Children's toothbrushing: a population survey on behaviours, attitudes, and knowledge in parents of Callao, Peru



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Abstract

Objective To determine the factors associated with behaviours, attitudes and knowledge of parents about children's toothbrushing (CTB).

Methods This is a cross-sectional analytical study of a calculated sample of 3,534 parents/guardians (92.6% female; 7.4% male; average age = 34 years [29–37]) of schoolchildren aged 3 to 8 years in 19 public schools in the province of Callao (Peru). A 31-item face-to-face/virtual questionnaire was divided into: 5 behavioural (18 (IQR)=3]; good 76%), 5 attitudes (13 [IQR=4]; negative 74.2%) and 10 knowledge (12 [IQR=4]; low 92.8%) (KMO≥0.537, Bartlett<0,001) and reliability (ω≥0.537) and 11 demographic domains. Bivariate and multivariate linear Poisson models were used with a P<0.05.

Results Bivariate models on CTB showed higher probabilities of high attitudes and knowledge at a higher educational level (PR: 6.68 a 105.47) and frequency of toothbrushing (PR: 23.31 to 106.57) (P≤0.02). Adjusted multivariate models of CTB showed a higher probability (P≤0.01) of good behaviours in parents with higher education (PR: 1.54; 95%CI: 1.41-1.70), positive attitudes in those with a technical education (PR: 43.8; 95%CI: 6.03-318.18) and higher education (RP: 135.29; 95%CI: 136-152), daily toothbrushing 2 times (PR: 104.45; 95%CI: 14.20-768.27) and ≥3 times (PR: 65.76; 95%CI: 9.00-480.47); and greater knowledge of CTB in parents with a higher education (PR: 4485.06; 95%CI: 512.98-39213.58), daily toothbrushing 2 times (PR: 1611.12; 95%CI: 194.38-13354.04) and ≥3 times (PR: 183.08; 95%CI: 24.95-1343.19).

Conclusions Children of parents with a higher education showed good behaviours related to CTB. Negative parental attitudes and low knowledge about CTB were associated with a lower parental education and toothbrushing frequency.

KEYWORDS Behaviour, attitude, knowledge, toothbrushing, Peru.

Introduction

Children are more likely to acquire an oral disease, either due to hereditary factors, lifestyle or environment. Hard tissues and dental pulp are affected by an increased presence or combination of etiologic factors [Bhatti et al., 2021]. Dental caries affects more than 2.5 million children according to the Global Burden of Disease Study [2019]. Currently, the aim is to prevent or treat this disease before its complications become greater [Acuña et al., 2019]. In view of this, the frequency of toothbrushing (TB) contributes to a reduction in the prevalence of caries [Aliakbari et al., 2021; Shitie et al., 2021; De Lira et al., 2019].

Parents or guardians play an essential role in children's toothbrushing (CTB). Their knowledge is the basis for habituating family cleaning practices, while positive attitudes promote behaviours for acceptance of oral hygiene [Tadakamadla et al., 2022]. Although these components induce a decrease in morbidity by oral diseases, however, there is not always a guarantee that these behaviours reflect regular and effective TB in children [Vallés et al., 2022].

There is a wide range of research on the oral health practices of parents of young children [Geetha et al., 2019], and a systematic review has described the literature on interventions promoting parental supervision of TB in the home. The results revealed that counseling parents about the importance of TB supervising had a long-term impact on reducing infant caries [Sigaud et al., 2017].

A lack of good TB habits among children leads to the risk of cavity injuries and gum conditions [Elamin et al., 2021]. Multiple oral hygiene variables are related to these conditions, such as incorrect TB, short TB time, infrequency of TB, type of toothbrush used, and hardness of bristles inappropriate for the age of the child [Cirelli et al., 2021]. However, it is important to support the positive behaviour of the child, the accompaniment of the parents and the use of appropriate hygiene implements [Collett et al., 2016; Kumar et al., 2017].

Given the complexity of the parent-child binomial in TB, it is necessary to investigate patient and child knowledge in order to assess their informational weaknesses, as well as evaluate the characteristics related to their parenteral interventions and practices specific to the children's toothbrushing. The purpose of this study was to determine the factors associated with behaviours, attitudes and knowledge about children's

toothbrushing in a population of parents.

Methods

Study design and ethical aspects

This cross-sectional analytical study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Research Ethics Committee of the Universidad Científica del Sur (N°379-CIEI-CIENTÍFICA-2021). The Regional Directorate of Education of Callao provided permission for the study to be carried out in all schools. Informed consent was obtained from each participant after explaining the objective of the study.

Population and sample

The population included 62,247 parents and/or guardians of schoolchildren enrolled from kindergarten to third grade of primary school in public schools in Callao (Peru) in 2022 (Source: ESCALE, Ministry of Education of Peru). The Constitutional Province of Callao is located on the central coast of Peru and is one of the 20 least poor districts in Peru (INEI: Poverty Map of Peru, 2018). A non-probabilistic sample was included consisting of 3,534 volunteer parent participants (92.6% female, 7.4% male, average age = 34 years [29–37]) and children aged 3 to 8 years (56% boys, 44% girls, average age = 6 years [4–8])) from 19 schools in three districts (Callao, Ventanilla and Mi Perú). The inclusion criterion was to have the cognitive capacity to answer an individual survey. Participants who were dental professionals and incomplete questionnaires were excluded. The calculation of a minimum sample of 1,728 participants was obtained with the G*Power 3.1.9.7 program based on Poisson regression estimation with two-tailed parameters, probability of predictor change (exp β1=1.2), 95% CI, 80% power, mean exposure (0.5), and binomial distribution (0.5)

Pilot study, validation and reliability

An online questionnaire on behaviours, attitudes and knowledge (BAK) of CTB via Google forms was applied to a pilot study including 102 parents of schoolchildren between 3 and 8 years of age from a school similar to that in the study (Modular code 1222553) in 2021. The minimum pilot size was calculated from five participants per 20 BAK-CTB questions. The instrument was evaluated by the judgment of three dental experts with experience in methodology, who assessed four criteria (clarity, coherence, relevance and sufficiency) by levels of compliance (no, low, moderate, and high) with an Aiken V result of 0.701 (acceptable in a pilot study). Construct validity was evaluated with exploratory factor analysis with the principal component extraction method and varimax rotation resulting in a Kaiser-Meyer-Olkin (KMO) from 0.5 to 0.675 (acceptable in a pilot study) and Bartlett significance <0.001 (significant). Reliability assessed with McDonald's ω which ranged from 0.505 to 0.891 (acceptable to good in a pilot study)..

