

# A Preexperimental Study to Assess the Impact of an Interdisciplinary Educational Intervention on Nurses' Knowledge of Perinatal and Infant Oral Health Care

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ABSTRACT

**Objective:** The objective of this study was to assess the impact of an interdisciplinary educational intervention on the knowledge of nursing practitioners regarding perinatal and infant oral health (PIOH) care. **Materials and Methods:** This was a preexperimental study conducted among nursing practitioners in Lagos, Nigeria. Participants received hands-on training and didactic lectures, which included dental caries etiology and risk factors; oral hygiene and dietary education; teething and its management; dental trauma and its prevention; nonnutritive habits; screening, referrals, and counseling; and fluoride varnish application. Knowledge of the trainees was assessed using pre- and posttest questionnaires. Level of statistical significance was set at  $P < 0.05$ . **Results:** Overall, 110 nurses participated in the study with a mean age of  $40.9 \pm 10.8$  years; 106 (96.4%) were females. Approximately 88% of the participants had not received formal training on PIOH. The baseline mean scores of the participants' knowledge on oral hygiene, teething, trauma, caries, and oral habits were  $4.31 \pm 1.9$ ,  $9.84 \pm 2.6$ ,  $2.59 \pm 1.7$ ,  $4.24 \pm 1.8$ , and  $1.45 \pm 0.6$ , respectively; this increased significantly ( $P < 0.001$ ) following the educational intervention with posttest mean scores as  $7.58 \pm 0.8$ ,  $11.79 \pm 1.3$ ,  $4.34 \pm 1.9$ ,  $6.19 \pm 1.8$ , and  $1.82 \pm 0.4$  and six-month evaluation scores as  $6.21 \pm 1.8$ ,  $7.10 \pm 2.7$ ,  $4.39 \pm 1.5$ ,  $5.91 \pm 1.8$ , and  $1.79 \pm 0.5$ , respectively. Overall posttest ( $31.4 \pm 4.2$ ) and six-month ( $28.6 \pm 6.2$ ) knowledge scores were significantly higher than the pretest values ( $22.4 \pm 4.8$ ,  $P < 0.001$ ). At the six-month post-intervention survey, 84% of the nurses reported inclusion of PIOH education in their routine general health education sessions. **Conclusion:** There was a positive impact of the educational intervention as evidenced by an increase in the knowledge of the nurses on PIOH care and the inclusion of PIOH education in their general health education. A slight decline between posttest and six-month evaluation scores indicates a need for continuous education and evaluation.

**KEYWORDS:** Education, infant, intervention, nurses, oral health, perinatal

## INTRODUCTION

According to the American Academy of Pediatric Dentistry (AAPD), perinatal and infant oral health (PIOH) are the essentials on which preventive education and dental care must be built.<sup>[1]</sup> Early onset

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of good oral hygiene practices gives a child the prospect of a lifetime free of preventable oral diseases.<sup>[1]</sup> The perinatal period is the period around the time of birth, beginning with the completion of the 20th–28th week of gestation and ending one to four weeks after birth. This period is crucial to the health and well-being of pregnant women and their unborn children.<sup>[2,3]</sup> Poor maternal oral health may be associated with adverse pregnancy and infant outcomes, as most expectant mothers are not aware of the complications of poor oral health.<sup>[4]</sup> Dental caries is one of the most prevalent chronic conditions seen in children, especially those with unmet health-care needs and/or low socioeconomic status. It is a transmissible infectious disease, which can occur in children as early as 10 months of age.<sup>[5,6]</sup>

However, early interventions in infancy, such as maternal use of xylitol gums has significantly reduced cariogenic bacteria colonization and caries experience in children up to the age of 10 years.<sup>[7,8]</sup> Children who had early preventive dental visits or counseling had significantly fewer carious lesions and dental expenditures than those who did not received them.<sup>[9,10]</sup> The continuous increase in the prevalence of dental caries and periodontal diseases in developing countries is connected with inadequate oral hygiene and low levels of oral health knowledge among mothers and caregivers.<sup>[5,11–13]</sup> Timely delivery of oral health education and preventive measures can help reduce the incidence of early childhood caries (ECC) and improve the oral health of mothers and their children. Dentists, physicians, nurses, and other allied health professionals and community organizations have a role to play.<sup>[1,14]</sup>

Although the AAPD recommends that all infants have established dental homes by age one,<sup>[15]</sup> many children do not have a dental home by that age.<sup>[16,17]</sup> In contrast, most infants have a well-established medical home at an early stage of life.<sup>[18]</sup> The concept of dental homes is yet to be established in Nigeria. There is a shortage and misdistribution of pediatric dentists, and currently, there are 32 pediatric dentists to a population of 58 million children aged 0–14 years.<sup>[19]</sup> Furthermore, most of the dentists are located in the southern part of the country. These are some of the factors contributing to poor access to oral care in young children, thus justifying the need for this study.<sup>[20]</sup>

The AAPD recommends that children have a minimum of seven routine visits to their pediatric primary care providers in the first years of life.<sup>[21]</sup> These visits can provide a valuable opportunity for pediatric primary care providers to perform basic oral health assessments and prevention service, to deliver oral health-care guidance to parents of infants, and to refer infants,

especially those at high risk, to dentists for early preventive oral care.

