PREVALENCE AND RISK FACTORS FOR EXTRINSIC DISCOLORATION IN DECIDUOUS DENTITION OF PERUVIAN SCHOOLCHILDREN[1]

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ABSTRACT. Introduction: *discoloration due to fluorosis is frequent in northern Peru, making extrinsic discoloration to go unnoticed or confused with other conditions due to lack of appropriate differential diagnosis. The aim of this study was to determine the prevalence and risk factors associated with extrinsic discoloration in deciduous dentition among schoolchildren of primary schools from Pimentel, Salas, and Chiclayo (Lambayeque, Peru) in 2015.* ***Methods:*** *This was an epidemiological analytical study using cases and controls, aimed at identifying risk factors associated with extrinsic discoloration. It used a census population of 238 clinical records of first and second graders from three different primary schools. Calibration was conducted by differential diagnosis of discoloration (kappa k = 0.76), using Odds Ratio (OR) as a measure of association to determine the significance of risk factors.* ***Results:*** *The prevalence of extrinsic discolorations was 6.72%. In all three schools there was significant association between low presence of caries and extrinsic discoloration, like this: Nicolás La Torre (OR: 23.46 CI95% 2.53-217.96), Santa Rosa (OR: 19.33 CI 95% 1.81-206.73), and Lanchaco (OR:16.88 CI95% 1.71-166.21). The association with chromogenic bacteria was also significant in the three schools: Nicolás La Torre (OR:15.56 CI95% 1.70-142.05), Santa Rosa (OR:13.75 CI95% 1.31-143.85), and Lanchaco (OR:10.91 CI95% 1.14-104.81).* ***Conclusions:*** *in the schoolchildren from Pimentel, Salas, and Chiclayo there was an approximation between expected and found results, agreeing with other studies and antecedents.*

Key words: *prevalence, risk factors, teeth, public health, epidemiological studies.*

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INTRODUCTION

Dental practitioners frequently see patients with alterations in teeth color, which is often a sign of an intrinsic etiologic factor that can even affect the structure of teeth. In other cases, they correspond to exogenous-acquired discolorations.[1, 2] In most cases, intrinsic discolorations affect all teeth, while those of extrinsic origin affect only some dental units.[1, 3] As for the stains of intrinsic origin, these are usually associated to fluorosis, hypocalcification, hypoplasia, early caries, tooth fracture, and pulp necrosis.[2, 3]

High rates of fluorosis prevalence have been reported in Lambayeque, as well as in other regions in northern Peru, where discolorations due to demineralization is often found in early caries.[4] This public health problem leads to the confusion and misdiagnosis of other types of pigmentation, especially those of extrinsic nature, which even go unnoticed as colorations of no importance. It is therefore necessary to identify the most significant risk factors, such as nutrition patterns, oral hygiene, iatrogenic practices, tobacco use, presence of chromogenic bacteria, or administration of drugs after tooth eruption,[5, 6] with special attention to those associated with deciduous dentition, as pointed out by some dental specialists.[7, 8] Although characteristics such as structure, morphology, and physiology do not indicate marked differences between deciduous and permanent dentition, the present study focuses on deciduous teeth because of the high frequency of cases reported by pediatric dentists, who claim that such pigmentations stop occurring once the transition from temporary to permanent dentition is completed,[8, 9] which also agrees with the concern and relevance of differential diagnosis based on accurate clinical recording and additional examination if necessary.[8, 10]

Previously, in 2008, Peruvian dental surgeons Frank Mayta Tovalino and Joselyn Torres Quevedo conducted a study at the Pediatric Dental Service of Hospital Central Fuerza Aérea del Perú, evaluating 185 children with mixed dentition, finding out a prevalence of 6.49% in extrinsic black stains, association between such pigmentations and the consumption of iron-containing dietary supplements, and a significant association with a low presence of caries.[11] Similarly, Peruvian dentist Mónica Huamán Palacios carried out a bibliographical review in 2013, showing that the prevalence of extrinsic black stains varies from 1 to 20%. The author found association with the presence of chromogenic bacteria in saliva, warning that in most cases such colorations tend to reappear even after prophylaxis.[12] On the other hand, a team of Chilean dentists and researchers conducted a study on exogenous stains in 2015, evaluating a random sample of 267 schoolchildren aged 6 to 12 years from the community of San Juan de la Costa, finding out 11.6% frequency of dental stains in the form of lines or points parallel to the

gingival margin with firm adherence to the cervical enamel, agreeing with the world literature, which reports a prevalence ranging from 6 to 19%.[13]

