

Vol 12 / Issue 1 / January-February 2022

# Journal of International Society of Preventive & Community Dentistry

Publication of International Society of Preventive and Community Dentistry

# JISPCD

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# Impact of Puppet Theater on Oral Health Knowledge and Oral Hygiene in Preschoolers from a Peruvian Educational Institution: A Quasi-experimental Study

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## ABSTRACT

**Aim:** The puppet theater, due to its artistic and educational characteristics, could allow children to develop oral health self-care in an attractive and fun way. The aim of this study was to evaluate the impact of puppet theater on oral health knowledge and oral hygiene in preschoolers from a Peruvian public school.

**Materials and Methods:** An analytical, longitudinal, and quasi-experimental study was conducted in 132 preschoolers divided into three age-matched groups (3, 4, and 5 years old) from August to November 2019 in a Peruvian public school. At 4 weeks and 4 months after performing the puppet theater, a validated questionnaire of five closed questions was used to evaluate oral health knowledge, and the Greene–Vermillion index [only bacterial plaque index (BPI) part] was used to evaluate oral hygiene, considering good (0–0.6), fair (0.7–1.8), and poor (1.9–3.0). The theater sessions were held every week for the first month and every 2 weeks for the following 3 months. To analyze the levels in the BPI, the Wilcoxon and Friedman test was used to compare related measures, and to compare the knowledge for each question of the questionnaire, the McNemar and Cochran’s *Q* tests were used, considering a *P*-value less than 0.05. **Results:** The BPI in relation to age (3, 4, and 5 years), before and after 4 months of performing the puppet theater, was 1.9 [confidence interval (CI): 1.7–2.0], 1.8 (CI: 1.6–1.9), and 1.8 (CI: 1.7–2.0), decreasing to 0.9 (CI: 0.8–1.0), 0.8 (CI: 0.7–0.9), and 0.9 (CI: 0.8–1.00), respectively. In relation to gender (men and women), it was 1.8 (CI: 1.7–2.0) and 1.8 (CI: 1.7–1.9), decreasing to 0.9 (CI: 0.8–1.0) and 0.8 (CI: 0.8–0.9), respectively. In relation to origin (urban or rural), it was 1.8 (CI: 1.7–1.9) and 1.8 (CI: 1.4–2.2), decreasing to 0.9 (CI: 0.8–0.9) and 0.8 (CI: 0.7–0.9), respectively. The level of BPI and oral health knowledge improved significantly (*P* < 0.001) over time in all preschoolers, except in those who came from the rural area (*P* > 0.05). **Conclusion:** The application of the puppet theater positively influenced the preschoolers in such a way that it significantly improved their oral health knowledge and oral hygiene at 4 weeks and 4 months, in both genders of 3, 4, and 5 years of age, and in those whose origin was the urban area. However, no significant improvements in oral health knowledge and oral hygiene were observed in those preschoolers whose origin was the rural area.

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**How to cite this article:** Ladera-Castañeda M, Córdova-Limaylla NE, Briceño-Vergel G, Rosas-Díaz JC, Cervantes-Ganoza LA, Cayo-Rojas CF. Impact of puppet theater on oral health knowledge and oral hygiene in preschoolers from a Peruvian educational institution: A quasi-experimental study. *J Int Soc Prevent Communit Dent* 2022;12:28-37.

### Access this article online

#### Quick Response Code:



**Website:** www.jispcd.org

**DOI:** 10.4103/jispcd.JISPCD\_212\_21

Received : 21-07-21  
 Revised : 20-08-21  
 Accepted : 16-09-21  
 Published : 29-01-22

**KEYWORDS:** *Dentistry, Guignol theater, oral health knowledge, Peru, plaque index, puppets*

## INTRODUCTION

Oral diseases affect about 3.5 billion people worldwide, with caries in permanent teeth being the most frequent disorder. Worldwide, an estimated 2.3 billion people suffer from caries in permanent teeth and more than 530 million children suffer from caries in deciduous teeth.<sup>[1,2]</sup> In addition, it has been reported that dental caries is the fourth most expensive oral pathology to treat and affects between 60% and 90% of schoolchildren, becoming one of the most common chronic diseases today.<sup>[3,4]</sup>

In a study carried out in Lima, Peru, in 3-year-old children, a prevalence of 64.3% of dental caries with dentin and pulp involvement was found, including the presence of abscess or fistula, and a prevalence of 93.4% of dental caries with enamel involvement only was found.<sup>[5]</sup> In this regard, untreated dental caries has a high incidence in preschoolers; however, its appearance can be attenuated through educational and demonstrative sessions that promote healthy habits. Strategies to strengthen preventive actions are of great importance in the oral health of children, especially when performed in school environments.<sup>[6-8]</sup>