Nurses are important group of personnel in the delivery of oral health and general care and are more likely to see pregnant women and their infants than dentists.<sup>[1]</sup> Despite these, many qualified nurses have been reported to be deficient in knowledge and adequate skills to maintain good oral health or assist patients.<sup>[22,23]</sup> It is important to train these health-care providers on oral diseases, etiology, and risk factors. Several studies have shown that the knowledge of physicians, nurses, and allied health professionals in Nigeria on oral health is low.<sup>[2,14,22–24]</sup> Yet, to the best of our knowledge, no study has evaluated the potential impact of educational intervention on the knowledge and attitude of these health-care professionals with regard to PIOH. Therefore, the purpose of this study was to assess the impact of an interdisciplinary educational intervention on the knowledge and attitude of nursing practitioners regarding PIOH care. We hypothesized that an educational intervention will not only improve the knowledge of the nurses but will also improve their attitude toward PIOH.

## MATERIALS AND METHODS

### STUDY DESIGN, SETTING, AND PARTICIPANTS

This was a one group pretest–posttest preexperimental study conducted among nurses caring for children and mothers for 6 months (October 2017 to April 2018). The study was approved by the Health Research and Ethics Committee of the Lagos University Teaching Hospital (LUTH), Idi-Araba, Lagos, Nigeria. Approval was obtained on September 29, 2017 (Protocol Number: ADM/DCST/HREC/APP/1948).

The sample size for the study was calculated from an equation for longitudinal intervention studies,<sup>[25]</sup> using the mean and standard deviation (SD) values derived from a similar study.<sup>[26]</sup>

The formula:

$$n = \frac{(u + v)^2 (s_1 + s_2)^2}{(m_1 - m_2)^2}$$

where,  $n$  = number of patients,  $u$  = one-sided percentage point of the normal distribution corresponding to  $1 - \text{the power}$ ,  $v$  = percentage point of the normal distribution corresponding to two-sided significance level,  $s$  = estimated SD of an attribute (i.e., clinical attachment loss) present in the population,  $s_1$  = estimated SD of an attribute present in the population before treatment,  $s_2$  = estimated SD of an attribute present in the population after

treatment,  $m$  = estimated mean of an attribute present in the population,  $m_1$  = estimated mean score in the population before treatment, and  $m_2$  = estimated mean score in the population after treatment.

At 95% confidence level with 80% power, from the reference study<sup>[26]</sup> with the following values:  $v = 1.96$ ,  $u = 0.84$ ,  $s_1 = 0.49$ ,  $s_2 = 0.97$ ,  $m_1 = 4.58$ , and  $m_2 = 3.96$ , the calculated minimum sample size ( $N$ ) =  $(1.96 + 0.84)^2 / (0.49 + 0.87)^2 / (4.58 - 4.96)^2$

$$= (7.84) (1.84) / 0.14$$

$$= 103.$$

Provision for dropout or attrition rate = additional 20% of calculated sample size = 22.

Therefore, the total sample size = 125.

A probability random sampling method was used to select nursing practitioners from two major hospitals in Lagos state based on the inclusion criteria of having prenatal, immunization, and well-baby clinics. Letters were written to the two institutions (LUTH and Lagos State University Teaching Hospital [LASUTH]) requesting for the list of nursing practitioners working with children and mothers with an emphasis on prenatal clinics, immunization clinics/wards, neonatal wards, and pediatric clinics, which served as the sampling frame. A total of 125 nurses were selected with 63 participants recruited from LUTH and 62 enlisted from LASUTH. This was carried out by simple random sampling using a table of random numbers to select study subjects from the sampling frame of nurses obtained from the two institutions. The participants were invited to attend a two-day workshop on PIOH through phone calls, text messages, and e-mails. A total of 110 nurses that gave informed consent and were available for the pretest, educational intervention, and the posttest were enlisted.