Due to the lack of similar studies in northern Peru, this study becomes relevant because of the valuable information it offers for the identification of exogenous pigmentation beyond discoloration due to fluorosis and early caries, traditionally reported in the Lambayeque region. It also makes a social contribution, as it will provide dental surgeons with additional tools for diagnosis according to pigmentation type, especially among people from low socioeconomic groups, who usually have limited opportunities to access oral health services, making it critical to identify risk factors, in order to establish effective preventive measures.[14] In this regard, oral hygiene and healthy eating habits are highly indicated in the prevention of caries and periodontal disease;[15, 16] they should also become consistent actions to prevent some extrinsic discoloration.[4, 17]

The present study is therefore necessary as it is aimed at producing epidemiological information—which is generally scarce in Peru—, identifying cases and prevalence of extrinsic discoloration, as well as the main associated factors, making differential diagnosis against discoloration due to early caries and fluorosis.

Accordingly, this study seeks to determine the prevalence and risk factors associated with extrinsic discoloration in deciduous dentition among schoolchildren of schools from Pimentel, Salas, and Chiclayo (Lambayeque, Peru).

MATERIALS AND METHODS

Initially, this project had the characteristics of an analytical study with epidemiological evaluation of cases and controls, aimed at identifying possible risk factors associated with extrinsic discolorations in a transversal manner; that is, evaluating the clinical records in one measurement and in the period of May to August of 2014. This was a study of cases and controls because it considered two groups, one of patients exposed to the possible associated factors, and another group of non-exposed patients, to observe the effect characterized by discoloration in the present, and therefore it was necessary to refer to the past medical history to identify factors or causes.

In a second phase of the study, and to assess prevalence by incorporating more cases in addition to the ones previously registered by means of clinical records, new dental notations were made between September and November 2015, recording more diagnosed cases of extrinsic discoloration.

The study population was formed by 714 clinical records of first and second graders from three state primary schools: Nicolás La Torre García (from Chiclayo), Lanchaco (from Salas) and Santa Rosa (from Pimentel). The sample was formed by the entire study population, so it was considered a census sample. The three schools were randomly and probabilistically selected from six schools where the researches had access in the designated locations. For group distribution, the cases were obtained from the dental records of patients showing pigmentations, while the controls were healthy patients with no color alterations, whose cases were obtained from the same records.

The study included clinical records of children aged 6 and 7 years who had an informed consent from their parents or guardians; poorly detailed clinical records and those without the required information were excluded, as well as the records from schoolchildren who were not subjected to the dental notation in 2015.

Data was collected by recording information from the clinical records and the dental notation, registering the clinical records kept at the health centers of Chiclayo, Lanchaco, and Santa Rosa (corresponding to Lambayeque's Regional Health Department of the Ministry of Health of Peru), which were conducted to create an epidemiologic baseline of caries, oral hygiene, malocclusions, and pigmentations. Special attention was paid to register the information concerning risk factors, including lab tests to identify chromogenic bacteria, providing that the clinical records used the polymerase reaction technique—which was conducted in alliance with a private laboratory, since this technique is not common in laboratories in our area.

In order to properly register cases based on the new dental notations, a calibration was performed to properly ascertain a differential diagnosis of discolorations (kappa coefficient k = 0.76), thus controlling possible errors of registration. The study's design and procedures helped control possible biases. Despite some initial economic limitations, resources were obtained to self-finance this research project.

The study was carefully conducted following all the necessary measures to comply with the bioethics guidelines set forth by the Declaration of Helsinki and UNESCO, as well as by the provisions of Universidad San Martín de Porres' Code of Ethics for Research, as stated in affidavit number 54/17 CE-

FO-USMP of the Bioethics Commission of Universidad San Martín de Porres' School of Dentistry, in order to safeguard the integrity and confidentiality of participants.