The main strategies aimed at creating better health conditions include interventions aimed at preschool and school-age children, since it is at this stage that the attitudes and behavioral patterns that regulate life in adulthood are developed.<sup>[9,10]</sup> Playful activity contributes to the physical and social development of children, improving their ability to concentrate, perception, and memory and also helps them adapt to situations that simulate real life.<sup>[9-13]</sup>

To carry out health promotion, educational and/or demonstrative sessions have been identified as a powerful tool to prevent diseases, empowering people to take control of their health in an informed way.<sup>[10]</sup> In this educational task, it is necessary to introduce demonstrative methodologies that favor the learning of oral health care; therefore, health professionals could incorporate the puppet (or marionette) theater as an effective methodological resource to achieve this objective.<sup>[10,14,15]</sup> Puppet theater can be used as a learning strategy that promotes the development of oral health self-care behaviors in preschool and schoolchildren. This type of theater uses dolls with heads and hands attached to a dress, which adapt like a glove to the hand

of the operator to give them movement and children can see, hear, and even identify with them, interacting directly with them, being able to externalize their self and at the same time have fun while they are educated in different themes appropriate for their age.<sup>[9,11]</sup>

Some authors have reported that the application of oral health programs that include various educational strategies in preschool and schoolchildren is effective in improving knowledge and developing positive oral health and hygiene habits in the short term.<sup>[9,12,15]</sup> However, other authors report no improvements in relation to oral hygiene in the short and medium term after educational interventions.<sup>[6,16]</sup>

Therefore, the objective of this research was to evaluate the impact of puppet theater on oral health knowledge and oral hygiene in preschoolers studying in a Peruvian public educational institution.

## MATERIALS AND METHODS

### TYPE OF STUDY

A longitudinal, prospective, analytical study was conducted with a quasi-experimental design.

### SAMPLE CALCULATION AND SELECTION

The sample consisted of 132 children, being the sample size per group (3, 4, and 5 years) equal to 44 children and was calculated using a mean comparison formula considering an  $\alpha = 0.05$ , a statistical power  $(1-\beta) = 0.80$ , mean difference  $(X1-X2) = 0.25$ , and variances  $S1 = 0.23$  and  $S2 = 0.12$ . These values were obtained from a pilot study in 30 preschoolers, in whom the BPI was measured at two different times (before performing the puppet theater and 4 weeks after the performance). The sampling technique was simple random, considering the following selection criteria.

### INCLUSION CRITERIA

The inclusion criteria were as follows:

1. Preschoolers of both sexes from 3 to 5 years of age from the José Olaya Balandra Educational Institution—Chorrillos.
2. Preschoolers whose parents accepted the informed consent.
3. Preschoolers who completed the questionnaire.
4. Preschoolers who attended all educational sessions with puppets.
5. Preschoolers with complete deciduous dentition.

**EXCLUSION CRITERIA**

The exclusion criteria were as follows:

1. Preschoolers who do not wish to participate in this study.
2. Preschoolers whose parents who did not want to collaborate with the study.
3. Preschoolers who irregularly attended the educational sessions with puppets.

**INTERMEDIATE VARIABLES**

The intermediate variables considered in the study were age, sex, and place of origin.

**INSTRUMENT TO MEASURE ORAL HEALTH KNOWLEDGE**

To measure oral health knowledge, a validated hetero-administered questionnaire with five closed questions<sup>[12]</sup> was used [Table 1]. These questions were validated by three experts (one pediatric dentist, one methodologist, and one specialist in dental public health) with an Aiken *V* of 0.96. In addition, the instrument reliability was evaluated with the Kuder–Richardson test (KR-20), whose value was 0.754. Questions were related to bacterial plaque, frequency and time of brushing, visits to the dentist, and cariogenic foods. The final values for each question were: correct and incorrect. This questionnaire was applied before providing the educational session with puppet theater. Subsequently, it was applied again after 4 weeks and finally after 4 months.

**INSTRUMENT FOR MEASURING THE BACTERIAL PLAQUE INDEX**

The Greene and Vermillion Simplified Oral Hygiene Index (OHI-S) evaluates two aspects: presence of bacterial plaque or debris and dental calculus. In the present study, only the evaluation of bacterial plaque index (BPI) was considered and the parameters were:

good (0–0.6), fair (0.7–1.8), and poor (1.9–3.0).<sup>[17]</sup> Considering that children aged 3–5 years presented deciduous dentition, teeth 5.5, 5.1, 6.5, and 7.1 were evaluated vestibularly and teeth 7.5 and 8.5 were evaluated lingually. The BPI measurement was carried out before the educational session with puppet theater, then 4 weeks later, and finally 4 months later [Figure 1].

