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ORIGINAL RESEARCH

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Mothers' choice of toothpaste for their children: evaluation of fluoride content

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Abstract

Background: It is essential that mothers, as the primary caregivers of children, are well-informed about the oral and dental health products their children use. This study aimed to evaluate the accuracy of the information provided by mothers concerning the toothpaste used by their children. **Methods**: A total of 133 mothers of children who presented to the Inonu Dentistry Pedodontics Clinic were randomly selected for inclusion in this study. The research was conducted in two phases involving the mothers. Chi-square tests were employed to compare categorical variables, while the McNemar test was used to assess differences between repeated or paired measurements. **Results**: The pediatric dentist's examination of the toothpastes revealed that 61.7% of the samples contained fluoride levels appropriate for the children's age. In contrast, the fluoride content in the toothpastes used by 21.8% of the children was deemed inadequate for their age. A statistically significant but weak agreement was found between the assessments of mothers and the pediatric dentist concerning the presence of fluoride in the children's toothpaste. **Conclusions**: The reports provided by mothers concerning the fluoride content of the toothpaste used by their children were found to be inaccurate.

Keywords

Fluoride; Toothpaste; Parents; Choice

1. Introduction

Dental caries is among the most prevalent diseases affecting both pediatric and adult populations [1]. A global study published in 2017 estimated that 2.3 billion individuals were affected by tooth decay in their permanent dentition, while more than 530 million children exhibited dental caries in their primary dentition [2]. The prevention and management of dental caries rely on a range of oral hygiene practices, including proper tooth brushing techniques, the use of fluoride-containing toothpaste and the modification of dietary habits [3–5]. Among these preventive measures, fluoride plays a pivotal role by promoting the remineralization of tooth enamel and inhibiting bacterial activity [6]. Research indicates that nearly all commercially available toothpastes contain fluoride in varying concentrations, a key factor in maintaining optimal oral health [7]. However, the effectiveness of fluoride toothpaste depends not only on its fluoride content but also on its proper use, particularly the appropriate amount applied during tooth brushing.

Due to limited motor skills and insufficient knowledge, children rely on their parents—particularly their mothers, who are more likely to provide oral care—for the proper execution of oral hygiene practices. The attitudes and knowledge of mothers, who generally assume primary responsibility for their children's oral health, have a direct and significant impact on their overall well-being [8, 9]. The efficacy of maternal oral care practices depends on several factors, including the age-appropriateness of the fluoride content in the toothpaste and the quantity of toothpaste used. Without adherence to these factors, the oral care regimen may fail to achieve the intended outcomes [10]. A multitude of factors have been identified as contributing to variations in maternal oral care practices and attitudes. These include the mother's demographic characteristics, such as age, educational background, occupation and income level [11, 12]. These factors collectively influence a mother's attitudes and knowledge regarding oral care. Despite the widespread availability of fluoride-containing toothpaste, research indicates that many parents lack sufficient knowledge about its fluoride content, including the appropriate amount to use [11, 13–15].

This study aimed to assess mothers' knowledge and practices concerning the fluoride content and appropriate amount of toothpaste used for their children. By comparing their self-reports with the observations of pediatric dentists, the study sought to identify potential knowledge gaps and misconceptions related to the use of fluoride toothpaste.

The hypothesis (H1) of this study posits that there is poor agreement between mothers' responses concerning the fluoride content of their children's toothpaste and the pediatric dentist's observations of the actual fluoride content.

2. Material and methods

The design of this cross-sectional study was approved by the University Inonu Research Ethics Committee (ethics approval number: 2023/4799). The aim of the study was to examine the consistency between mothers' reports concerning the fluoride content of the toothpaste used by their children and the pediatric dentist's observations of the actual fluoride content. The power analysis for the study was conducted based on a similar published article [16]. With a 95% confidence level ($1 - \alpha$), 80% test power ($1 - \beta$), and an assumed interobserver agreement value of 0.22, the minimum required sample size for the study was calculated to be 126. To account for potential participant loss, the sample size was increased to 133. Based on the *post hoc* power analysis, the actual power of the test was determined to be 81.98%.