RESULTS

Table 1 shows that extrinsic discolorations were more prevalent (6.72%) than caries-related discolorations (2.52%), but less prevalent than discolorations due to fluorosis (16.81%). Schoolchildren from Institución Educativa Santa Rosa were the ones with the highest prevalence of extrinsic discolorations (11.32%).

Table 1. *Discoloration type prevalence in schoolchildren from three primary schools in Chiclayo, Peru*

Discoloration type		School: Nicolás La Torre	School: Lanchaco	School: Santa Rosa	Total per discoloration type
Extrinsic discoloration	N	18	12	18	48
	%	6.25	4.49	11.32	6.72
Discoloration due to fluorosis	N	39	48	33	120
	%	13.54	17.98	20.75	16.81
Caries-related discoloration	N	9	6	3	18
	%	3.13	2.25	1.89	2,52
Healthy units with no discoloration	N	222	201	105	528
	%	77.08	75.28	66.04	73.95
Total per school	N	288	267	159	714
	%	100	100	100	100

Source: Dental records and notations made between September and November 2015

Table 2 shows that, according to the results of the bivariate analysis at Institución Educativa Nicolás La Torre García, caries-free schoolchildren have 23.46 times (95% CI: 2.53-217.96) more risk of having extrinsic discoloration than kids with caries. In addition, schoolchildren with chromogenic bacteria have 15.56 times (95% CI: 1.70-142.05) more risk of presenting extrinsic discoloration than kids without such bacteria.

Table 2. *Bivariate analysis between the presence of extrinsic discolorations and risk factors in schoolchildren from Institución Educativa Nicolás La Torre García, Chiclayo, Peru*

Variables	OR	CI (95%)	*p* value
Poor oral hygiene			
No			

Yes	7.76	(0.86-69.82)	0.05
Consumption of foods			
No			
Yes	2.49	(0.43-14.42)	0.41
Posteruption medicines			
No			
Yes	0.98	(0.17-5.72)	0.982
Nutritional supplement			
No			
Yes	0.78	(0.13-4.51)	0.777
Consumption of natural water			
No			
Yes	0.94	(0.10-8.72)	0.955
Low presence of caries			
No			
Yes	23.46	(2.53-217.96)	0.000
Chromogenic bacteria			
No			
Yes	15,56	(1.70-142.05)	0.002

Source: Clinical records collected between May and August 2014

OR: Odds Ratio; CI: Confidence interval; p: Value of probability per the Odds Ratio test

Table 3 presents the bivariate analysis at Institución Educativa Santa Rosa, showing that caries-free schoolchildren have 19.33 times (95% CI: 1.81-206.73) more risk of presenting extrinsic discoloration than schoolchildren with caries. Also, schoolchildren with chromogenic bacteria have 13.75 times (95% CI: 1.31-143.85) more risk of presenting extrinsic discoloration than schoolchildren without such bacteria.

Table 3. *Bivariate analysis between the presence of extrinsic discoloration and risk factors in schoolchildren from Institución Educativa Santa Rosa, Pimentel, Peru*

Variables	**OR**	**IC (95%)**	***p* value**
Poor oral hygiene			
No			
Yes	2.05	(0.27-15.50)	0.481
Consumption of foods			
No			
Yes	2.58	(0.26-26.12)	0.406
Posteruption medicines			
No			
Yes	0.73	(0.07-7.44)	0.790
Nutritional supplement			
No			
Yes	0.84	(0.08-8.61)	0.885
Consumption of natural water			
No			

Yes	0.91	(0.09-9.29)	0.935
Low presence of caries			
No			
Yes	19,33	(1.81-206.73)	0.001
Chromogenic bacteria			
No			
Yes	13,75	(1.31-143.85)	0.007

Source: Clinical records collected between May and August 2014

Table 4 presents the bivariate analysis at Institución Educativa Lanchaco, showing that caries-free schoolchildren have 16.88 times (IC95%: 1.71-166.21) more risk of presenting extrinsic discoloration than schoolchildren with caries, while kids who have chromogenic bacteria have 10.91 times (95% CI: 1.14-104.81) more risk of presenting extrinsic discoloration than schoolchildren without such bacteria.