**PROCEDURE**

Permission was requested from the school principal, classroom teachers, and parents, and the study was explained to them. After obtaining informed consent from the parents, an initial assessment of the children's oral health knowledge was performed. For this purpose, each question was asked individually to the children and then the alternative answers were read to them while they observed the figures. They were then asked to indicate their responses and these were recorded on a data collection form prepared in a Microsoft Excel 2016 spreadsheet with the help of another researcher. Next, the initial BPI was measured and registered. The main researcher was in charge of performing both evaluations, whereas another researcher made the annotations. The latter researcher has previously prepared and calibrated for the IPB measurement, obtaining an intraclass correlation coefficient = 0.96; confidence interval (CI): 0.89–0.98, which is a very good result. Regarding the annotation of correct answers in the knowledge test, a Kappa index = 1.00 was obtained.

The children were then given 10 puppet theater sessions with the following topics: oral cavity diseases, oral hygiene, importance of visiting the dentist, and cariogenic foods. Each puppet theater session had a total duration of 30 min and ended with a 5-min

**Table 1: Oral health questionnaire**

Question	Answer
1. Is plaque (bacteria) on your teeth good or bad?	- Good - Bad* - I don't know
2. How many times a day should you brush your teeth?	- Once a day - After you wake up, after every meal, and when you go to bed* - I don't know
3. How long should you brush your teeth?	- 30 seconds - Two minutes* - I don't know
4. How often should you see your dentist?	- Every 6 months* - Only when your teeth hurt - I don't know
5. Which type of these foods is risky for your health?	- Milk - Sticky, sugary, sweet foods* - I don't know

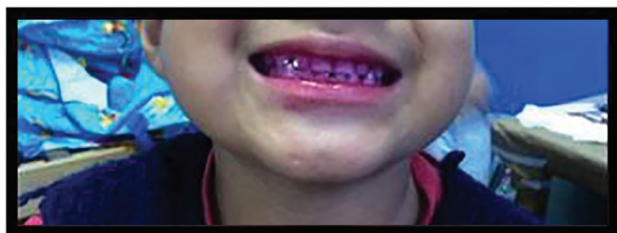
\*The correct answer to the question



feedback during which the puppets interacted with the children through questions and answers [Figure 2]. The sessions were held at the beginning of the week and the frequency was every 7 days during the first month and then from the second month every 2 weeks, until completing the 4 months. Knowledge and BPI were assessed at 4 weeks and at the end of 4 months. Teachers and at least one parent of each child were present during the puppet theater sessions.

#### STATISTICAL ANALYSIS

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 24.0, and descriptive statistics were used to obtain percentages of the categorical variables and measures of central tendency and dispersion for the numerical variables. The Kolmogorov–Smirnov test (for more than 30 data) and the Shapiro–Wilk test (for 30 data or less) were used to evaluate the normal distribution of quantitative values. In contrast, for the inferential analysis regarding the BPI levels, the Wilcoxon and Friedman test was used to compare two related measures and more than two related measures, respectively. In addition, for comparisons of knowledge for each question of the questionnaire, the McNemar test and Cochran's  $Q$  test were used to compare two measures and more than two measures, respectively. All analyses were performed, considering  $P$ -value  $< 0.05$  as significant.



**Figure 1:** Bacterial plaque detection in a 4-year-old child



**Figure 2:** Development of the puppet theater called “Importance of visiting the dentist,” in 4-year-old children

#### BIOETHICAL CONSIDERATIONS

The present research complied with the bioethical principles for medical research involving human subjects, which are part of the Declaration of Helsinki<sup>[18]</sup> related to confidentiality, freedom, respect, and non-maleficence and approved by the Ethics Committee of the Faculty of Stomatology of the Universidad Inca Garcilaso de la Vega with resolution no. 434-2019-DFE.

#### RESULTS

Regarding age, it was observed that the BPI values, before the educational sessions with puppets, were 1.85 (CI: 1.71–1.98), 1.77 (CI: 1.63–1.91), and 1.84 (CI: 1.69–1.98) in preschoolers aged 3, 4, and 5 years, respectively, decreasing to 0.89 (CI: 0.79–0.99), 0.82 (CI: 0.73–0.91), and 0.90 (CI: 0.81–1.00) after 4 months [Table 2].

Regarding gender, it was observed that the BPI values, before the educational sessions with the puppets, were 1.82 (CI: 1.69–1.95) and 1.82 (CI: 1.71–1.92) in male and female preschoolers, respectively, decreasing to 0.92 (CI: 0.84–0.99) and 0.84 (CI: 0.76–0.92) after 4 months [Table 2].