In this study, a written questionnaire was administered to the mothers of 150 child patients who presented to the Department of Pedodontics, Faculty of Dentistry, University of Inonu between February 2023 and May 2023 for examination or treatment. Prior to the commencement of the study, informed consent was obtained from all participants for all study procedures. Ten mothers did not bring their child's toothpaste during the follow-up visit, and seven completed the questionnaire incompletely or incorrectly; therefore, their data were excluded from the analysis. As a result, 133 mothers were included in the final sample.

Inclusion Criteria: The study included mothers of pediatric patients aged 3–12 years who were able to read and write, had at least one child without systemic disease or special needs, and agreed to complete the questionnaire.

Exclusion Criteria: Mothers working in professions such as dentistry, dental assisting or dental hygiene were excluded from the study.

During the preparation of the self-administered survey, existing questions were modified and new items were added. These modifications were based on survey questions that had previously been tested for validity and reliability in other studies [11, 13, 14].

The survey was reviewed by a panel of experts, consisting of three pediatric dentists, one general dentist and one biostatistician, to evaluate its content validity. Based on the experts' recommendations, revisions were made to the survey content, including minor terminology adjustments to improve clarity and comprehensibility. Subsequently, the revised survey was submitted to three additional pediatric dentists for a second round of evaluation. Following their approval, a linguist was consulted to further refine the language of the survey to ensure clarity and ease of understanding.

A test-retest reliability assessment was conducted in the pilot study using Cohen's Kappa coefficient. The survey was administered twice, with a two-week interval, to 15 randomly selected volunteers. The data obtained from this pilot group were not included in the main analysis. No modifications were made to the survey questions based on the pilot results.

The survey consisted of three sections. The first section, comprising six questions, explored sociodemographic characteristics, including the mother's and child's age, the child's gender, the mother's level of education, income level and number of children. The second section, consisting of two questions, recorded the frequency of the child's tooth brushing and the mother's knowledge regarding the toothpaste used by her child. Mothers were instructed to bring the toothpaste used by their children to the clinic during their second visit. The four questions in the third section of the survey were evaluated and recorded by the pediatric dentist based on the mothers' responses in the second section and the toothpaste they brought to the clinic. In this section, mothers were asked to select a toothbrush from those available in the clinic that resembled the one their child used at home and to practically demonstrate the amount of toothpaste their child should use during each brushing session. The fluoride content of the toothpaste was evaluated by a single pediatric dentist who had been calibrated according to the recommendations of the International Association of Paediatric Dentistry (IAPD) [17] and the European Academy of Paediatric Dentistry (EAPD) [18]. The evaluation aimed to determine the appropriate amount of toothpaste for children of different ages to use during tooth brushing. Following the examination of the children's toothpaste, the pediatric dentist provided the mothers with information on appropriate toothpaste options for their children.

All data were recorded and analyzed using IBM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, NY, USA). In the analysis, participants' demographic characteristics and responses to selected questions were evaluated and presented as percentages and frequencies. To assess the relationships between categorical variables, the Chi-Square Test of Independence was used. When one or both variables contained more than two categories, Pearson's Chi-Square values were applied. If more than 20% of the cells in the contingency table had expected values less than 5, Fisher's Exact Test was used. The McNemar test was employed to evaluate differences between repeated or paired measurements. All results were assessed within a 95% confidence interval, and a p-value of < 0.05 was considered statistically significant.

3. Results

The mean ages of the 133 mothers and their children were 36.4 ± 5.33 years and 8.26 ± 2.23 years, respectively. The majority of participants (57.1%) were over 35 years of age. Analysis of the educational background showed that 30.0% of the mothers had completed primary school, and 48.1% reported low income levels. Most participants were mothers with two children. A summary of the sociodemographic characteristics of the mothers and children is provided in Table 1.

The study found that 55.6% of the children engaged in at least one daily dental hygiene practice. All children had access to toothpaste. A significant proportion of mothers (53.4%) reported being uncertain about the fluoride content of the toothpaste their children were currently using (Table 2).