Table 4. *Bivariate analysis between the presence of extrinsic discoloration and risk factors in schoolchildren from Institución Educativa Lanchaco, Salas, Peru*

Variables	**OR**	**IC (95%)**	***p* value**
Poor oral hygiene			
No			
Yes	4.21	(0.45-39.86)	0.182
Consumption of foods			
No			
Yes	2.61	(0.27-24.94)	0.391
Posteruption medicines			
No			
Yes	0.58	(0.06-5.63)	0.633
Nutritional supplement			
No			
Yes	0.68	(0.07-6.65)	0.735
Consumption of natural water			
No			
Yes	0,38	(0.04-3.67)	0.391
Low presence of caries			
No			
Yes	16,88	(1.71-166.21)	0.003
Chromogenic bacteria			
No			
Yes	10,91	(1.14-104.81)	0.016

Source: Clinical records collected between May and August 2014

As shown in tables 2, 3, and 4, other risk factors were assessed, including poor oral hygiene, consumption of foods, administration of medicines posteruption, and consumption of nutritional supplements and natural water; however, no statistical significance was found.

DISCUSSION

Intrinsic tooth discolorations are highly prevalent among the Peruvian population, with fluorosis being the most determining cause, with 10.1%, and exposure to natural water sources the most important risk factor.[4] A similar epidemiological situation was reported in 2012 by the medical team for maternal-infant research of the State of Mexico, with researchers Raúl Palacios, David Cabrera, and Juan Hernández, who conducted a study in a population of 904 schoolchildren aged 5 to 12 years, finding out a prevalence of 8% of fluorosis—higher than other risk factors for intrinsic and extrinsic pigmentation in that country.[18]

The present study found a prevalence of endogenous fluorosis-related discoloration of 16.81% and a lower prevalence of extrinsic discoloration, of 6.72%. In an agreeing antecedent in 2008, dental surgeons Frank Mayta and Jocelyn Torres conducted a study in 185 children with mixed dentition at the Dental Service of Hospital Central Fuerza Aérea del Perú, finding out a prevalence of 6.49%.[11] Similarly, in 2012 Natalie Guzmán, Stephanie Super, Álvaro Pinochet et al evaluated a random sample of 267 schoolchildren aged 6 to 12 years from the community of San Juan de la Costa in Chile, finding a frequency of dental stains of 11.6%, agreeing with the world literature, which reports a prevalence ranging from 6 to 19%.[13] in Argentina, in 2002, dentist Maria Elisa Bircher conducted a research project for her doctoral dissertation at Universidad Nacional de Rosario, examining 433 children aged 3 to 10 years, finding out a prevalence of 5.33% of black extrinsic stains.[19] In a similar experience, in 2005, in Spain, researchers Paredes Gallardo and Paredes Cencillo assessed 1,100 schoolchildren aged 4 to 11 years, finding out a prevalence of exogenous discoloration of 7.54% due to chromogenic bacteria.[20]

Other findings of the present study suggest that the low presence of caries and the presence of chromogenic bacteria were risk factors significantly associated to extrinsic discolorations. Accordingly, the findings reported by Mayta and Torres in 2008 indicate that the epidemiological index assessing the amount of decayed, missing, and filled deciduous teeth (DMF), and the epidemiologic index assessing the amount of decayed, lost, and filled permanent teeth (DLF), adding up DMF+DLF in children with

extrinsic discolorations, was lower than the DMF+DLF in children who did not have such discolorations. Since this difference was statistically significant, an association between discolorations and a lower presence of caries was suggested.[11]

In 2013, Indira Canales and María Elena Díaz, pediatric dentistry specialists at Universidad Peruana Cayetano Heredia, agreed concluding that extrinsic discolorations, especially black stains, are associated with a low frequency of caries.[21] María Elisa Bircher also found that black exogenous discolorations are associated with a low presence of caries.[19]

As for the association between chromogenic bacteria and extrinsic discolorations, dentist Mónica Huamán conducted a bibliographical review and a study of two cases of patients with black stains of extrinsic origin, concluding that these appear due to the presence of chromogenic bacteria in saliva,[12] as observed in the present study.

