



# Cross-sectional study on factors associated with flossing in Brazilian young children

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## Abstract

**Purpose** This cross-sectional study aimed at evaluating the factors associated with flossing by caregivers in Brazilian young children.

**Methods** Its sample consisted of 305 children aged 1–3 and their mothers from the Brazilian city of Diamantina. They were selected through the Municipal Health Department from a list of registered children who had recently used the public health services. Data collection was done by means of the mothers answering a questionnaire which addressed economic and socio-demographic factors and also the mother and child characteristics and habits. In addition, an oral clinical examination was performed in order to assess Baume arch type and caries occurrence. Descriptive statistical analysis, chi-square test and Poisson regression were performed.

**Results** It was found that the sample presented a prevalent flossing habit in 20.3% of the subjects. The flossing habit in the children was associated with the mothers' own habit of flossing daily (PR 2.32; 95% CI 1.12–4.82) and with the frequent children's tooth brushing by the mother (PR 2.85; 95% CI 1.05–7.76).

**Conclusion** A higher prevalence of flossing by caregivers in young children is associated with the mothers' own habit of flossing daily and with the frequent children's tooth brushing by the mother.

**Keywords** Child · Floss · Oral health · Oral hygiene · Healthy habit

## Introduction

Early years in life are the period of habits acquisition and the exposure to adequate health practices in this period is fundamental to good health practices throughout life (Lynch and Smith 2005; Darling et al. 2020). As to oral health, it would contribute to the prevention of conditions such as dental caries, halitosis, and gingivitis (Patil et al. 2014; Borges-Yáñez

et al. 2017; Colombo et al. 2019), which are related to the effective control of dental biofilm through the adequate oral hygiene (Samuel et al. 2020).

There is a controversy between studies that evaluated whether flossing in primary teeth is associated with a reduction of proximal caries (de Oliveira et al. 2017; Hujoel et al. 2006; Ghasemianpour et al. 2019). Nevertheless, the most common recommendation for the control of dental biofilm and conditions caused by its accumulation is tooth brushing and the regular flossing (American Academy of Pediatric Dentistry 2016). Flossing is justified by the fact that a toothbrush is unable to penetrate the interdental area and effectively remove biofilm from this region, where periodontal disease and dental caries are more prevalent (Lang et al. 1995; Albandar et al. 2002; Berchier et al. 2008; Demirci et al. 2010). Despite the increasing population awareness on the importance of flossing and the increasing access to dental floss, adherence to regularly flossing remains low, especially in childhood. A study conducted with preschool children aged 1–5 found that their vast majority (73.12%) did not floss (Moraes et al. 2019).

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Parents and guardians are the ones responsible for the oral health care of preschool children (Corrêa-Faria et al. 2013). Thus, the habits and knowledge of parents and guardians affect the quality of oral hygiene in children (Castilho et al. 2013). Studies have demonstrated that the habit of using dental floss in children is influenced by socioeconomic characteristics (such as socioeconomic status) and environmental factors (such as a more favorable housing with a support network) increase the likelihood of using dental floss (Moraes et al. 2019). The parents' education level also influence the adoption of good oral health habits (Corrêa-Faria et al. 2013).

Knowing what determines the adherence to dental flossing could assist in guiding disease prevention strategies and the maintenance of oral self-care practices, such as flossing. However, few studies have investigated determinants of this behavior in preschool children. Therefore, the aim of this study was to evaluate the factors associated with flossing by caregivers in children aged one to three.

## Materials and methods

The recommendations of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE statement) (Malta et al. 2010) were used to guide this study and write the document.

### Ethical considerations

This study was approved by the Ethics and Research on Human Beings of *Universidade Federal dos Vales do Jequitinhonha e Mucuri* (UFVJM) (protocol number: 470863). All parents/guardians were informed of the study objectives and signed the informed consent form agreeing to their own and their children participation.