Adaptation and application of the instrument

The BAK-CTB questionnaire was adapted from a previous validation study [Tadakamadla et al., 2022]. A selection, translation, and validation and reliability review of the pilot study questions was carried out by all authors, resulting in 20 questions (Q) (Appendix: Table S1): 5 for behaviours, 5 for attitudes, and 10 for knowledge. Demographic data of the children (4 questions: age, sex, district, and school) and parents were obtained (8 questions: age, sex, marital status, family composition, education, employment status, nationality, and frequency of TB). The survey was applied virtually in 2022 in groups of parents via WhatsApp or zoom and in person at schools. Oral education talks were held during parent meetings in appreciation of participation.

Children's toothbrushing behaviours

The behaviours variable included two dimensions: acceptance (Q1 and Q2) and avoidance (Q3-Q5). The responses were on a Likert scale: (0) never, (1) almost never, (2) sometimes, (3) almost always, and (4) always. The questions with inverse value were Q3, Q4 and Q5. The final score from 0 to 20 points was categorised as: bad (0-15 points: <80%) and good (16-20 points: ≥80%). Factorial validation and reliability in the final sample resulted in McDonald's ω (0.632=acceptable), KMO (0.618=acceptable) and Bartlett's sphericity <0.001=significant), factor loads (0.38 to 0.828=moderate-strong), and two-dimensional explanation (67.6%).

Attitudes About Children's toothbrushing

The attitudes variable included two dimensions: alteration (Q6 and Q7) and permissibility (Q8-Q10). The responses on the Likert scale were: (0) never, (1) almost never, (2) sometimes, (3) almost always, (4) always. All questions had an inverse value. The final score from 0 to 20 points was categorised as: negative (0-15 points: <80%) and positive (16-20 points: ≥80%). Factorial validation and reliability in the final sample resulted in McDonald's ω(0.537=questionable), KMO (0.590=acceptable) and Bartlett's sphericity (<0.001=significant), factor loads (0.378 to 0.832=moderate-strong) and two-dimensional explanation (59.8%).

Knowledge about children's toothbrushing

The knowledge variable was worked on a dimensionless way. The questions had four multiple choice answers with a single correct answer: (0) incorrect, (2) correct, and (-) don't know. The final score from 0 to 20 points was categorised as: low (0-15 points: <80%) and high (16-20 points: ≥80%). Factorial validation and reliability in the final sample resulted in McDonald's ω (0.276=questionable), KMO (0.537=questionable), Bartlett's sphericity (<0.001=significant), factor loads (0.313 to 0.795=moderate-strong) and four-dimensional explanation (52.1%)

Statistical analysis

Descriptive statistics included frequencies (n), percentages (%), medians, interquartile range (IQR), quartile 1 and quartile 3. Inferential statistics included non-parametric Mann-Whitney U and Chi-square tests. Prevalence ratios (PRs) were obtained using generalised linear, bivariate and multivariate Poisson models to study demographic factors associated with BAK-CTB. For the analysis, the STATA v.17 software was used, considering statistical significance when P<0.05.

Results

Parents/guardians were: mothers (92.5%), cohabiting/single (77.8%), nuclear/single-parent family (83.4%), secondary/technical education (72.1%), not working (42.4%), Peruvian nationality (86.6%) and TB ≥3 times a day (61.3%). These paternal variables were differentiated by sex (P=0.000). The number of children was distributed between 499 and 925 by age group, from schools in Callao and Ventanilla (94.1%), with between 52 and 425 children per school, with sex differences with respect to age (P=0.000) (Table 1).