#### ORAL HEALTH EDUCATION INTERVENTION

This was a two-day program titled train the trainer workshop conducted at the LUTH. This was the first phase of the research titled: "Developing an infant oral health care program in Nigeria, using LUTH as a pilot." The first phase aimed to train health-care professionals that care for mothers and infants, thereby creating awareness and improving their knowledge. Participants received hands-on training and visual training by experienced pediatric dentists and orthodontists on PIOH. The visual training included the use of an oral health education booklet and PowerPoint presentations [Figure 1]. These PowerPoint presentations included topics on dental caries etiology and risk factors; oral hygiene and dietary education; teething, dental trauma,

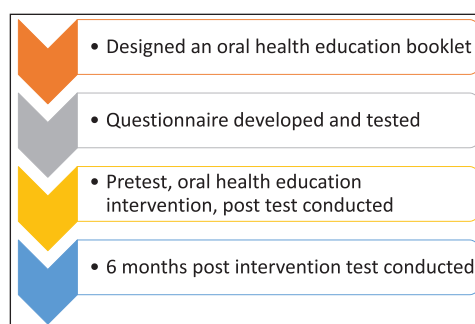


Figure 1: Sequence of study events

and prevention; nonnutritive habits; screening, referral, and counseling; and fluoride varnish application.

#### DATA COLLECTION

A 47-item questionnaire was adapted from previously validated questionnaires.<sup>[26-28]</sup> The questionnaire was pretested for face and content validity by four experts in pediatric dentistry who gave their expert opinion with regard to its relevance and straightforwardness and tested the content validity. Those questions with low reliability and validity were expunged. The English language questionnaire was translated into Yoruba language by two bilingual experts in English and Yoruba by forward and backward translation method. Furthermore, a pilot test was performed on a random sample of nurses from secondary and tertiary health institutions ( $n = 20$ ) to test the reliability of the questionnaire and to give their opinion on making the questionnaire simpler and shorter. Amendments from the nurses were implemented into the questionnaire without altering the meaning of relevant terms. Questionnaire reliability coefficient obtained by calculating Cronbach's alpha ( $\alpha$ ) was found to be adequate (0.79). After the final assessment, the questionnaire consisted of 44 questions.

The interviewer-administered questionnaire consisted of five main parts. The first part included personal information (age, gender, qualification, and work experience) of the study participants. The second part explored the knowledge of the participants on oral hygiene, whereas the third part assessed the participants' knowledge on the signs, symptoms, and management of teething. The fourth part tested the participants' knowledge on the etiology and prevention of caries in children, and the fifth part of the questionnaire assessed the participants' knowledge on the emergency management of dental traumatic injuries and oral habits. The questionnaire was administered to the participants before and after the educational intervention by calibrated researchers. The questionnaires were coded using four-digit numbers to conceal the identity of the study subjects.

### SIX-MONTH FOLLOW-UP EVALUATION

The participants' knowledge on perinatal and maternal oral health were evaluated six months after the educational program. The evaluation was carried out over the phone by the same calibrated researchers. Those who did not pick their calls and those who did not indicate any further interest were excluded. Eighty nurses participated in the six-month evaluation test.

### DATA ANALYSIS

Data were presented as mean values  $\pm$  SD and frequency for continuous and categorical variables, respectively. In each oral health domain, frequency and proportions were used for individual scores and the mean and SD for the sum of scores. A score of 1 was given to each correct response and 0 was assigned for each question answered wrongly. Chi-squared tests were used to evaluate the impact of the intervention by comparing the pretest, posttest, and six-month post-intervention survey scores for each individual question, whereas the nonparametric equivalent of the repeated measures analysis of variance (Friedman signed-rank test) was used for the overall change on the sum of scores. A 95% confidence interval and a 5% level of significance were adopted. All analyses were conducted using the Statistical Package for the Social Sciences (SPSS) software, version 23.0 (IBM, Armonk, New York), and the level of significance was set at  $P < 0.05$ .

### RESULTS

A total of 110 nurses were enrolled in the study. The mean age of the nurse was  $40.9 \pm 10.8$  years, 106 (96.4%) were females. A total of 88% of the participants had no formal training on PIOH. Approximately 50% of the nurses have work experience greater than 10 years. All the nurses participated in the pre-intervention and immediate post-intervention survey, whereas 84 of them were available for the six-month evaluation [Table 1].

Table 2 shows the oral hygiene knowledge of respondents before, after intervention, and six-month follow-up. A significant increase was observed in the oral hygiene knowledge of the nurses after the intervention and six-month follow-up (mean [SD] sum of scores was 4.31 [1.85], 7.58 [0.92], and 6.21 [1.76] for before, after intervention, and six-month follow-up, respectively,  $P < 0.001$ ). The baseline knowledge of the nurses was low with respect to the questions on the appropriate method of cleaning an infant's gum before tooth eruption, age appropriate amount of toothpaste to be used for tooth cleaning, and time of child's first dental visit, with 24.5%, 21.8%, and 45.5% of the respondents correctly answering the questions, respectively.