Regarding place of origin, it was observed that the BPI values, before the educational sessions with puppets, were 1.82 (CI: 1.74–1.90) and 1.77 (CI: 1.38–2.16) in preschoolers from urban and rural areas, respectively, decreasing to 0.87 (CI: 0.82–0.93) and 0.83 (CI: 0.72–0.94) after 4 months [Table 2].

In contrast, all the BPI values did not present normal distribution ( $P < 0.05$ ), with the exception of initial measurement in the 4-year-old preschoolers ( $P = 0.127$ ) and in preschoolers from the rural area both at the initial measurement ( $P = 0.099$ ) and at the end of 4 months ( $P = 0.591$ ) [Table 2].

Regarding age and gender, the BPI level decreased very significantly ( $P < 0.001$ ) as time passed, both at 4 weeks and 4 months, in males and females aged 3, 4, and 5 years. However, related to place of origin, it can be noticed that the BPI level decreased very significantly ( $P < 0.001$ ) at 4 weeks and 4 months in preschoolers from the urban area, whereas there were no significant changes ( $P = 0.097$ ) in the BPI level of preschoolers from the rural area [Table 3].

Regarding knowledge of preschoolers on all Q1 (Is the bacterial plaque on your teeth good or bad?), Q2 (How many times a day should you brush your teeth?), Q3 (How long should you brush your teeth?), Q4 (How often should you visit the dentist?), and Q5 (Which of these foods is dangerous for your health?) questions, it could be noticed that there was a significant

improvement ( $P < 0.001$ ) consistently both at 4 weeks and 4 months in preschoolers of 3, 4, and 5 years of age, of both sexes, and in those coming from the urban area. However, in preschoolers from the rural area, no significant improvements were observed for both questions at 4 weeks and 4 months ( $P > 0.05$ ) [Table 4].

### DISCUSSION

In the present study, it could be noticed that by using puppet theater (puppetry), the BPI level decreased

very significantly as time passed, both at 4 weeks and 4 months, in preschoolers of both genders aged 3, 4, and 5 years, and also in those who came from the urban area. However, the same did not occur in preschoolers coming from the rural area. On the contrary, regard to the level of knowledge about their oral health, it was noticed that there were consistently significant improvements both at 4 weeks and 4 months, in all preschoolers of both genders aged 3, 4, and 5 years and in those whose origin was the urban area; however,

**Table 2: Descriptive analysis of the BPI according to intermediate variables and time of measurement**

Variable	Category	BPI	n (%)	Mean	Median	SD	SE	95% CI	Min	Max	P-value
Age	3 years	Initial	44 (33)	1.85	1.80	0.45	0.07	1.71 1.98	0.90	2.60	0.029 <sup>a</sup>
		4 weeks		1.39	1.40	0.32	0.05	1.30 1.49	0.70	2.20	0.008 <sup>a</sup>
		4 months		0.89	0.80	0.33	0.05	0.79 0.99	0.50	1.80	0.012 <sup>a</sup>
	4 years	Initial	44 (33)	1.77	1.70	0.49	0.07	1.63 1.91	0.90	2.60	0.127 <sup>a</sup>
		4 weeks		1.32	1.25	0.31	0.05	1.23 1.41	0.70	2.20	0.014 <sup>a</sup>
		4 months		0.82	0.70	0.29	0.04	0.73 0.91	0.50	1.80	0.001 <sup>a</sup>
	5 years	Initial	44 (33)	1.84	1.80	0.48	0.07	1.69 1.98	0.90	2.60	0.004 <sup>a</sup>
		4 weeks		1.40	1.40	0.34	0.05	1.29 1.50	0.70	2.00	<0.001 <sup>a</sup>
		4 months		0.90	0.80	0.33	0.05	0.81 1.00	0.50	1.60	0.018 <sup>a</sup>
Gender	Male	Initial	58 (43.94)	1.82	1.60	0.51	0.07	1.69 1.95	1.00	2.60	<0.001 <sup>a</sup>
		4 weeks		1.39	1.40	0.32	0.04	1.31 1.47	0.80	2.00	<0.001 <sup>a</sup>
		4 months		0.92	0.90	0.28	0.04	0.84 0.99	0.50	1.50	<0.001 <sup>a</sup>
	Female	Initial	74 (56.06)	1.82	1.80	0.45	0.05	1.71 1.92	0.90	2.50	0.07 <sup>a</sup>
		4 weeks		1.35	1.40	0.33	0.04	1.28 1.43	0.70	2.20	0.001 <sup>a</sup>
		4 months		0.84	0.70	0.34	0.04	0.76 0.92	0.50	1.80	<0.001 <sup>a</sup>
Place of origin	Urban	Initial	125 (94.70)	1.82	1.80	0.47	0.04	1.74 1.90	0.90	2.60	<0.001 <sup>a</sup>
		4 weeks		1.37	1.40	0.33	0.03	1.31 1.43	0.70	2.20	<0.001 <sup>a</sup>
		4 months		0.87	0.80	0.33	0.03	0.82 0.93	0.50	1.80	<0.001 <sup>a</sup>
	Rural	Initial	7 (5.30)	1.77	1.50	0.53	0.20	1.38 2.16	1.20	2.50	0.099 <sup>b</sup>
		4 weeks		1.33	1.20	0.28	0.10	1.12 1.53	1.10	1.70	0.031 <sup>b</sup>
		4 months		0.83	0.80	0.15	0.06	0.72 0.94	0.60	1.00	0.591 <sup>b</sup>