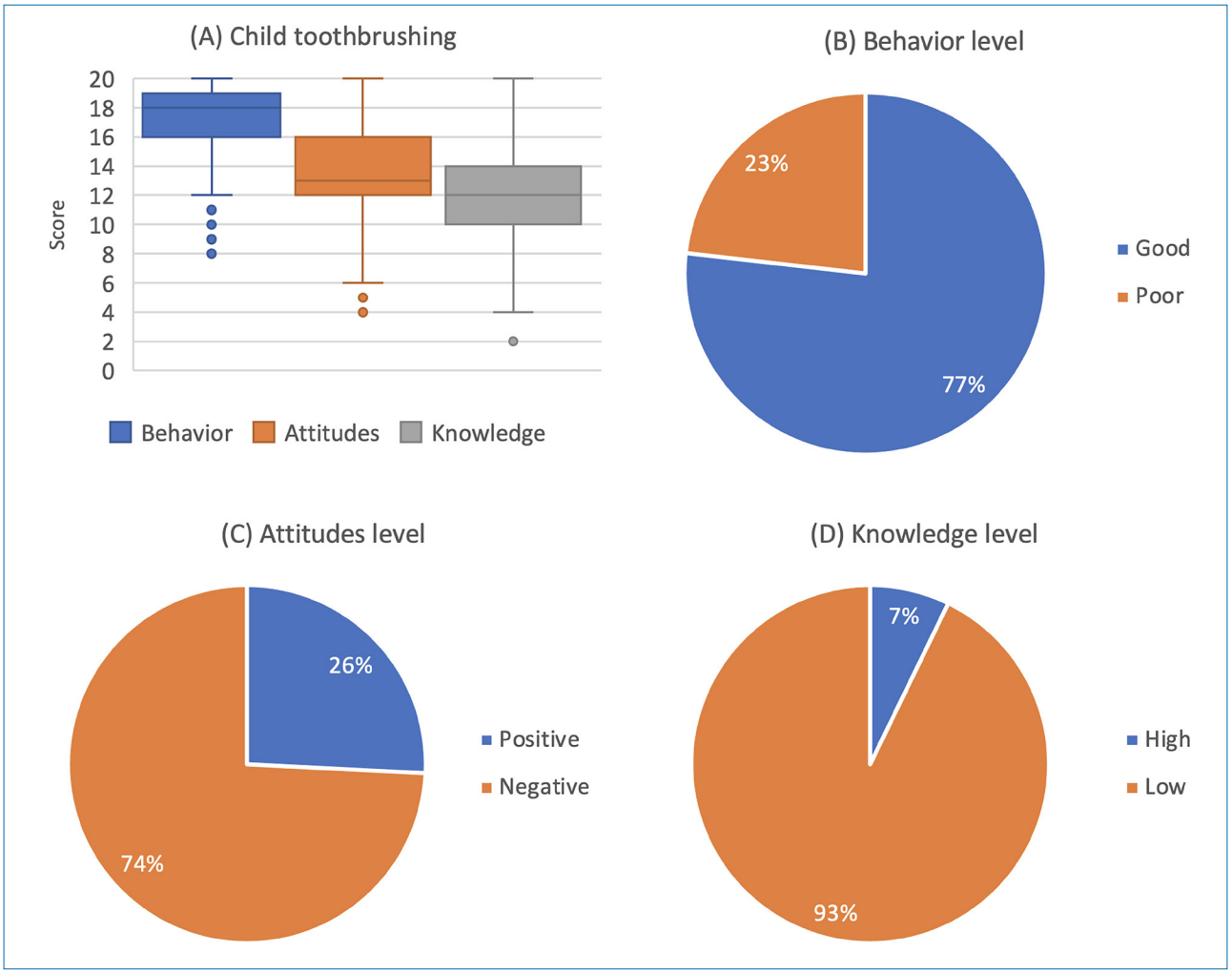


FIG. 1 Children's toothbrushing in relation to: (A) Scores BAK-CTB, (B) level of behaviours, (C) level of attitudes, and (D) level of knowledge.

Good behaviours in children were predominant in the acceptance of night and general TB (49.1 to 56.2%) and non-evasion involved escape, avoidance or crying over TB (75.2 to 90.7%). Negative paternal attitudes were considered from sometimes to always in difficulty (77.7%) and permissibility as guilt and tolerance (53,9 a 56,5%) due to their children's lack of TB (53.9 to 56.5%). Knowledge of CTB was incorrect (57.1% to 92.1%) in identifying the brush to reduce plaque (both manual and electrical), minimum frequency of TB (2 times/day) and unsupervised TB (if they knew how to wash) (Table 2). The medians and IQRs of the BAK-CTB scores resulted in behaviourss 18 [IQR=3], attitudes 13 [IQR=4] and knowledge 12 [IQR=4] (Figure 1A), while the most frequent levels were good behaviourss (76.8%) [Figure 1B], negative attitudes (74.2%) (Figure 1C) and low knowledge (92.8%) (Figure 1D).

The levels of behaviourss, attitudes, and knowledge were found to be associated with the demographics of children (age) and their parents (age, role, marital status, family composition, education, employment status, nationality, and frequency of TB) (P<0.05) (Table 3). Bivariate models showed higher probabilities of good attitudes and knowledge among parents with a higher educational level (PR: 6.68 to 105.47) and frequency of TB (PR: 23.31 to 106.57) (P≤0.02) (Table 4). Multivariate adjusted models on CTB showed a higher probability (P≤0.01) of good behaviours in parents with a higher education (PR: 1.54; 95% CI: 1.41-1.70), positive attitudes in those with a technical (PR: 43.8; 95% CI: 6.03–318.18) and higher (PR: 135.29; CI95%: 136–152) education, TB twice a day (PR: 104.45; 95% CI: 14.20–768.27) and ≥3 times (PR: 65.76; 95% CI: 9.00–480.47); and greater knowledge in those with a higher education (PR: 4485.06; 95% CI: 512.98–3,9213.58), daily TB twice a day (PR: 1611,12; 95% CI: 194.38–13354.04) and ≥3 times (PR: 183,08; 95% CI: 24.95–1,343.19) (Table 5).

Discussion

Dental caries in children is a public health problem worldwide and a reduction in caries depends largely on the use of fluoride, considered a "cornerstone" of dental remineralisation [Matsuyama et al., 2023]. Moreover, a reduction in dental caries in children cannot be achieved if they do not brush their teeth for multiple reasons, among which the lack of environmental habits taught by their parents is of note. This study applied a representative survey to parents in a port province on the central coast of Peru. The main result showed that poor behaviours, negative attitudes and low knowledge about CTB were

Variables		Children's sex				P value	Total		P value
		Male (n=1979, 56%)		Female (n=1555, 44%)					
		n	%	n	%		n	%	
Children's demographics									
Age (years)	Median [Quartil 1-Quartil 3]	6 [4-8]		6 [4-8]		0,000*	6 [4-8]		0.000*
	3 years	65	4.2%	444	22.4%	0.000*	509	14.4%	0.000*
	4 years	375	24.1%	159	8.0%		534	15.1%	
	5 years	284	18.3%	269	13.6%		553	15.6%	
	6 years	174	11.2%	340	17.2%		514	14.5%	
	7 years	231	14.9%	268	13.5%		499	14.1%	
	8 years	426	27.4%	499	25.2%		925	26.2%	
District	Callao	797	22.6%	1037	29.3%	0.751	1834	51.9	0.000*
	Ventanilla	663	18.8%	829	23.5%		1492	42.2	
	Mi Perú	95	2.7%	113	3.2%		208	5.9	
Modular school code	0208694-UGEL Ventanilla	71	2.0%	97	2.7%	0.959	168	4.8	0.000*
	0208710-UGEL Ventanilla	174	4.9%	251	7.1%		425	12.0	
	0524462-DRE Callao	122	3.5%	164	4.6%		286	8.1	
	0541995-DRE Callao	61	1.7%	90	2.5%		151	4.3	
	0656801-DRE Callao	66	1.9%	85	2.4%		151	4.3	
	0659458-DRE Callao	53	1.5%	76	2.2%		129	3.7	
	0659474-DRE Callao	103	2.9%	127	3.6%		230	6.5	
	0659714-DRE Callao	181	5.1%	237	6.7%		418	11.8	
	0659938-DRE Callao	125	3.5%	153	4.3%		278	7.9	
	0728535-UGEL Ventanilla	56	1.6%	82	2.3%		138	3.9	
	0780494-UGEL Ventanilla	75	2.1%	80	2.3%		155	4.4	
	0780551-UGEL Ventanilla	52	1.5%	61	1.7%		113	3.2	
	0782466-DRE Callao	86	2.4%	105	3.0%		191	5.4	
	0782557-UGEL Ventanilla	53	1.5%	63	1.8%		116	3.3	
	1083997-UGEL Ventanilla	25	0.7%	27	0.8%		52	1.5	
	1195197-UGEL Mi Perú	50	1.4%	63	1.8%		113	3.2	
	1268846-UGEL Ventanilla	65	1.8%	70	2.0%		135	3.8	
	1268887-UGEL Ventanilla	92	2.6%	98	2.8%		190	5.4	
	1381193-UGEL Mi Perú	45	1.3%	50	1.4%		95	2.7	
Parent/Guardian Demographics									
(years)	Median [Quartil 1-Quartil 3]	34 [28-36]		32 [30-39]		0.071	34 [29-37]		0.000*
Role	Mother/guardian	1349	38.2%	1921	54.4%	0.000*	3270	92.5	0.000*
	Father/guardian	206	5.8%	58	1.6%		264	7.5	
Civil status	Single	704	19.9%	486	13.8%	0.000*	1190	33.7	0.000*
	Married	291	8.2%	459	13.0%		750	21.2	
	Cohabitant	547	15.5%	1012	28.6%		1559	44.1	
	Widower	13	0.4%	0	0.0%		13	0.4	
	Divorced	0	0.0%	22	0.6%		22	0.6	
Family composition	Single parent	568	16.1%	593	16.8%	0.000*	1161	32.9	0.000*
	Nuclear family	781	22.1%	1005	28.4%		1786	50.5	
	Binuclear	78	2.2%	189	5.3%		267	7.6	
	Extended family	128	3.6%	192	5.4%		320	9.1	
Education	Primary	3	0.1%	205	5.8%	0.000*	208	5.9	0.000*
	Secondary	560	15.8%	713	20.2%		1.273	36.0	
	Technical	501	14.2%	775	21.9%		1276	36.1	
	Superior	491	13.9%	286	8.1%		777	22.0	
Employment situation	Housewife	18	0.5%	236	6.7%	0.000*	1245	35.2	0.000*
	Does not work	426	12.1%	819	23.2%		254	7.2	
	Part time ≤20 h	626	17.7%	515	14.6%		1141	32.3	
	Part time >20 hours	485	13.7%	409	11.6%		894	25.3	
Nationality	Peruvian	1284	36.3%	1778	50.3%	0.000*	3062	86.6	0.000*
	Venezuelan	271	7.7%	201	5.7%		472	13.4	
Brushing frequency	Once a day	0	0.0%	366	10.4%	0.000*	366	10.4	0.000*
	Twice daily	400	11.3%	601	17.0%		1001	28.3	
	≥ three times a day	1155	32.7%	1012	28.6%		2167	61.3	