### Study design and population

This cross-sectional study was conducted in the Brazilian city of Diamantina, which is located in the northeast region of Minas Gerais state. According to the most recent demographic census, Diamantina has a population of 45,880 residents, 3013 of whom are aged between zero and four. The city Human Development Index is 0.716, ranked 1427th in Brazil (IBGE 2010). The participants were children selected from a list provided by the Municipal Health Department, which contained 1089 registered children who had recently used the public health services for vaccination purposes in 2013 and 2014. These children were randomly selected using a simple lots-drawing method. To be eligible, the children needed to be aged between one and three and they could not have any chronic disease or systemic condition. The selected

children should also be able to attend UFVJM post-graduation department clinic for data collection accompanied by the main caregiver (who took care of them for most of the day), which happened from December 2013 to July 2014.

Sample size was calculated using Open Source Epidemiologic Statistics for Public Health (*OpenEpi* software), and a simple proportion formula was adopted. Considering the 29% of flossing prevalence (pilot study data), a 95% confidence interval and 5% standard error, the minimum sample totalled 246 children. In addition to that, so as to compensate for possible dropouts, a 25% was added (62 additional children), and the final sample consisted of 308 children.

### Training and calibration

Two researchers underwent training and calibration exercises supervised by an experienced researcher prior to the data collection to ensure the standardization of the evaluations. The training comprised the criteria for caries diagnosis (ICDAS index) (ICDAS, 2012) and arch type (Baume 1950), with theory explanations and images analysis of different oral clinical conditions. The researchers' training also included the questionnaire completion. The calibration exercise involved the evaluation of 50 children by the two examiners and one experienced researcher on two occasions, with a one-week interval between examinations. Minimum Kappa coefficients for intra-examiner and inter-examiner agreement were respectively 0.86 and 0.83.

### Pilot study

A pilot study was conducted with a sample of 32 children and their mothers to test the data collection methods and obtain information to calculate the main study sample size. The children in the pilot study were not included in the main study. The results demonstrated no need to change the proposed methods.

### Data collection

After the selection process, the subjects and their mothers were asked to attend UFVJM postgraduate program clinic for data collection. The mothers answered a questionnaire in interview form by a blinded interviewer for the collection of the following information: child's age and sex; whether the child attended a preschool or day-care center (yes or no); whether the child had access to a dentist (yes or no); whether the child had a history of toothache (yes or no); whether the mother performed tooth brushing on the child (yes or no); whether the child teeth were flossed daily (dependent variable) (yes or no); family income (based on the Brazilian monthly minimum wage [BMMW: currently equivalent to approximately US\$212.56] and categorized as 'lower than

BMMW', 'from one up to lower than twice the BMMW' or 'more than twice the BMMW'); number of individuals living on the income (dichotomized by the median as 'more than three' or 'three or less'); mother's schooling ('up to 8 years or less'; '9–11 years' or 'more than 12 years' of education); mother's history of toothache (yes or no); mother's daily flossing (yes or no) and mother's access to a dentist (yes or no).

The second phase of data collection process was the children oral clinical examinations. For such, the child was positioned on a dental chair appropriate for their age and was restrained by the mother, if necessary. The examinations were performed by two trained and calibrated examiners under artificial light and after teeth prophylaxis. All procedures were performed in accordance with the university biosafety norms.

The presence of caries was evaluated using the International Caries Detection and Assessment System (ICDAS). The dental surfaces were first examined while wet and re-examined after being dried with compressed air for five seconds. The surfaces were classified as sound tooth surface (code 0), initial carious lesions (codes 1 or 2) and moderate to severe carious lesions (codes 3–6). Each child was classified by their worst situation in oral caries. For example, if a subject had one initial carious lesion and one severe lesion, they were classified as having severe cavity.

Arch type was determined using the classification proposed by Baume (1950): type I—space between anterior teeth; type II—no generalized spaces in the anterior region (Baume 1950). Children with at least one type II arch were classified as Baume Type II.

### Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS for Windows, version 22.0, SPSS Inc., Chicago, IL, USA). Descriptive analysis was performed for sample characterization and the prevalence ratio (PR) was applied. Poisson regression with robust variance was then employed to determine associations between flossing and factors related to the child, family, and oral clinical conditions. In the adjusted analysis, variables with a  $p$  value  $\geq 0.20$  were excluded. After adjustments, explanatory variables with a  $p$  value  $< 0.05$  remained in the final models and were considered associated with the dependent variable.