**Table 1: Demographic characteristics of the study subjects**

Characteristics	F	%
Age (years)		
20–29	21	19.1
30–39	32	29.1
40–49	21	19.1
50 and above	36	32.7
Mean (SD) $40.9 \pm 10.8$		
<b>Total</b>	<b>110</b>	<b>100.0</b>
Gender		
Male	4	3.6
Female	106	96.4
<b>Total</b>	<b>110</b>	<b>100.0</b>
Work experience (years)		
1–5	28	25.5
6–10	28	25.5
11–15	10	9.1
16–20	11	10.0
21–25	15	13.6
26–30	13	11.8
31–35	5	4.5
<b>Total</b>	<b>110</b>	<b>100.0</b>
Formal training on PIOH		
Yes	22	20.0
No	88	80.0
<b>Total</b>	<b>110</b>	<b>100.0</b>

Significance of bold numerical is total in each sub section

The respondents' knowledge of teething is shown in Table 3. The baseline knowledge of the nurses on teething was above average with a mean score of 9.84 (2.62). Following intervention, the posttest survey and six-month evaluation showed a significant increase in their knowledge of the signs and the management of teething, mean scores: 11.97 (1.27) and 10.27 (3.11), respectively,  $P < 0.001$ ). In the pretest survey, only 20.9% of the nurses answered correctly that fever was not a sign of teething, whereas 50% of them agreed that topical analgesics should not be rubbed on infants' gums to relieve pain.

Table 4 shows the knowledge of the nurses on the risk factors and prevention of ECC. The baseline knowledge of the nurses on dental caries was below average, mean (SD) sum of scores, 4.24 (1.84). Only three of ten questions were answered correctly by more than 50% of the nurses. Their baseline knowledge was very low, 29.1% of them answered correctly that bacteria causing tooth decay can be transmitted from mother to child; 26.4%, 35.5%, and 39.1% reported that on-demand/prolonged breastfeeding, breastfeeding  $>7$  times daily after 12 months of age, and nighttime bottle-feeding are risk factors for ECC, respectively. There was a significant increase in their knowledge of the etiology

**Table 2: Oral hygiene knowledge of respondents before, after intervention, and at six-month follow-up**

	<i>n</i> = 110		<i>n</i> = 110		<i>n</i> = 84		df	95% CI	<i>P</i> value
	Pretest	%	Posttest	%	Six-month follow-up	%			
At what age does a child's first tooth erupt (grow in) the mouth	90	81.8	105	95.5	72	85.7	2	0.01–0.01	0.012
When should a mother/ caregiver start cleaning a child's mouth?	77	70	99	90	70	83.3	2	0.00–0.00	0.000
When should a mother/ caregiver start cleaning a child's teeth?	99	90	108	98.2	81	96.4	2	0.01–0.02	0.000
What should be used to clean babies' teeth?	44	40	92	83.6	52	61.9	2	0.00–0.00	0.000
The correct amount of toothpaste to be used for children age 3 years and below	24	21.8	99	90	63	75.0	2	0.00–0.00	0.000
The correct amount of toothpaste to be used for children aged 3–6 years	44	40	102	92.7	62	73.8	2	0.00–0.00	0.000
The most appropriate method of cleaning an infant's gums before tooth eruption	27	24.5	108	98.2	60	71.4	2	0.00–0.00	0.000
Time for a child's first dental examination	50	45.5	108	98.2	67	79.8	2	0.00–0.00	0.000
<b>Sum of scores</b>	<b>Mean (SD)</b>	<b>Mean rank</b>	<b>Mean (SD)</b>	<b>Mean rank</b>	<b>Mean (SD)</b>	<b>Mean rank</b>			<b><i>P</i> value</b>
	4.31 (1.85)	1.26	7.58 (0.79)	2.68	6.21 (1.76)	2.06	2	0.00–0.00	0.000*

CI = confidence interval, df = degrees of freedom

\*Friedman test

**Table 3: Knowledge of respondents on teething before, after intervention, and at six-month follow-up**

	<i>n</i> = 110		<i>n</i> = 110		<i>n</i> = 84		df	95% CI	<i>P</i> value
	Pretest	%	Posttest	%	Six-month follow-up	%			
Signs of teething									
Fever <sup>a</sup>	23	20.9	94	85.5	38	45.2	2	0.00–0.00	0.000
Diarrhea <sup>a</sup>	72	65.5	100	90.9	58	69.0	2	0.00–0.00	0.000
Gum irritation	107	97.3	103	93.6	82	97.6	2	0.71–0.69	0.565
Salivation	96	87.3	101	91.8	76	90.5	2	1.00–1.00	0.949
Vomiting <sup>a</sup>	82	74.5	105	95.5	62	73.8	2	0.00–0.00	0.000
Eye infection <sup>a</sup>	93	84.5	105	95.5	68	81.0	2	0.02–0.03	0.026
Skin infection (boils)/rash <sup>a</sup>	91	82.7	108	98.2	64	76.2	2	0.36–0.38	0.347
Convulsion <sup>a</sup>	91	82.7	105	95.5	73	86.9	2	0.01–0.01	0.014
Desire to bite	94	85.5	95	86.4	77	91.7	2	0.26–0.28	0.254
Respiratory tract infection <sup>a</sup>	81	73.6	107	97.3	66	78.6	2	0.00–0.00	0.000
Ear problems <sup>a</sup>	94	86.2	105	95.5	74	88.1	2	0.19–0.22	0.170
Teething powder should be used when a child is teething <sup>a</sup>	86	78.2	107	97.3	74	88.1	2	0.01–0.01	0.000
Topical anesthetic, teething gels can be rubbed on the gums to relieve pain <sup>a</sup>	61	55.5	78	70.9	53	63.1	2	0.49–0.48	0.464
<b>Sum of scores</b>	<b>Mean (SD)</b>	<b>Mean rank</b>	<b>Mean (SD)</b>	<b>Mean rank</b>	<b>Mean (SD)</b>	<b>Mean rank</b>			<b><i>P</i> value</b>
	9.84 (2.62)	1.63	11.79 (1.27)	2.43	10.27 (3.11)	1.94	2	0.00–0.00	0.001*