DRE, Regional Educational Directorate. UGEL, Local Educational Management Unit.

TABLE 1 Demographic data on parents and students from schools in Callao (n=3534)

ID	Ítems	Answer options, n (%)				
Behaviours and attitudes		Never (0)	Hardly ever (1)	Sometimes (2)	Almost always (3)	Always (4)
Q1	Does your child allow all of his/her teeth to be brushed?	36 (1.0)	130 (3.7)	371 (10.5)	1237 (35.0)	1760 (49.8)
Q2	Does your child brush his/her teeth at night?	144 (4.1)	102 (2.9)	740 (20.9)	563 (15.9)	1985 (56.2)
Q3	Does your child run away or hide during tooth brushing?	2656 (75.2)	321 (9.1)	440 (12.5)	98 (2.8)	19 (0.5)
Q4	Does your child try to avoid having to brush their teeth?	2311 (65.4)	507 (14.4)	609 (17.2)	17 (0.5)	90 (2.6)
Q5	Does your child cry when brushing their teeth?	3204 (90.7)	152 (4.3)	175 (5.0)	3 (0.1)	0 (0.0)
Q6	Do you get upset when you brush your child's teeth?	2834 (80.2)	278 (7.9)	406 (12.0)	16 (0.5)	0 (0.0)
Q7	Is brushing your child more complicated than you thought?	2549 (72.1)	571 (16.2)	337 (9.5)	77 (2.2)	0 (0.0)
Q8	When your child doesn't brush their teeth, do you feel guilty?	1409 (39.9)	127 (3.6)	1390 (39.3)	186 (5.3)	422 (11.9)
Q9	Do you tolerate your child's bad behavior as long as he manages to brush his teeth?	1486 (42.1)	146 (4.1)	869 (24.6)	533 (15.1)	500 (14.2)
Q10	If there was a way to get my child to cooperate, would brushing teeth be easier?	490 (13.9)	300 (8.5)	409 (11.6)	557 (15.8)	1778 (50.3)
Knowledge		Incorrect (0)		Does not know (-)	Correct (2)	
Q11	How often is it recommended that you change your child's toothbrush?	687 (19.4)		327 (9.3)	2520 (71.3)	
Q12	How much is the minimum amount (portion) of toothpaste indicated for brushing your child's teeth?	166 (4.7)		11 (0.3)	3357 (95.0)	
Q13	Regarding manual and electric toothbrushes, what type of toothbrush reduces plaque bacteria the most?	3253 (92.1)		50 (1.4)	231 (6.5)	
Q14	Should your child brush his/her teeth alone?	2017 (57.1)		26 (0.7)	1491 (42.2)	
Q15	How many times a day do you think your child should brush his/her teeth to avoid tooth decay?	2019(59.7)		115 (3.3)	1310 (37.1)	
Q16	What type of toothbrush is recommended for your child?	50 (1.4)		22 (0.6)	3462 (98.0)	
Q17	When is it recommended that children start brushing their teeth frequently?	1383 (39.1)		426 (12.1)	1725 (48.8)	
Q18	What could ingesting (eating) toothpaste during brushing cause children?	924 (26.2)		110 (3.1)	2500 (70.1)	
Q19	After brushing with toothpaste, is it indicated for children to rinse their teeth with water?	814 (23.0)		1659 (46.9)	1061 (30.0)	
Q20	What is the minimum time indicated for brushing your child's teeth?	843 (23.9)		787 (22.3)	1907 (53.9)	

TABLE 2 Items on behaviours, attitudes, and knowledge about children's toothbrushing of parents of children in schools in Callao.

associated with an infrequency of TB and lower parental educational levels. This is compatible with the fact that the family environment influences how and what children will do regarding oral hygiene from the earliest stages [Chang et al., 2021; Benadof et al., 2015; Duijster et al., 2015]. Therefore, the BAK-CTB interrelationship and its associated factors as well as multidisciplinary work with dental professionals are essential to reduce the risk of oral diseases [Tadakamadla et al., 2022; Menegaz et al., 2020; Matsuyama et al., 2020].