BPI = bacterial plaque index; n = sample; SD = standard deviation; SE = standard error; 95% CI = 95% confidence interval; Min = minimum value; Max = maximum value

<sup>a</sup>Kolmogorov–Smirnov test with Lilliefors correction

<sup>b</sup>Shapiro–Wilk test;  $P < 0.05$ : no normal distribution

**Table 3: Comparison of BPI levels, according to age, gender, and origin**

Variable	Category	BPI level							*P	**P-value		
		Initial (X)		4 weeks (Y)			4 months (Z)			(X) vs. (Y)	(X) vs. (Z)	(Y) vs. (Z)
		Poor f(%)	Regular f(%)	Poor f(%)	Regular f(%)	Good f(%)	Regular f(%)	Good f(%)				
Age	3 years	18 (49.9)	26 (59.1)	2 (4.5)	39 (88.6)	3 (6.8)	30 (68.2)	14 (8.31)	<0.001	<0.001	<0.001	<0.001
	4 years	16 (4.36)	28 (63.6)	1 (2.3)	43 (97.7)	0 (0.0)	28 (63.6)	16 (4.36)	<0.001	<0.001	<0.001	<0.001
	5 years	20 (45.5)	24 (54.5)	8 (2.18)	36 (81.8)	0 (0.0)	31 (70.5)	13 (5.29)	<0.001	<0.001	<0.001	<0.001
Gender	Male	22 (9.37)	36 (62.1)	4 (6.9)	52 (89.7)	2 (3.4)	44 (75.9)	14 (1.24)	<0.001	<0.001	<0.001	<0.001
	Female	32 (43.2)	42 (56.8)	7 (5.9)	66 (89.2)	1 (1.4)	45 (60.8)	29 (2.39)	<0.001	<0.001	<0.001	<0.001
Place of origin	Urban	52 (41.6)	73 (58.4)	11 (8)	111 (88.8)	3 (2.4)	83 (66.4)	42 (6.33)	<0.001	<0.001	<0.001	<0.001
	Rural	2 (6.28)	5 (71.4)	0 (0.0)	7 (100.0)	0 (0.0)	6 (85.7)	1 (3.14)	0.097	0.157	0.083	0.317