CI = confidence interval, df = degrees of freedom

<sup>a</sup>Correct response is "No"

\*Statistically significant

and prevention of ECC, which was seen in the posttest and six-month evaluation,  $P < 0.001$ .

The respondents' knowledge on traumatic injuries and oral habits before, after intervention, and six-month follow-up is shown in Table 5. The baseline knowledge of the nurses on the emergency management of an avulsed tooth and appropriate storage media was tested, with mean (SD) sum of scores, 2.25 (1.68). A total of 19% and 29.1% of the respondents knew that an avulsed tooth can be transported in a child's saliva and milk, respectively. Their knowledge on trauma (avulsion) and oral habits increased significantly after intervention as seen in the posttest and six-month evaluation,  $P < 0.001$ .

The overall pretest, posttest, and six-month scores of the respondents on the various aspect of oral health

is shown in Figure 2. There was a significant increase in the knowledge of the nurses after intervention; this decreased with time after six months but not below the baseline,  $P < 0.0001$ . A total of 84% of the nurses reported inclusion of PIOH education in their routine general health education at six months after intervention.

## DISCUSSION

Several studies<sup>[2,14,22,24]</sup> have reported poor oral health awareness among Nigerian non-dental health-care providers, but this study was the first to apply an intervention to improve their knowledge on PIOH. Our study was encouraging as the overall result showed the evidence of a positive impact from the educational program, evident by a significant increase in the knowledge, retention of knowledge, and positive

**Table 4: Knowledge of respondents on caries before, after intervention, and at six-month follow-up**

	<i>n</i> = 110		<i>n</i> = 110		<i>n</i> = 84		df	95% CI	<i>P</i> value
	Pretest	%	Posttest	%	Six-month follow-up	%			
Tooth decay can be transmitted from mother to child	32	29.1	61	55.5	48	57.1	2	0.00–0.00	0.000
Breastfeeding decreases the risk for large number of diseases in infants	56	50.9	78	70.9	76	90.5	2	0.00–0.00	0.000
Breastfeeding more than seven times a day after 12 months of age can cause tooth decay	41	37.3	65	59.1	11	13.1	2	0.00–0.00	0.000
On demand/prolonged breastfeeding can cause tooth decay in child	29	26.4	51	46.4	20	23.8	2	0.000–0.011	0.004
Nighttime bottle-feeding of child with milk can cause tooth decay	43	39.1	72	65.5	64	76.2	2	0.00–0.00	0.000
Infants should be weaned from bottle between 12 and 18 months	57	51.8	85	77.3	56	66.7	2	0.00–0.02	0.024
Breastfeeding on demand should be avoided after the first baby tooth erupts	39	35.5	54	49.1	6	7.1	2	0.00–0.00	0.000
Sharing of child feeding utensils/ cutting of food to pieces with mouth before giving to child can cause tooth decay	49	44.5	78	70.9	64	76.2	2	0.00–0.00	0.000
Eating of sugar-containing snacks and drinks containing sugar can cause tooth decay	70	63.6	81	73.6	82	97.6	2	0.00–0.00	0.000
It is not safe to have dental examination or treatment during pregnancy**	49	44.5	61	55.5	73	86.9	2	0.00–0.00	0.000
<b>Sum of scores</b>	<b>Mean (SD)</b>	<b>Mean rank</b>	<b>Mean (SD)</b>	<b>Mean rank</b>	<b>Mean (SD)</b>	<b>Mean rank</b>			<b><i>P</i> value</b>
	4.24 (1.84)	1.50	6.19 (1.79)	2.32	5.91 (1.80)	2.18	2	0.00–0.00	0.000*

CI = confidence interval, df = degrees of freedom

\* Significant \*\*Incorrect responses

**Table 5: Knowledge of respondents on traumatic injuries and oral habits before, after intervention, and at six-month follow-up**