Another finding of the study in agreement with several previous studies was that the infrequency of parents' TB was related to bad behaviours of their children [Matsuyama et al., 2020], negative attitudes [Vermaire et al., 2010; Skeie et al., 2006] and low parental knowledge [Mustafa et al., 2021] related to CTB. Various models have been postulated to explain health behaviours about dental caries based on beliefs and health control, and those associated with the behaviours [Duijster et al., 2015; Vermaire et al., 2010]. It has been described that intention is a precursor to behaviour [Tadakamadla et al., 2022; Skeie et al., 2006; Mustafa, Nasir y Astrom, 2021] and one study showed that parents' TB has an impact on their children's oral hygiene self-care and parental habits are stimuli to better control their children's TB behaviour [Skeie et al., 2006].

The present study also agreed with other authors in associating a lower educational level of parents with bad behaviours of their children [Skeie et al., 2006], negative attitudes [Chang et al., 2021] and low paternal knowledge [Chang et al., 2021] related to CTB. This connection could be explained by the fact that knowledge in oral health is enhanced by academic training and access to dental consultations. Educational circumstances affect human groups according to "social", "cultural" or "geographical" status, leading parents to focus their interest on solving the problems of their basic needs for food and shelter, but not oral health. Effort is needed to understand, and willingness is necessary to seek care [Chang et al., 2021; Benadof et al., 2015; Skeie et al., 2006; Mustafa et al., 2021; Diel et al., 2022].

Variables		Behaviours, n (%)		P value	Attitudes, n (%)		P value	Knowledge, n (%)		P value
		Poor	Good		Negative	Positive		Low	High	
Children's demographics										
Age (years)†	Median [Quartil 1-Quartil 3]	7 [5-8]	5 [4-7]	<0.001*	6 [4-8]	5 [5-8]	0.030*	6 [4-7]	7 [5-8]	<0.001*
Gender‡	Female	485 (59.1)	1070 (39.4)	<0.001*	871 (33.2)	684 (75.0)	<0.001*	1435 (43.7)	120 (47.4)	0.254
	Male	336 (40.9)	1643 (60.6)		1751 (66.8)	228 (25.0)		1846 (56.3)	133 (52.6)	
District‡	Callao	439 (53.5)	1395 (51.4)	0.006*	1377 (52.5)	457 (50.1)	0.422	1695 (51.7)	139 (54.9)	0.507
	Ventanilla	318 (38.7)	1174 (43.3)		1095 (41.8)	397 (43.5)		1394 (42.5)	98 (38.7)	
	Mi Perú	64 (7.8)	144 (5.3)		150 (5.7)	58 (6.4)		192 (5.9)	16 (6.3)	
Parent/Guardian Demographics										
Age (years)†	Median [Quartil 1-Quartil 3]	32[26-37]	34[30-37]	<0.001*	32[28-38]	34[29-37]	<0.001*	34[29-37]	37[30-41]	<0.001*
Role ‡	Mother/guardian	789 (96.1)	2481 (91.5)	<0.001*	2377 (90.7)	893 (97.9)	<0.001*	3026 (92.2)	244 (96.4)	0.014*
	Father/guardian	32 (3.9)	232 (8.6)		245 (9.3)	19 (2.1)		255 (7.8)	9 (3.6)	
Civil status‡	Single	427 (52.0)	763 (28.1)	<0.001*	871 (33.2)	319 (35.0)	<0.001*	1099 (33.5)	91 (36.0)	<0.001*
	Married	191 (23.3)	559 (20.6)		576 (22.0)	174 (19.1)		741 (22.6)	9 (3.6)	
	Cohabitant	190 (23.1)	1369 (50.5)		1153 (44.0)	406 (44.5)		1406 (42.9)	153 (60.5)	
	Widower	13 (1.6)	0 (0.0)		0 (0.0)	13 (1.4)		13 (0.4)	0 (0.0)	
	Divorced	0 (0.0)	22 (0.8)		22 (0.8)	0 (0.0)		22 (0.7)	0 (0.0)	
Family composition ‡	Single parent	266 (32.4)	895 (33.0)	<0.001*	763 (29.1)	398 (43.6)	<0.001*	1056 (32.2)	105 (41.5)	<0.001*
	Nuclear family	335 (40.8)	1451 (53.5)		1343 (51.2)	443 (48.6)		1647 (50.2)	139 (55.0)	
	Binuclear	118 (14.4)	149 (5.5)		248 (9.5)	19 (2.1)		258 (7.9)	9 (3.6)	
	Extended family	102 (12.4)	218 (8.0)		268 (10.2)	52 (5.7)		320 (9.8)	0 (0.0)	
Education‡	Primary	65 (7.9)	143 (5.3)	<0.001*	208 (7.9)	0 (0.0)	<0.001*	208 (6.3)	0 (0.0)	<0.001*
	Secondary	281 (34.2)	992 (36.6)		1077 (41.1)	196 (21.5)		1140 (34.8)	133 (52.6)	
	Technique	365 (44.5)	911 (33.6)		954 (36.4)	322 (35.3)		1236 (37.7)	40 (15.8)	
	Superior	110 (13.4)	667 (24.6)		383 (14.6)	394 (43.2)		697 (21.2)	80 (31.6)	
Employment situation‡	Housewife	259 (31.6)	986 (36.3)	<0.001*	904 (34.5)	341 (37.4)	<0.001*	1086 (33.1)	159 (62.9)	<0.001*
	Does not work	19 (2.3)	235 (8.7)		237 (9.0)	17 (1.9)		251 (7.7)	3 (1.2)	
	Part time ≤20 h	322 (39.2)	819 (30.2)		793 (30.2)	348 (38.2)		1114 (34.0)	27 (10.7)	
	Part time >20 hours	221 (26.9)	673 (24.8)		688 (26.2)	206 (22.6)		830 (25.3)	64 (25.3)	
Nationality‡	Peruvian	749 (91.2)	2313 (85.3)	<0.001*	2249 (85.8)	813 (89.1)	0.010*	2809 (85.6)	253 (100.0)	<0.001*
	Venezuelan	72 (8.8)	400 (14.7)		373 (14.2)	99 (10.9)		472 (14.4)	0 (0.0)	
Brushing frequency‡	=Once a day	61 (7.4)	305 (11.2)	0.002*	366 (14.0)	0 (0.0)	<0.001*	366 (11.2)	0 (0.0)	<0.001*
	=Twice daily	258 (31.4)	743 (27.4)		720 (27.5)	281 (30.8)		883 (26.9)	118 (46.6)	
	≥ three times a day	502 (61.1)	1665 (61.4)		1536 (58.6)	631 (69.2)		2032 (61.9)	135 (53.4)	

*Behaviors, attitudes and knowledge with scores from 0 to 20 categorized as good/positive/high of ≥80% and poor/negative/low of <80%. †Try U-Mann Whitney. ‡Chi-square of independence. *P<0.05.*

TABLE 3 Level of behaviours, attitudes, and knowledge about children's tooth brushing according to demographic data from schools in Callao.