While it is true that no significant association was found between the consumption of foods or beverages and discolorations, it should be noted, however, that some in vitro studies have found some evidence, like the study conducted in 2013 by stomatologists Gisella Castillo, Leyla Delgado, and Alexis Evangelista, who concluded that bovines teeth exposed to instant coffee for 28 days are more susceptible to pigmentation than those exposed to purple corn artificial beverage.[22] In 2014, Paraguayan dentists Andrea Balladares and Marta Becker, in an ex vivo study in 50 human premolars, concluded that carbonated beverages and the frequency of consumption have an effect on dentine, producing an opaque surface.[23] Also, in 2010 Chilean researchers Leonor Rosales, Carlos Larrucea et al, based on a study in 42 bovine healthy central incisors, assessed the recurrence of pigmentation due to tea, with a maximum color change when submitting the samples to 20 and 30 immersions.[24] In this regard, in a review study in 2015, stomatologists Eric Acuña, Katherine Vilchez et al concluded that consuming red wine during whitening may affect treatment outcomes, unlike the consumption of cigarette, tea, and coffee, which do not produce considerable effects in the short term.[25]

An article reported by Colombian dentists Andrea Durán, Ángela Lucumí et al, in an experimental study in 22 bicuspids, the authors showed that laser whitening does not produce severe clinical or microscopic effects on teeth structures,[26] suggesting that it is necessary to evaluate whether some whitening treatments can produce harmful effects on the physical and functional integrity of teeth, such as color regression and inflammatory cervical response. Given this concern, emphasis is placed on the

importance of following the most appropriate treatment plan according to the causes of mild, moderate, or severe pigmentations, which will surely contribute to reducing the possibility of recurrence. In 2014, dental surgeons César Lamas, Sergio Alvarado et al proposed a dental whitening protocol in different clinical situations to guarantee better results.[27]

It is important to note that other authors who have contributed to the international literature claim that extrinsic pigmentations are due to other risk factors, such as medicine intake, chemicals, tobacco use, and iatrogenesis due to dental coatings and the use of chlorhexidine[13, 28, 29]—which do not appear as significant risk factors in the present study, but should be evaluated in further research.

It is recommended to conduct comparative studies between intrinsic and extrinsic discolorations, since reports like the one by the professional team of dentists composed by Ana Mafla, Doris Córdoba et al show that opacities of intrinsic origin due to fluorosis and hypoplasia occur with moderate prevalence in individuals aged 6 to 15 years;[30] these results would have a greater impact if analyzed in an epidemiological map including pigmentation types according to geographic and demographic conditions.

In view of the limitations due to scarce information in the Lambayeque region, the conclusion is that in schoolchildren from Chiclayo, Salas, and Pimentel there was an approximation of the expected and found results, which also agrees with some of the aforementioned studies. One contribution of the present study suggests that the most prevalent risk factors are associated to cases with no caries and those with chromogenic bacteria, for which the sanitary due actions and strategies have been initiated by the Oral Health Sanitary Strategy of the Ministry of Health of Peru for its control and epidemiological surveillance.

The strengths of the present study, unlike the aforementioned studies, are mainly based on a differential diagnosis between extrinsic and intrinsic pigmentations, while the weaknesses include the lack of similar experiences in Peru. In terms of epidemiological information, the main findings of this study suggest that further research is still needed to develop an epidemiological map of pigmentations and oral pathologies in general. This would help specify and respond to the oral health needs of each region, responding in a more efficient way with actions and strategies aimed at each stage of life, particularly to pregnant women, preschoolers, schoolchildren, and the general population, especially the most vulnerable groups.

Another conclusion is that the prevalence of extrinsic discolorations (6.72%) is higher than caries-related discolorations (2.52%) but lower than discolorations due to fluorosis (16.81%). The main risk factors associated with extrinsic discoloration in this study correspond to free-caries patients and those with the presence of chromogenic bacteria.

Finally, some questions that can be used to encourage further research are formulated: What will be the result of comparing discolorations prevalence in other regions of Peru and Latin America? What other risk factors can be considered in future studies? Can a correlation between the absence of cavities and the presence of extrinsic pigmentation be demonstrated?

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CONFLICT OF INTERESTS

The authors state that there was no conflict of interest and that this research project was self-financed.

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