Trauma	n = 110		n = 110		n = 84		df	95% CI	P value
	Pretest	%	Posttest	%	Six-month follow-up	%			
Milk	32	29.1	91	82.7	65	77.4	2	0.00–0.00	0.000
Clean handkerchief/cloth**	36	32.7	40	36.4	29	34.9	2	0.43–0.46	0.420
Normal saline	58	52.7	90	81.8	74	88.1	2	0.00–0.00	0.000
Plastic bag**	42	38.2	70	63.6	49	58.3	2	0.03–0.03	0.032
Water	28	25.5	72	65.5	35	41.7	2	0.00–0.00	0.000
Child's mouth	21	19.1	77	70.0	47	56.0	2	0.00–0.00	0.000
Hand**	73	66.4	71	64.5	73	86.9	2	0.00–0.00	0.001
<b>Sum of scores</b>	<b>Mean (SD)</b>	<b>Mean rank</b>	<b>Mean (SD)</b>	<b>Mean rank</b>	<b>Mean (SD)</b>	<b>Mean rank</b>			<b>P value</b>
	2.59 (1.68)	1.49	4.34 (1.89)	2.24	4.39 (1.56)	2.28	2	0.00–0.00	0.001
Oral habits									
Thumb sucking is a nonnutritive oral habit	72	65.5	88	80.0	81	96.4	2	0.00–0.00	0.000
Thumb sucking can cause malocclusion/scattered teeth	76	69.1	101	91.8	70	83.3	2	0.00–0.00	0.000
<b>Sum of scores</b>	<b>Mean (SD)</b>	<b>Mean rank</b>	<b>Mean (SD)</b>	<b>Mean rank</b>	<b>Mean (SD)</b>	<b>Mean rank</b>			<b>P value</b>
	1.45 (0.61)	1.69	1.82 (0.41)	2.18	1.79 (0.49)	2.13	2	0.00–0.00	0.000*

CI = confidence interval, df = degrees of freedom

\* Significant \*\*Incorrect responses

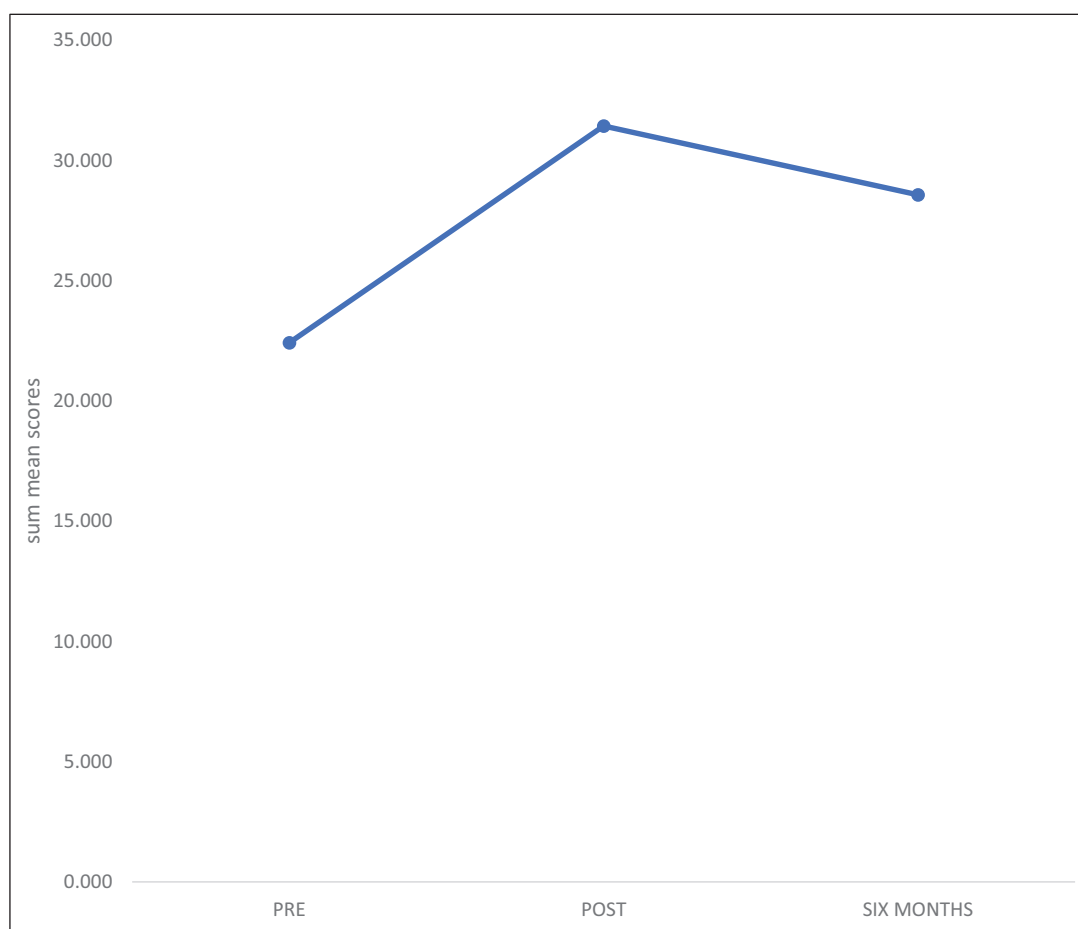
attitude of the nursing practitioners with regard to PIOH care; thus, there is a significant evidence that educational intervention improved the knowledge of nurses and their attitude with regard to PIOH.