Most of the children in this study had good behaviours for CTB, similar to what has been reported in population studies from Brazil [Menegaz et al., 2020], Ireland [O'Malley et al., 2018], Morocco [Duijster et al., 2015] and Norway [Mustafa et al., 2021] and in contrast to what was found in Japan [Matsuyama et al., 2020]. This result was supported mainly by parental reports that children accepted CTB, including nocturnal CTB [Menegaz et al., 2020; O'Malley et al., 2018], without the occurrence of crying [Vermaire et al., 2010]. The literature indicates that early intervention by parents in their children's oral hygiene is positive for better behaviour towards the frequency and timing of CTB [Menegaz et al., 2020]. The higher frequency of parents with negative attitudes toward CTB was similar to that of studies carried out in Norwegian [Skeie et al., 2006; Mustafa et al., 2021] and Brazilian [Soares et al., 2017] populations and unlike what was reported in Ireland [O'Malley et al., 2018]. In the present study, this result was due to the difficulty, guilt and tolerance to the lack of TB by their children. This could be due to adverse experiences that children may have had during their health care that could have a familiar emotional memory. Likewise, parents who may suffer from dental anxiety are almost three times more likely to transmit negative attitudes to their children by blocking them from attending a dental appointment [Soares et al., 2017; Meza and Cárdenas, 2017]. In this study, parents did not demonstrate adequate knowledge about CTB, similar to what was reported in China [Chang et al., 2021], Spain and Italy [Vallés et al., 2022], Norway [Skeie et al., 2006; Mustafa et al., 2021] and the Netherlands [Duijster, Verrips and Van, 2014]. This low knowledge was related to not identifying the most adequate brush to reduce bacterial plaque [Van and Slot, 2015; Martin et

Variables		Behaviours			Attitudes			Knowledge		
		PR	95%CI	P value	PR	95%CI	P value	PR	95%IC	P value
Children's demographics										
Age (years)	Years	0.94	0.93-0.95	<0.001*	1.03	1.01-1.07	0.020*	1.29	1.19-1.40	<0.001*
Gender (Female Ref.)	Male	1.20	1.16-1.25	<0.001*	0.26	0.23-0.30	<0.001*	0.87	0.69-1.10	0.254
District (Ref. Callao)	Ventanilla	1.03	0.99-1.07	0.071	1.07	0.95-1.20	0.267	0.87	0.68-1.11	0.261
	Mi Perú	0.91	0.83-1.00	0.050	1.11	0.89-1.41	0.343	1.01	0.62-1.67	0.953
Parent/Guardian Demographics										
Age (years)	Years†	1.01	1.00-1.01	0.001*	1.01	1.00-1.01	0.031*	1.02	1.01-1.03	0.004*
Role (Ref. Mother/guardian)	Father/Guardian	1.16	1.10-1.21	<0.001*	0.26	0.17-0.41	<0.001*	0.46	0.24-0.88	0.019*
Civil status (Ref. Single)	Married	1.16	1.10-1.23	<0.001*	0.86	0.74-1.01	0.078	0.16	0.08-0.31	<0.001*
	Cohabitant	1.37	1.31-1.43	<0.001*	0.97	0.86-1.02	0.652	1.28	1.00-1.64	0.049*
	Widower	0.12	0.02-0.78	0.027*	3.73	3.39-4.10	<0.001*	0.98	0.15-6.54	0.987
	Divorced	1.56	1.49-1.62	<0.001*	0.17	0.02-1.15	0.069	0.58	0.08-3.99	0.581
Family composition (Ref. Single parent)	Nuclear family	1.05	1.01-1.09	0.008*	0.72	0.64-0.81	<0.001*	0.86	0.67-1.10	0.162
	Binuclear	0.72	0.65-0.81	<0.001*	0.21	0.13-0.32	<0.001*	0.40	0.21-0.76	0.004*
	Extended family	0.88	0.81-0.96	0.003*	0.47	0.37-0.62	<0.001*	0.03	0.01-0.24	0.001*
Education (Ref. Primary)	Secondary	1.13	1.03-1.24	0.011*	32.03	4.51-227.30	0.001*	22.06	3.10-156.91	0.002*
	Technique	1.04	0.94-1.14	0.450	52.65	7.43-372.97	<0.001*	6.68	0.92-48.34	0.060
	Superior	1.25	1.13-1.37	<0.001*	105.47	14.91-746.35	<0.001*	21.95	3.07-156.81	0.002*
Employment situation (Ref. Housewife)	Does not work	0.86	0.82-0.89	<0.001*	4.10	2.57-6.55	<0.001*	11.02	3.54-34.25	<0.001*
	Part time ≤20 h	0.80	0.74-0.82	<0.001*	4.57	2.86-7.29	<0.001*	2.08	0.64-6.78	0.226
	Part time >20 hours	0.81	0.77-0.86	0.035*	3.44	2.14-5.53	<0.001*	6.25	1.98-19.72	0.002*
Nationality (Ref. Peruvian)	Venezuelan	1.12	1.07-1.17	<0.001*	0.79	0.66-0.95	0.012*	0.05	0.01-0.20	<0.001*
Brushing frequency (Ref. =Once a day)	=Twice daily	0.89	0.84-0.94	<0.001*	103.11	14.52-732.05	<0.001*	43.87	6.15-312-96	<0.001*
	≥ three times a day	0.92	0.87-0.97	0.002*	106.57	15.03-755.59	<0.001*	23.31	3.27-166.16	0.002*

*Ref.: Reference category. PR: Crude prevalence ratio. CI: confidence interval. † Bivariate Poisson generalized linear model. *P<0.05.*

TABLE 4 Bivariate results of factors associated with behaviours, attitudes and knowledge about children's tooth brushing according to demographic data from schools in Callao.

al., 2023], minimum frequency of TB [Menegaz et al., 2020] and TB supervised [Matsuyama et al., 2020]. This may be influenced by a lack of family functioning and effective oral health programs that incorporate differentiating the variability of parent profiles in relation to BAK [Vallés et al., 2022; Vermaire et al., 2010; Duijster et al., 2014]. According to a systematic review on public health programs in Latin America, only five countries (Brazil, Chile, Panama, Colombia and Uruguay) they included a dental evaluation in their national health surveys [Duran et al., 2018].

