfer truly leads to changes in people's habits.

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