The baseline knowledge of the nurses was below average with respect to questions on the etiology and prevention of ECC and the management of avulsed teeth. Less than 50% of them agreed that bacteria responsible for caries could be transmitted from mother to child, and on-demand/prolonged breastfeeding and nighttime bottle-feeding were risk factors for ECC. Mutans streptococci (MS) have been well documented as a microbial risk marker for ECC.<sup>[29-31]</sup> MS can be transmitted vertically from mother to child through saliva-sharing activities. It has been reported that infants, whose mothers have high levels of MS due to untreated caries, are at a higher risk of acquiring MS earlier than infants whose mothers have low levels.<sup>[32,33]</sup> Poor feeding practices such as frequent nighttime bottle-feeding with milk, juice,<sup>[34]</sup> ad libitum breastfeeding, and frequent consumption of sugar-containing snacks or drinks in between meals have also been shown to increase the risk for ECC.<sup>[35-37]</sup>

It is not surprising that most of the nurses did not agree that prolonged breastfeeding and ad libitum breastfeeding are a risk factors for ECC because the World Health Organization<sup>[38]</sup> recommends exclusive breastfeeding for the first six months of life and complementary breastfeeding up to 2 years. Nurses

often dutifully tell mothers that breast milk is good for a child and that breastfeeding on demand should be done. It is important to emphasize that although breastfeeding is good and should be encouraged, children who are breastfed for greater than 12 months tend to have an increased risk of dental due to their expanding diet, intake of cariogenic meals and presence of deciduous teeth.<sup>[39]</sup>

AAPD recommends that ad libitum breastfeeding be avoided after the first primary tooth erupts and other carbohydrates have been introduced to a child's diet.<sup>[40]</sup> The poor awareness on the risk factors for ECC observed among the nurses in our study is similar to that in previous studies conducted among pediatricians and undergraduate medical students in Lagos, Nigeria; the authors reported that less than 30% of the respondents had good knowledge of the risk factors for ECC.<sup>[14,37,41]</sup> In contrast, a study among child and family health nurses in Australia<sup>[42]</sup> showed that the nurses were not only aware of the importance of childhood oral health and the effect that ECC could potentially have on the growth and development of children but they felt confident and took ownership of their role of incorporating oral health promotion into practice and referring children to dental services, even going to the extent of identifying ECC risks in other siblings and family members. This level and practice can be linked to their training and level of exposure. The role of nurses in prevention of ECC has been well documented;<sup>[43-45]</sup> a study in the United States showed that implementing



**Figure 2:** Comparison of the overall mean knowledge scores of the respondents, before, immediately after intervention, and at 6-month follow-up

a practice-based oral health intervention through registered nurses and nurse practitioners was associated with overall greater health provider knowledge and a significantly decreased incidence of ECC.<sup>[43]</sup> These findings were supported by a recent review of ECC prevention and nursing interventions, which showed that one of the most effective methods for reducing ECC was through pediatric nurse interventions.<sup>[46]</sup>

Our study also assessed the knowledge of the nurses on teething. Their overall baseline knowledge of the nurses was above average, and this increased significantly after the training. It was not surprising that their baseline knowledge on teething was above average, this can be attributed to the fact that teething is one of the dental topics that is taught in the nursing school and well emphasized. Also, there has been a lot of public awareness as a result of a horrendous incident, which occurred in Nigeria in 2008, where 84 infants died as a result of consumption of a teething syrup called “My Pickin,” which was by many Nigerian mothers to prevent “teething problems.” Investigators found that “My Pickin” syrup, a paracetamol-based mixture, was laced with engine coolant—diethylene glycol, this

mixture left a lot of children with fever, convulsion, diarrhea, vomiting, and inability to urinate.<sup>[47]</sup> A larger proportion, 86% of the nurses in our study agreed that teething powder should not be given to infants, this is in contrast to the findings reported by Bankole *et al.*,<sup>[48]</sup> where 68% of the Traditional Birth Attendants (TBAs) recommended teething powder/syrup to treat teething problems. Despite the awareness of the nurses on teething, most of the nurses still associated teething with fever as evident in the six-month evaluation after intervention. Our findings were similar to those reported in previous studies.<sup>[48,49]</sup>

Teething is a natural physiologic process that all children experience commencing from six months to approximately three years of age. It can be associated with intermittent localized areas of discomfort, but irritability and excessive salivation, high temperature (>39°C), and other clinically important symptoms should not be attributed to teething and should be investigated.<sup>[48-50]</sup> AAPD recommends teething symptoms be treated with oral analgesics, chilled teething rings, the use of topical anesthetics, whereas over the counter gels should be avoided due to the



potential toxicity of the products on infants.<sup>[1]</sup> The findings from our study underscores the need for training of nurses, especially those involved in child and maternal care as they are in a good position to educate mothers/caregivers at immunization, well-baby, and prenatal clinics.