At the second visit to the dental clinic, mothers presented the toothpastes used by their children for evaluation by a single pediatric dentist. Analysis of the toothpastes revealed that 91% contained fluoride. According to the pediatric dentist, 61.7% of the children were using toothpaste with an age-appropriate fluoride concentration. However, the fluoride concentration in the toothpaste used by 21.8% of the children was deemed

TABLE 1. Sociodemographic status of the parents/children.

Questions	Answers	n	%
Mother's Age (yr)			
	25–30	20	15.0
	30–35	37	27.8
	35+	76	57.1
Mother's Education level			
	Primary school	40	30.1
	Middle school	24	18.0
	High school	37	27.8
	University	32	24.1
Family income			
	Low	64	48.1
	Medium	35	26.3
	High	34	25.6
Number of children			
	1	15	11.3
	2	55	41.4
	3	41	30.8
	4+	22	16.5
Child's gender			
	Girl	72	54.1
	Boy	61	45.9
Child's age (yr)			
	3–5	27	20.3
	6–8	50	37.6
	9–12	56	42.1

TABLE 2. Mother's answers about their child toothpaste.

Questions	Answers	n (%)
How many times a day does your child brush their teeth?		
	Twice a day or more	45 (33.8)
	Once a day	74 (55.6)
	Rarely	14 (10.5)
	None	0 (0.0)
Does the toothpaste your child uses contain fluoride?		
	Yes	37 (27.8)
	No	25 (18.8)
	I don't know	71 (53.4)

insufficient for their age, while 7.5% were using toothpaste with an excessively high fluoride concentration (Table 3).

The study results indicated that 32.3% of the surveyed mothers accurately identified the fluoride content of their children's toothpaste. Additionally, 58.7% demonstrated the appropriate amount of toothpaste to be used by their child, as observed by the pediatric dentist during the evaluation (Table 4).

To compare the reports of mothers and pediatric dentists regarding whether the toothpaste contained fluoride, consistency was assessed after excluding the responses of mothers who answered "I don't know".

According to Table 5, the comparison between mothers' reports and the pediatric dentist's observations regarding whether the toothpaste contained fluoride revealed a statistically significant consistency ($p < 0.05$). The p-value obtained from Cohen's Kappa analysis was 0.004, and the Cohen's Kappa coefficient was 0.284, indicating a statistically significant but weak agreement between the evaluations of the mothers and the pediatric dentist regarding the fluoride content of the children's toothpaste.

No statistically significant difference was found between the accuracy of mothers' responses regarding the fluoride content of their children's toothpaste and the mothers' level of education, income or number of children (**Supplementary Table 1**). No statistically significant difference was observed between the accuracy of mothers in determining the amount of toothpaste used by their children and the mothers' level of education, income or number of children (**Supplementary Table 2**).

4. Discussion

Recent studies have demonstrated that mothers play a pivotal role in fostering the development of essential oral and dental health habits in children. Given children's limited decision-making and critical thinking capacities, the knowledge, attitudes and behaviors of their primary caregivers—particularly mothers—regarding oral health have been identified as influential factors in the prevention and progression of dental health conditions in children [19]. A study on oral and dental health compared the positive effects of mothers' and fathers' education levels. The findings indicated that the father's education did not have a statistically significant impact on the child's oral health, whereas the mother was identified as the primary influence on the child's oral health [20]. Consequently, initiatives aimed at enhancing maternal knowledge and modifying detrimental behaviors may be effective in improving children's dental health.

The most commonly employed methodology for evaluating health conditions is the analysis of patient self-reports and survey data [14, 21]. However, parental responses to questionnaires are often subject to bias, particularly when parents attempt to present themselves as attentive to their children's health or when they fail to recall relevant information accurately. Therefore, it is essential to verify the consistency of responses provided by patients or parents in practical settings. In this study, mothers' reports regarding the fluoride content of their children's toothpaste were compared with the data obtained from the pediatric dentist's examination of the actual

TABLE 3. Pediatric dentist's comments about children's toothpaste.