### Results

Three subjects from the group of 308 invited children could not participate, then, the study counted with 305 participants (response rate: 99.02%). It was caused by the children arrival at the clinic not accompanied by their main caregiver,

but by another person. For the majority of the subjects, the main caregiver was their mothers. Most children belonged to families with an income of less than twice the monthly minimum wage (62.0%). Most of the mothers had between 9 and 12 years of education (50.8%). The prevalence of flossing habits among the children was 20.3%. As to arch type, 138 children were classified as Baume Type II (45.2%) and, of these, 33 (55%) had their teeth flossed.

Table 1 displays the distribution of flossing prevalence according to socio-demographic and economic variables, mothers' characteristics and habits, and aspects related to the children. The lowest prevalence of flossing were among 1-year-old children (20.0%). The majority of mothers who would floss on a daily basis reported flossing their children teeth (86.7%). In addition, mothers who brushed their children's teeth also reported flossing their children teeth daily (93.3%).

Table 2 displays the associations between the flossing of children's teeth, family factors, factors related to the child and oral clinical conditions. In the unadjusted analysis, child's age, mothers' daily flossing and child's teeth brushing by the mother were associated with the child's teeth flossing. In the multivariate analysis, flossing was significantly associated with the mother's daily flossing habit (PR = 2.32; 95% CI 1.12–4.82) and child's teeth brushing by the mother (PR = 2.85; 95% CI 1.05–7.76).

### Discussion

The present study evaluated factors associated with the flossing of children teeth aged 1–3. The main findings were the higher prevalence of daily flossing habit in children whose mothers had the habit of flossing on a daily basis and in those whose mothers performed the child's teeth brushing.

Among the 305 children who participated in this study, only 20.3% had their teeth flossed, which is similar to the rate found in a previous study conducted with preschool children in southern Brazil (26.88%) (Moraes et al. 2019). The low prevalence of dental flossing may be attributed to a lack of motivation by parents/guardians, who often find it difficult to handle dental floss and who need to deal with frequent negative child behavior (Mattos-Silveira et al. 2017; Demari et al. 2016).

One of the factors associated with the flossing of 1–3-year-old children teeth was the mother's daily habit of flossing of their own teeth. A previous study found that the parents' influence is important to the habit adoption by children and demonstrated that the flossing by a parent/guardian was directed associated with floss use by their children (Toyama et al. 2019). Another study reported that one of the difficulties mothers face is the lack of knowledge and technique regarding flossing, and it affects the adoption and

**Table 1** Descriptive analysis of flossing prevalence according to the socio-demographic and economic variables, mothers' characteristics and habits, and aspects related to the child ( $n = 305$ )

Covariates	Yes <i>n</i> (%)	No <i>n</i> (%)	<i>p</i> *
<i>Sex</i>			
Female	33 (55.0)	133 (54.3)	0.921
Male	27 (45.0)	112 (45.7)	
<i>Age</i>			
1 year old	12 (20.0)	89 (36.3)	<b>0.015</b>
2 years old	25 (41.7)	90 (36.7)	
3 years old	23 (38.3)	66 (26.9)	
<i>Child attended a preschool or day-care center</i>			
No	34 (56.7)	132 (53.9)	0.697
Yes	26 (43.3)	113 (46.1)	
<i>Monthly family income</i>			
≥ 2 minimum wage	25 (41.7)	91 (37.1)	0.829
1 to < 2 minimum wage	25 (41.7)	119 (48.6)	
< 1 minimum wage	10 (16.7)	35 (14.3)	
<i>Number of individuals living on the income</i>			
≤ 3	27 (45.0)	102 (41.6)	0.636
> 3	33 (55.0)	143 (58.4)	
<i>Mother's schooling</i>			
> 12 years of education	23 (38.3)	75 (30.6)	0.211
9 to 11 years of education	29 (48.3)	126 (51.4)	
≤ 8 years of education	8 (13.3)	44 (18.0)	
<i>Mother's access to a dentist</i>			
Yes	39 (65.0)	139 (56.7)	0.244
No	21 (35.0)	106 (43.3)	
<i>Mother's toothache history</i>			
No	31 (51.7)	147 (60.0)	0.241
Yes	29 (48.3)	98 (40.0)	
<i>Mother's daily flossing habit</i>			
No	8 (13.3)	82 (33.5)	<b>0.002</b>
Yes	52 (86.7)	163 (66.5)	
<i>Mother brushed the child's teeth</i>			
No	4 (6.7)	60 (24.5)	<b>0.002</b>
Yes	56 (93.3)	185 (75.5)	
<i>Child's access to a dentist</i>			
Yes	29 (48.3)	93 (38.0)	0.142
No	31 (51.7)	152 (62.0)	
<i>Child's toothache history</i>			
No	49 (81.7)	180 (73.5)	0.188
Yes	11 (18.3)	65 (26.5)	
<i>Type II Baume Arch</i>			
No	27 (45.0)	140 (57.1)	0.090
Yes	33 (55.0)	105 (42.9)	
<i>Dental caries</i>			
Sound	17 (28.3)	91 (37.1)	0.122
Initial caries	12 (20.0)	54 (22.0)	
Moderate to severe cavity	31 (51.7)	100 (40.8)	