\*Friedman's test,  $P < 0.05$ : significant differences

\*\*Wilcoxon's test,  $P < 0.05$ : significant differences

BPI = bacterial plaque index; f = frequency

**Table 4: Comparison of preschoolers' knowledge according to age, gender, and origin, by time**

Questions	Variable	Category	Knowledge						*p		**p-value		
			Initial (X)		4 weeks (Y)		4 months (Z)		(X) vs (Y)	(X) vs (Z)	(Y) vs (Z)		
			Incorrect (%)	Correct (%)	Incorrect (%)	Correct (%)	Incorrect (%)	Correct (%)					
Q1. Is plaque (bacteria) on your teeth good or bad?	Age	3 years	23 (52.27)	21 (47.73)	12 (27)	32 (72.73)	1 (2.27)	43 (97.73)	<0.001	0.001	<0.001	0.001	
		4 years	24 (54.55)	20 (45.45)	8 (18)	36 (81.82)	0 (0.00)	44 (100.00)	<0.001	<0.001	<0.001	0.008	
		5 years	22 (50.00)	22 (50.00)	9 (20.45)	35 (79.55)	1 (2.27)	43 (97.73)	<0.001	<0.001	<0.001	0.008	
	Gender	Male	28 (48.28)	30 (51.72)	11 (18.97)	47 (81.03)	0 (0.00)	58 (100.00)	<0.001	<0.001	<0.001	0.001	
		Female	41 (55.41)	33 (44.59)	18 (24.32)	56 (75.68)	2 (2.70)	72 (97.30)	<0.001	<0.001	<0.001	<0.001	
		Urban	67 (53.60)	58 (46.40)	28 (22.40)	97 (77.60)	2 (1.60)	123 (98.40)	<0.001	<0.001	<0.001	<0.001	
	Place of origin	Rural	2 (28.57)	5 (71.43)	1 (14.29)	6 (85.71)	0 (0.00)	7 (100.00)	0.223	1.000	0.500	1.000	
		3 years	22 (50.00)	22 (50.00)	8 (18)	36 (81.82)	1 (2.27)	43 (97.73)	<0.001	<0.001	<0.001	0.016	
		4 years	21 (47.73)	23 (52.27)	8 (18)	36 (81.82)	2 (4.55)	42 (95.45)	<0.001	<0.001	<0.001	0.031	
Q2. How many times a day should you brush your teeth?	Age	4 years	22 (50.00)	22 (50.00)	6 (13.64)	38 (86.36)	2 (4.55)	42 (95.45)	<0.001	<0.001	<0.001	0.125	
		5 years	38 (65.52)	20 (34.48)	19 (32.76)	39 (67.24)	5 (8.62)	53 (91.38)	<0.001	<0.001	<0.001	<0.001	
		Female	27 (36.49)	47 (63.51)	3 (4.05)	71 (95.95)	0 (0.00)	74 (100.00)	<0.001	<0.001	<0.001	0.250	
	Place of origin	Urban	60 (48.00)	65 (52.00)	19 (15.20)	106 (84.80)	4 (3.20)	121 (96.80)	<0.001	<0.001	<0.001	<0.001	
		Rural	5 (71.43)	2 (28.57)	3 (42.86)	4 (57.14)	1 (14.29)	6 (85.71)	0.049	0.500	0.125	0.500	
		3 years	27 (61.36)	17 (38.64)	14 (31.82)	30 (68.18)	1 (2.27)	43 (97.73)	<0.001	<0.001	<0.001	<0.001	
	Q3. How long should you brush your teeth?	Age	4 years	25 (56.82)	19 (43.18)	12 (27)	32 (72.73)	1 (2.27)	43 (97.73)	<0.001	<0.001	<0.001	0.001
			5 years	26 (59.09)	18 (40.91)	12 (27)	32 (72.73)	1 (2.27)	43 (97.73)	<0.001	<0.001	<0.001	0.001
			Male	36 (62.07)	22 (37.93)	16 (27.59)	42 (72.41)	0 (0.00)	58 (100.00)	<0.001	<0.001	<0.001	<0.001
Gender		Female	42 (56.76)	32 (43.24)	22 (29.73)	52 (70.27)	3 (4.05)	71 (95.95)	<0.001	<0.001	<0.001	<0.001	
		Urban	74 (59.20)	51 (40.80)	37 (29.60)	88 (70.40)	3 (2.40)	122 (97.60)	<0.001	<0.001	<0.001	<0.001	
		Rural	4 (57.14)	3 (42.86)	1 (14.29)	6 (85.71)	0 (0.00)	7 (100.00)	0.039	0.250	0.125	1.000	

Table 4: Continued

Questions	Variable	Category	Knowledge						*p	**p-value		
			Initial (X)		4 weeks (Y)		4 months (Z)			(X) vs (Y)	(X) vs (Z)	(Y) vs (Z)
			Incorrect (%)	Correct (%)	Incorrect (%)	Correct (%)	Incorrect (%)	Correct (%)				
Q4. How often should you see your dentist?	Age	3 years	31 (70.45)	13 (29.55)	15 (34.09)	29 (65.91)	3 (6.82)	41 (93.18)	<0.001	<0.001	<0.001	<0.001
		4 years	30 (68.18)	14 (31.82)	13 (29.55)	31 (70.45)	3 (6.82)	41 (93.18)	<0.001	<0.001	<0.001	0.002
		5 years	32 (72.73)	12 (27)	16 (36)	28 (63.64)	2 (4.55)	42 (95.45)	<0.001	<0.001	<0.001	<0.001
	Gender	Male	39 (67.24)	19 (32.76)	19 (32.76)	39 (67.24)	5 (8.62)	53 (91.38)	<0.001	<0.001	<0.001	<0.001
		Female	54 (72.97)	20 (27.03)	25 (33.78)	49 (66.22)	3 (4.05)	71 (95.95)	<0.001	<0.001	<0.001	<0.001
		Urban	89 (71.20)	36 (28.80)	41 (32.80)	84 (67.20)	8 (6.40)	117 (93.60)	<0.001	<0.001	<0.001	<0.001
	Place of origin	Rural	4 (57.14)	3 (42.86)	3 (42.86)	4 (57.14)	0 (0.00)	7 (100.00)	0.039	1.000	0.125	0.250
		3 years	15 (34.09)	29 (65.91)	8 (18)	36 (81.82)	2 (4.55)	42 (95.45)	<0.001	0.016	<0.001	0.031
		4 years	16 (36)	28 (63.64)	8 (18)	36 (81.82)	2 (4.55)	42 (95.45)	<0.001	0.008	<0.001	0.031
Q5. Which type of these foods is risky for your health?	Gender	4 years	16 (36)	28 (63.64)	8 (18)	36 (81.82)	2 (4.55)	42 (95.45)	<0.001	<0.001	<0.001	0.031
		5 years	16 (36)	28 (63.64)	8 (18)	36 (81.82)	2 (4.55)	42 (95.45)	<0.001	0.008	<0.001	0.031
		Male	23 (39.66)	35 (60.34)	12 (20.69)	46 (79.31)	6 (10.34)	52 (89.66)	<0.001*	0.001	<0.001	0.031
	Place of origin	Female	24 (32.43)	50 (67.57)	12 (16.22)	62 (83.78)	0 (0.00)	74 (100.00)	<0.001*	<0.001	<0.001	<0.001
		Urban	45 (36.00)	80 (64.00)	23 (18.40)	102 (81.60)	6 (4.80)	119 (95.20)	<0.001*	<0.001	<0.001	<0.001
		Rural	2 (28.57)	5 (71.43)	1 (14.29)	6 (85.71)	0 (0.00)	7 (100.00)	0.223	1.000	0.500	1.000