It is necessary to mention some limitations of the study. The results respond to a theoretical context of the binomial parents and children, which could influence the veracity of what was reported by the parents. The questionnaire had a limited number of questions, ideal for epidemiological studies, but which do not necessarily express the reality in the daily life of households. However, the study samples were large to reduce response bias and have a greater practical scope. The context of application was public schools, which could lead to selection bias. For this

Variables		Behaviours			Attitudes			Knowledge		
		PR	95%CI	P value†	PR	95%CI	P value	PR†	95%CI	P value†
Children's demographics										
Age (years)	Years	0.93	0.92-0.94	<0.001	0.99	0.95-1.02	0.447	1.20	1.11-1.29	<0.001
Gender (Female Ref.)	Male	1.26	1.21-1.32	<0.001	0.35	0.31-0.40	<0.001	2.58	1.69-3.93	<0.001
District (Ref. Callao)	Ventanilla	1.00	0.97-1.04	0.842	1.09	0.99-1.20	0.060	1.32	0.91-1.93	0.029
	Mi Perú	1.01	0.93-1.11	0.751	1.04	0.85-1.28	0.660	0.91	0.44-1.88	0.806
Parent/Guardian Demographics										
Age (years)	Years†	0.99	0.99-1.00	0.952	1.03	1.02-1.04	<0.001	1.06	1.02-1.10	0.003
Role (Ref.Mother/guardian)	Father/Guardian	1.17	1.06-1.29	0.002	0.15	0.08-0.26	<0.001	0.30	0.06-1.48	0.138
Civil status (Ref. Single)	Married	1.13	1.04-1.23	0.006	0.93	0.75-1.16	0.545	0.05	0.02-0.13	<0.001
	Cohabitant	1.18	1.10-1.27	<0.001	1.31	1.09-1.56	0.003	0.45	0.27-0.76	0.003
	Widower	0.09	0.01-0.62	<0.001	0.95	0.71-1.26	0.706	53.70	1.85-1555.38	0.020
	Divorced	1.21	1.11-1.33	<0.001	0.07	0.01-0.52	0.009	0.10	0.01-0.72	0.022
Family composition (Ref. Single parent)	Nuclear family	1.00	0.94-1.07	0.904	0.26	0.21-0.31	<0.001	0.18	0.10-0.33	<0.001
	Binuclear	0.78	0.70-0.88	<0.001	0.45	0.31-0.65	<0.001	1.04	0.68-1.60	0.837
	Extended family	0.67	0.59-0.75	<0.001	0.56	0.44-0.72	<0.001	0.01	0.00-0.05	<0.001
Education (Ref. Primary)	Secondary	1.44	1.29-1.60	<0.001	29.39	4.00-215.84	0.001	1697.58	201.30-14315.22	<0.001
	Technique	1.04	0.95-1.15	0.404	43.80	6.03-318.18	<0.001	276.64	34.69-2206.10	<0.001
	Superior	1.54	1.41-1.70	<0.001	135.29	0.36-0.52	<0.001	4485.06	512.98-39213.58	<0.001
Situación laboral (Ref. Housewife)	Does not work	1.07	0.98-1.17	<0.001	0.35	0.22-0.54	<0.001	0.05	0.02-0.15	<0.001
	Part time ≤20 h	0.85	0.80-0.89	<0.001	0.52	0.22-0.54	<0.001	0.02	0.01-0.03	<0.001
	Part time >20 hours	1.00	0.93-1.08	<0.001	0.43	0.35-0.52	<0.001	0.03	0.01-0.04	<0.001
Nationality (Ref. Peruvian)	Venezuelan	1.24	1.16-1.33	<0.001	0.65	0.52-0.80	<0.001	0.01	0.00-0.11	<0.001
Brushing frequency (Ref. =Once a day)	=Twice daily	1.09	0.99-1.18	0.076	104.45	14.20-768.27	<0.001	1611.12	194.38-13354.04	<0.001
	≥ three times a day	1.08	0.98-1.18	0.110	65.76	9.00-480.47	<0.001	183.08	24.95-1343.19	<0.001

*Ref. Reference category. PR: Adjusted prevalence ratio. CI: confidence interval. † Multivariate Poisson generalised linear model. *P<0.05.*

TABLE 5 Multivariable results of factors associated with behaviours, attitudes and knowledge about children's tooth brushing according to demographic data from schools in Callao.

reason, it is recommended that future studies be extended to private areas.

Conclusions

In conclusion, the children showed good behaviourss of CTB related to higher parental educational levels. Parents had negative attitudes and low knowledge about CTB among parents was associated with lower education and infrequency of toothbrushing. Children had frequent behaviourss in accepting total and nighttime toothbrushing and not crying over toothbrushing, while parents they showed negative attitudes due to their children's difficulty, guilt and tolerance for not toothbrushing. Parental knowledge of CTB was incorrect in identifying the brush to reduce plaque, minimum frequency, and toothbrushing