\*Chi-square test

**Table 2** Univariate analysis and final multivariate model of associations between factors related to the children, their family, and oral clinical conditions and flossing for children aged 1 to 3 ( $n=305$  children)

Covariates	$n$ (%)	PR not adjusted (CI 95%)	$p$	PR adjusted (CI 95%)	$p$
<i>Sex</i>					
Female	166 (54.4)	1			
Male	139 (45.6)	0.98 (0.62–1.54)	0.921		
<i>Age</i>					
1 year old	101 (33.1)	1			
2 years old	115 (37.7)	1.83 (0.97–3.45)	0.062		NS
3 years old	89 (29.2)	2.17 (1.15–4.11)	<b>0.017</b>		
<i>Child attended a preschool or day-care center</i>					
No	166 (54.4)	1			
Yes	139 (45.6)	0.91 (0.58–1.44)	0.698		
<i>Monthly family income</i>					
$\geq 2$ minimum wage	45 (14.8)	1			
1 to $< 2$ minimum wage	144 (47.2)	0.80 (0.49–1.32)	0.394		
$< 1$ minimum wage	116 (38.0)	1.03 (0.54–1.97)	0.926		
<i>Number of individuals living on the income</i>					
$\leq 3$	176 (57.7)	1			
$> 3$	129 (42.3)	0.90 (0.57–1.41)	0.636		
<i>Mother's schooling</i>					
$> 12$ years of education	98 (32.1)	1			
9 to 11 years of education	155 (50.8)	0.80 (0.49–1.29)	0.360		
$\leq 8$ years of education	52 (17.0)	0.66 (0.32–1.36)	0.257		
<i>Mother's access to a dentist</i>					
Yes	178 (58.4)	1			
No	127 (41.6)	0.75 (0.47–1.22)	0.250		
<i>Mother's toothache history</i>					
No	178 (58.4)	1			
Yes	127 (41.6)	1.31 (0.83–2.06)	0.240		
<i>Mother's daily flossing habit</i>					
No	215 (70.5)	1		1	
Yes	90 (29.5)	2.72 (1.35–5.49)	<b>0.005</b>	2.32 (1.12–4.82)	<b>0.024</b>
<i>Mother brushed the child's teeth</i>					
No	241 (79.0)	1		1	
Yes	64 (21.0)	0.27 (0.10–0.72)	<b>0.008</b>	2.85 (1.05–7.76)	<b>0.040</b>
<i>Child had access to a dentist</i>					
Yes	122 (40.0)	1			
No	183 (60.0)	0.71 (0.45–1.12)	0.141		NS
<i>Child's toothache history</i>					
No	229 (75.1)	1			
Yes	76 (24.9)	0.68 (0.37–1.23)	0.202		
<i>Type II Baume Arch</i>					
No	167 (54.8)	1			
Yes	138 (45.2)	1.48 (0.94–2.33)	0.092		
<i>Dental caries</i>					
Sound	108 (35.4)	1			
Initial caries	66 (21.6)	1.15 (0.59–2.26)	0.674		NS
Moderate to severe cavity	131 (43.0)	1.50 (0.88–2.56)	0.134		