\*Cochran's Q-test

\*\*McNemar's test; P<0.05: significant differences



significant improvements were not noticed in those who came from the rural area.

The prevention of oral diseases at an early age will allow preschoolers to enjoy good oral health for a longer period of time; therefore, it is important to make children aware of the importance of taking care of their health in first years of life, as many of them in the preschool stage have access to a large amount of products with high sugar content.<sup>[19]</sup> To mitigate this situation, Aldrete *et al.*<sup>[9]</sup> recommended the implementation of strategies that facilitate the learning of self-care; for example, demonstrative educational activities that improve the children's capacity for concentration, perception, and memory in a real context. In this sense, in a research conducted by the same authors, they reported that schoolchildren acquired more knowledge about oral health through the puppet theater strategy in both genders. This is consistent with the present study, as it was observed that the level of knowledge about oral health care improved significantly in preschoolers of both genders and at all ages (3, 4, and 5 years), through a longitudinal follow-up at 4 weeks and 4 months. In general, the evaluation of the preschoolers' level of knowledge after applying the educational program through puppet theater was satisfactory, which demonstrates the effectiveness of the actions carried out in this research, coinciding with what was reported in the study by Cervantes *et al.*<sup>[15]</sup> Regarding oral hygiene, in this study, significant improvements were obtained at all times evaluated up to 4 months; however, this differs from what was obtained by Calderón *et al.*<sup>[6]</sup> and Blake *et al.*,<sup>[16]</sup> as they did not observe significant improvements after applying educational interventions for 6 months and 6 weeks, respectively. Perhaps, these differences are due to the fact that in both studies,<sup>[6,16]</sup> they did not use puppet theater as an educational strategy, but rather carried out conventional educational sessions led by a dental professional. In contrast, results obtained in this research regarding the significant improvement in oral health knowledge corroborate what was reported by the same authors.<sup>[6,16]</sup>

In a study carried out by Araújo *et al.*,<sup>[20]</sup> about compliance with oral hygiene habits, they stated that the experimental group which received educational sessions on oral health through the use of puppets and playful games did not present significant differences with the control group. These results differ from our findings because in the present study it was noticed that the group sensitized by the puppet theater significantly reduced their BPI, which could indicate an improvement in their oral hygiene habits. The differences obtained with the present investigation could be due to the design used, since Araújo *et al.*<sup>[20]</sup> used a cross-sectional

comparison in all the times evaluated, whereas in the present study, a quasi-experimental design was used with longitudinal comparisons in two different times.

Regarding the place of origin, the BPI values found in preschoolers from the urban area differed from the results of preschoolers from the rural area, as it could be noticed that the BPI level decreased very significantly at 4 weeks and 4 months in urban preschoolers, whereas there were no significant changes in the BPI level of rural preschoolers, being in accordance with the findings of Hernández-Vásquez *et al.*,<sup>[21]</sup> who determined that 4 out of 10 Peruvian children living in rural areas performed adequate oral hygiene practices compared with 6 out of 10 children from the urban area, so it would be important to strengthen oral health promotion strategies to reduce the inequalities in the acquisition of oral hygiene habits. However, our results disagree with those obtained by Blake *et al.*,<sup>[16]</sup> as they found no differences between students from the urban and rural areas in terms of oral health knowledge and behaviors either before or after the intervention. These differences in contrast to the present research may be due to the fact that the number of students from the rural area is much lower than that studied by Blake *et al.*<sup>[16]</sup>