SUPPLEMENTARY MATERIALS
Appendix 1

N°	Behaviours and attitudes about children's tooth brushing	Answer options				
		Never	Hardly ever	Sometimes	Almost always	Always
Q1	Does your child allow all of his/her teeth to be brushed?					
Q2	Does your child brush his/her teeth at night?					
Q3	Does your child run away or hide during tooth brushing?					
Q4	Does your child try to avoid having to brush their teeth?					
Q5	Does your child cry when brushing their teeth?					
Q6	Do you get upset when you brush your child's teeth?					
Q7	Is brushing your child more complicated than you thought?					
Q8	When your child doesn't brush their teeth, do you feel guilty?					
Q9	Do you tolerate your child's bad behavior as long as he manages to brush his teeth?					
Q10	If there was a way to get my child to cooperate, would brushing teeth be easier?					
ID	Knowledge about children's tooth brushing	Answer options				
Q11	How often is it recommended that you change your child's toothbrush?	Only when the bristles are worn (0 points) Every 6 months and/or when the bristles are worn (0 points) Every 3 months and/or when the bristles are worn (2 points)				
Q12	How much is the minimum amount (portion) of toothpaste indicated for brushing your child's teeth?	No toothpaste (0 points) Portion equivalent to "Grain of rice" (0 points) Portion equivalent to «Pea» (2 points) I don't know				
Q13	Regarding manual and electric toothbrushes, what type of toothbrush reduces plaque bacteria the most?	Only manual toothbrushes (0 points) Only electric toothbrushes (0 points) Both manual and electric brushes (2 points) I don't know				
Q14	Should your child brush his/her teeth alone?	No, they always need parental supervision (0 points) Yes, they never need parental supervision (0 points) They only need supervision when they do not know how to brush correctly (2 points) I don't know				
Q15	How many times a day do you think your child should brush his/her teeth to avoid tooth decay?	None (0 points) Once a day (0 points) Twice a day (2 points) I don't know				
Q16	What type of toothbrush is recommended for your child?	Small head and soft bristles (2 points) Medium head and medium hard bristles (0 points) Large head and soft bristles (0 points) I don't know				
Q17	When is it recommended that children start brushing their teeth frequently?	When the first baby tooth appears: ± 6 months (2 points) When they have all their baby teeth: ± 24 months (0 points) When the first permanent tooth appears: ± 6 years (0 points) I don't know				
Q18	What could ingesting (eating) toothpaste during brushing cause children?	Causes benefits (0 points) Nothing, neither benefits nor toxicity (0 points) Toxicity, harmful effects (2 points) I don't know				
Q19	After brushing with toothpaste, is it indicated for children to rinse their teeth with water?	Yes, they should rinse until all traces of toothpaste are removed from the mouth (0 points) No, they should ingest (eat) the excess toothpaste (0 points) No, you should just spit out the excess toothpaste and let the rest work on your teeth (2 points) I don't know.				
Q20	What is the minimum time indicated for brushing your child's teeth?	30 seconds (0 points) One minute (0 points) Two minutes (2 points) I don't know				

TABLE S1A Survey used in this research study (English version).

N	Comportamientos y actitudes sobre cepillado dental infantil	Opciones de respuestas				
		Nunca	Casi nunca	A veces	Casi siempre	Siempre
P1	¿Su hijo(a) permite que le cepillen todos los dientes?					
P2	¿Su hijo(a) se deja lavar los dientes por la noche?					
P3	¿Su hijo(a) se escapa o se esconde durante su cepillado dental?					
P4	¿Su hijo(a) trata de evitar tener que cepillarse los dientes?					
P5	¿Su hijo(a) llora al cepillarse los dientes?					
P6	¿Usted se altera cuando le cepilla los dientes a su hijo(a)?					
P7	¿El cepillado de su hijo(a) resulta más complicado de lo que pensó?					
P8	¿Cuándo su hijo(a) no se cepilla los dientes, usted siente culpabilidad?					
P9	¿Tolera el mal comportamiento de su hijo(a) mientras logre cepillarse sus dientes?					
P10	Sí existiera la manera de hacer que mi hijo(a) coopere, ¿Sería más sencillo el cepillado dental?					
ID	Conocimientos sobre cepillado dental infantil	Opciones de respuestas				
P11	¿Cada cuánto tiempo se recomienda que cambie el cepillo dental de su hijo(a)?	Solo cuando las cerdas estén desgastadas (0 puntos) Cada 6 meses y/o cuando las cerdas están desgastadas (0 puntos) Cada 3 meses y/o cuando las cerdas están desgastadas (2 puntos) No sé				
P12	¿Cuánto es la cantidad mínima (porción) de pasta dental indicada para el cepillado dental de su hijo(a)? Vea imagen referencial	Sin pasta dental (0 puntos) Porción equivalente a «Grano de arroz» (0 puntos) Porción equivalente a «Alverja» (2 puntos) No sé				
P13	Respecto a los cepillos manuales y eléctricos ¿Qué tipo de cepillo dental reduce más la placa bacteriana?	Solo los cepillos manuales (0 puntos) Solo los cepillos eléctricos (0 puntos) Ambos, tanto el cepillo manual como eléctricos (2 puntos) No sé				
P14	¿Su hijo(a) debe cepillarse sus dientes solo(a)?	No, siempre necesitan la supervisión de los padres (0 puntos) Sí, nunca necesitan la supervisión de los padres (0 puntos) Solo necesitan supervisión cuando no sepan cepillarse correctamente (2 puntos) No sé				
P15	¿Cuántas veces al día como mínimo considera que debe cepillarse los dientes su hijo(a) para evitar la caries dental?	Ninguna (0 puntos) Una vez al día (0 puntos) Dos veces al día (2 puntos) No sé				
P16	¿Qué tipo de cepillo dental es lo recomendado para su hijo(a)?	Cabezal pequeño y cerdas suaves (2 puntos) Cabezal mediano y cerdas de dureza media (0 puntos) Cabezal grande y cerdas suaves (0 puntos) No sé				
P17	¿Cuándo es recomendado que los niños inicien el cepillado los dientes frecuentes?	Cuando aparezca el primer diente de leche: ± 6 meses (2 puntos) Cuando tengan todos los dientes de leche: ± 24 meses (0 puntos) Cuando aparezca el primer diente permanente: ± 6 años (0 puntos) No sé				
P18	¿Qué podría provocar en los niños la ingesta (comer) de la pasta dental durante el cepillado?	Provoca beneficios (0 puntos) Nada, ni beneficios ni toxicidad (0 puntos) Toxicidad, efectos perjudiciales (2 puntos) No sé				
P19	Luego del cepillado con la pasta dental ¿Es indicado que los niños se enjuaguen con agua los dientes?	Sí, deberían enjuagarse hasta retirar todo resto de pasta dental en la boca (0 puntos) No, deberían injerir (comer) el exceso de pasta dental (0 puntos) No, solo deberían escupir el exceso de pasta dental y dejar que el resto actué en los dientes (2 puntos) No sé.				
P20	¿Cuánto es el tiempo mínimo indicado que considera par el cepillado dental de su hijo(a)?	30 segundos (0 puntos) Un minuto (0 puntos) Dos minutos (2 puntos) No sé				

TABLE S1B Survey used in this research study (Spanish version).

supervision.

Author contributions

RCG wrote the manuscript and performed data collection in compliance with the requirements for a professional degree in Peru. JDV contributed to the idea, study design, and writing of the manuscript. KCS analysed the results and critically revised the manuscript. All authors gave final approval and agreed to be accountable for all aspects of the work.

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Disclosure

This study is based on undergraduate thesis of Ruth Chavez Garamonte.

Conflict of interest statement

The authors declare no conflicts of interest.

Data availability statement

Data are available upon request.

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