PR prevalence ratio, CI Confidence Interval, NS non-significant association ( $p > 0.05$ )

replication of the habit in their children (Rank et al. 2006). Therefore, it is critical for parents/guardians to incorporate this habit in their daily routine, along with other attitudes that are beneficial to health, as they are examples for their children. Discussions are needed on oral hygiene practices and oral health programs that encompass the entire family.

Children's teeth brushing by their mother was also associated with the flossing of young children teeth. It is essential that a young child's oral hygiene be performed by an adult for the effective removal of biofilm, including the interproximal region (Choo et al. 2001), as children younger than 10 years old have not got yet the manual skills to perform effective hygiene (Demari et al. 2016). While they learn to clean their teeth, young children interpret the process as a game and do not perform it effectively (Finlayson et al. 2007). A previous study that investigated the association between dental caries and the supervision of brushing time concluded that preschool children have not got sufficient dexterity to perform adequate cleaning of the teeth (Corrêa-Faria et al. 2013). In addition, some children in the present study required restraint for an oral exam, and studies have linked children's negative behavior in dental office to one of the highest prevalence of caries (Viswanath et al. 2020; Howenstein et al. 2015). Another study found that, even though 71% of mothers were aware of the need to be present in brushing time, 31% did not do so because they felt insecure (Castilho et al. 2013). The negative behavior of children during oral hygiene is a major challenge for mothers to perform this task (Marshman et al. 2016). In this study, some children needed protective stabilization for oral examination, which could be a predictor of children's negative behavior also during oral hygiene at home.

The present study has the limitation inherent to the cross-sectional design, which does not enable the establishment of causality between the variables analyzed. However, it was possible to calculate the prevalence of the flossing and describe associations with the variables studied. Future studies should perform a qualitative investigation of the barriers and difficulties faced by mothers in using dental floss on their children's teeth. In addition, we suggest that future longitudinal studies investigate the relationship between interproximal caries and flossing, as there is still a gap in literature regarding this association.

The present findings are relevant and could assist in guiding strategies aimed at the incorporation of this habit by young people. Although the association between the children's age and flossing in the univariate analysis, this association was lost when the multivariate analysis was adjusted for dental caries. Children aged 1 and 2 often have partially spaced teeth, which could make oral hygiene with dental floss unnecessary. However, flossing should be included in the child's hygiene routine, given that childhood is a time when habits are taken into the future (Pantano 2018;

Cordeiro and Teixeira 2021). Thus, it is fundamental to adopt the habit of dental flossing and other healthy habits in this period (Cordeiro and Teixeira 2021). The findings of the present study demonstrate the influence of parents/caregivers on the adoption of habits and importance of health strategies that involve the entire family.

## Conclusion

Considering the limitations of the present study, it has been shown that a higher prevalence of flossing among young children was associated with their mothers' habit of flossing daily and with those who brush their children's teeth.

**Author contributions** ANR was responsible for collecting patient data and writing the manuscript. JRJ was responsible for statistical analysis, the critical review of the manuscript and orientation of the work. PSM was responsible for collecting patient data and writing the manuscript. RAG was responsible for collecting patient data and writing the manuscript. MLR-J was responsible for statistical analysis and for the critical review of the manuscript. IBF was responsible for collecting patient data, for statistical analysis, writing the manuscript and orientation of the work. All authors discussed and approved the final version of this article.

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**Data availability** Data supporting the results in this paper were not archived in an public repository. The data sets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declarations

**Conflict of interest** The authors have no relevant financial or non-financial interests to disclose.

**Ethical approval** This study received approval from the Human Research Ethics Committee of the *Universidade Federal dos Vales do Jequitinhonha e Mucuri*, Brazil (protocol number 1.921.084).

**Informed consent** Informed consent was obtained from legal guardians.

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