In a meta-analysis carried out in 2018 by Ghaffari *et al.*<sup>[22]</sup> in relation to oral health promotion and education programs, they concluded that these were effective and had positive impacts on children in relation to dental visits, attitude, brushing, and flossing. Furthermore, they emphasized that it is important that these educational interventions be evaluated on an ongoing basis, regardless of whether it is short or long term. Additionally, according to other authors, the dental health habits of parents influence the oral health of their children.<sup>[15,16,19,23]</sup> For this reason, in the present study, parents were invited to attend the presentation of the puppet theater with the preschoolers; however, no questionnaire was administered to them to evaluate their knowledge on the subject.

Among the limitations of this research, we can mention the small number of preschoolers available from the rural area. Another limitation was that the level of knowledge of teachers and parents who accompanied their children to see the puppet theater was not evaluated.<sup>[24]</sup> Finally, the design of this study did not include a negative control group; in other words, a quasi-experimental research was carried out.

The importance of this study lies in the fact that puppet theater due to its artistic, interactive, and educational nature allows the presentation of health issues with

a didactic, attractive, and involving scheme, and it can also generate reflective thinking in its spectators, especially in children.<sup>[25]</sup> Additionally, this type of theater facilitates preschool children to learn in a fun way to exercise self-care of their oral health, feeling identified directly with the characters and creating positive awareness,<sup>[26]</sup> as evidenced by the results of this study as BPI decreased significantly when applying puppet theater as an educational technique for 4 months.

According to the results obtained and taking into account that the dental professional and the dental student should actively participate in taking measures to reduce the risk factors for dental caries such as low oral health education, poor hygiene habits, among others,<sup>[27-29]</sup> it would be important to use the puppet theater as an educational strategy in the development of oral health education programs as it can teach basic health concepts to children in their early stages of life and modify their hygiene habits in an attractive, didactic, and fun way.<sup>[30]</sup>

In contrast, as there are very few published studies in which puppet theater is applied as an educational strategy in dental field,<sup>[9,20]</sup> it is recommended to conduct studies similar to the present one, with the inclusion of a negative control group so that a pure experimental design can be applied. In addition, it is advisable to evaluate the puppet theater in comparison to other learning strategies, applied to preschool children, both in urban and rural areas.

## CONCLUSIONS

In spite of the limitations mentioned in this research, it can be concluded that the application of puppet theater positively influenced preschoolers in such a way that their oral health knowledge and oral hygiene improved significantly at 4 weeks and 4 months, in both genders of 3, 4, and 5 years of age and in those whose origin was the urban area. However, no significant improvements in oral health knowledge and oral hygiene were observed in preschoolers from the rural area.

Considering preschoolers as a vulnerable population, it is important to reinforce educational programs based on oral health promotion and prevention through puppet theater as an effective strategy for learning self-care, as evidenced in this study.

## ACKNOWLEDGEMENTS

We would like to thank the authorities and professors of the José Olaya Balandra Educational Institution

and the Social Responsibility team of the Universidad Privada San Juan Bautista, Academic Program of Stomatology, Lima e Ica, Peru, for their constant support in the elaboration of this manuscript.

## FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

## CONFLICTS OF INTEREST

None to declare.

## AUTHORS' CONTRIBUTIONS

They conceived the research idea (ML-C, CFC-R), elaborated the manuscript (ML-C, CFC-R, NC-L, GB-V), collected and tabulated the information (ML-C, LAC-G, CFC-R), carried out the bibliographic search (GB-V, NC-L), interpreted the statistical results and helped in the development from the discussion (CFC-R, NC-L, GB-V, JCR-D). They performed the critical revision of the manuscript (ML-C, NC-L, GB-V, JCR-D, LAC-G, CFC-R). All authors approved the final version of the manuscript.

## ETHICAL POLICY AND INSTITUTIONAL REVIEW BOARD STATEMENT

This research respected the bioethical principles for medical research with human beings of the Declaration of Helsinki related to confidentiality, freedom, respect, and non-maleficence. This research was approved by the Ethics and Research Committee of the Faculty of Stomatology of the Inca Garcilaso de la Vega University with resolution no. 434-2019-DFE.

## PATIENT DECLARATION OF CONSENT

All the parents or tutors of the participants signed an informed consent.

## DATA AVAILABILITY STATEMENT

The data that support the study results are available from the author (Dr. Marysela Ladera-Castañeda, e-mail: marysela.ladera@upsjb.edu.pe) on request.

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