Our study similarly assessed the knowledge of the nurses on emergency management of avulsed permanent teeth, and we observed a significant increase in their knowledge after intervention. At baseline, less than 20% of them knew that an avulsed tooth could be replanted, although their knowledge of appropriate storage media for transporting an avulsed tooth was below average. Emergency management of an avulsed permanent tooth involves keeping the patient calm; if the tooth is found, it should be picked by the crown, rinsed under running water, and replanted in the socket. When this is not possible, the tooth should be placed in a storage medium and brought to the clinic with the patient for replantation. The tooth can also be transported in the mouth by placing it inside the lip or cheek, ensuring the child does not swallow nor aspirate it. Maintaining an avulsed tooth in a suitable wet storage medium, which can preserve the vitality of the tooth is key to a successful replantation.<sup>[51]</sup> A recent literature review showed that several types of wet storage media have been evaluated in laboratory studies and clinical reports, these include bovine milk, saliva, egg white, coconut water, green tea, and tissue culture solutions such as Hank's Balance Salt Solution. They concluded that apart from solutions designed specifically for storage and culture purposes, regular pasteurized whole milk was the most frequently recommended media with the best prognosis due to its ready availability, easy access, physically compatible pH, and the presence of nutrients and growth factors.<sup>[51]</sup> Findings from our study were similar to that conducted in Dubai among different groups of professionals<sup>[52]</sup> and among school teachers in India,<sup>[53]</sup> where they reported significant increase in the knowledge of the emergency management of avulsed permanent teeth following educational intervention.

The knowledge of the nurses on appropriate oral hygiene practices similarly increased significantly after intervention. Although most of the nurses agreed that an infant's mouth and teeth should be cleaned, they lacked knowledge on the appropriate method of cleaning a child's gums and mouth before tooth eruption and the age-appropriate amount of toothpaste to be used following tooth eruption. A large proportion of the nurses reported that glycerin or salt water with cotton wool should be used for cleaning an infant's mouth before tooth eruption. Glycerin is often recommended

to mothers for cleaning by nurses in Nigeria. The AAPD recommends oral hygiene measures be implemented no later than the eruption of the first tooth. An early commencement is encouraged through cleaning the child's gums with a soft infant toothbrush or cloth and water.<sup>[40]</sup> Twice daily brushing with a smear or rice-sized amount of fluoridated toothpaste for children below three years of age and a pea-sized amount of fluoridated toothpaste is recommended for children aged three to six years. Parents are encouraged to brush their children's teeth and to assist those of preschool age.<sup>[40]</sup>

It was interesting to note that at the six-month evaluation period, 84% of the nurses reported including oral health education in their routine general health education at the immunization, well-baby clinics, and prenatal clinics. This was a positive finding and should be encouraged. It was worth noting that the knowledge of the nurses decreased marginally over time, this was a pointer to the fact that there is a need for continuous training and retraining.

In summary, results from our study showed that educational intervention program through lectures and demonstrations is an effective and efficient way to enhance the knowledge of nurses on PIOH care. Our study also showed that with adequate knowledge, the nurses can be motivated to apply their knowledge of PIOH during routine immunization and antenatal clinics. Our study, though limited by a relatively small study population and absence of a control group, is the first kind among Nigerian nurses. It thus provides a template for future studies that will include larger populations across the country as well as randomized controlled clinical trials to further validate and evaluate the continuing sustainability of the impact of the educational intervention.

## CONCLUSION

Our study showed that an interdisciplinary educational intervention program, which included lectures, videos, and hands-on demonstration had a positive impact on the nurses as evident by an increase in their knowledge and the positive attitude shown through inclusion of PIOH in their routine immunization, well-baby, and prenatal clinics. Thus, it appears that this educational intervention significantly improved the knowledge of nurses and their attitude with regard to PIOH.

## ETHICAL POLICY AND INSTITUTIONAL REVIEW BOARD STATEMENT

This study was approved by the Health Research and Ethics Committee of the Lagos University Teaching Hospital (LUTH), Idi-Araba, Lagos, Nigeria. Approval was obtained on September 29, 2017 (Protocol Number:

ADM/DCST/HREC/APP/1948). All procedures were performed as per the ethical guidelines laid down by the Declaration of Helsinki in the Edinburgh (2000) revision.

#### DATA AVAILABILITY STATEMENT

The datasets and other materials on this study can be made available by the corresponding author on reasonable request.

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#### CONFLICTS OF INTEREST

There are no conflicts of interest.

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