Questions	Answers	n (%)
Does the children's toothpaste that mothers bring with them contain fluoride?		
	Yes	121 (91.0)
	No	12 (9.0)
Is the amount of fluoride in the toothpaste used by the child appropriate for his/her age?		
	Yes	82 (61.7)
	No	51 (38.3)
The reason why the amount of fluoride in the child's toothpaste is not appropriate		
	Fluoride-free	12 (9.0)
	Low fluoride content	29 (21.8)
	High fluoride content	10 (7.5)
	Appropriate	82 (61.7)
Fluoride content in children's toothpastes		
	Less than 1000 ppm and equel	29 (21.8)
	More than 1000 ppm	92 (69.2)
	Fluoride-free	12 (9.0)

TABLE 4. Pediatric dentist's evaluation of mothers' responses about children's toothpaste.

Questions	Answers	n (%)
Did the mother know the correct amount of paste her child "should use"?		
	Correct	78 (58.7)
	Wrong	55 (41.4)
The amount of toothpaste a mother should use for her child		
	Sufficient	78 (58.7)
	Less	31 (23.3)
	More	24 (18.1)
Does the mother know whether her child's toothpaste contains fluoride?		
	Correct	43 (32.3)
	Wrong	19 (14.3)
	Does not know	71 (53.4)

TABLE 5. Comparison of mothers' reports of fluoride in their child's toothpaste with pediatric dentists' observations of fluoride in their child's toothpaste.

	Pediatric dentists' observations of fluoride in their child's toothpaste						
	Yes		No		*p* value	Agreement %	K (SE)
	n	%	n	%			
Mothers' reports of fluoride in their child's toothpaste							
Yes	36	97.3	1	2.7			
No	18	72.0	7	28.0	0.001*	69.4	0.284 (0.103)
Total	54	87.1	8	12.9			

*SE: Standard Error. McNemar Test. $p < 0.05$. *Statistically significant.*

fluoride content in the toothpaste.

The IAPD and EAPD guidelines recommend that children brush their teeth twice daily using an appropriate dental hygiene product [17, 18]. In this study, more than half of the children (55.6%) reported brushing their teeth once daily. Fluoride, a common component in many toothpastes, has been shown to prevent the development of dental caries. The IAPD guidelines refer to "toothpaste appropriate for the child's age" when specifying suitable products. In contrast, the EAPD guidelines recommend toothpastes containing 1000 ppm fluoride for children aged 0–2 and 2–6 years, and 1450 ppm for those aged 6 years and older. According to the IAPD, this represents the optimum fluoride concentration [17, 18]. A systematic review of the literature concluded that the use of fluoridated toothpaste is an effective method for preventing dental caries in children under six years of age [22].

Ilisulu *et al*. [13] and Dagon *et al*. [23] reported that 18% and 29.2% of mothers of children under four years of age, respectively, accurately identified the fluoride content in their children's age-appropriate toothpaste [13].

A study conducted with parents of children aged 1–17 years found that 89.4% reported their children's toothpaste contained fluoride. Additionally, 64.2% indicated that they specifically used toothpaste formulated for children. However, only 0.8% were able to report the fluoride concentration in the toothpaste used [21].

The design of these studies suggests that mothers' survey responses may not be entirely reliable and may not accurately reflect the fluoride content of the toothpaste used by their children. To reduce response bias, mothers in the present study were asked about the fluoride content of their children's toothpaste, which was subsequently verified by a pediatric dentist. While 27.8% of mothers reported that their children's toothpaste contained fluoride, 91% of the toothpastes examined by the pediatric dentist were found to include fluoride. Among these, 61.7% contained fluoride at levels appropriate for children. The pediatric dentist further identified that 21.8% of the toothpastes had fluoride concentrations below the recommended level, while 7.5% exceeded the recommended level.

The results demonstrated a statistically significant poor agreement between the assessments of mothers and pediatric dentists concerning whether children's toothpastes contained fluoride. This finding suggests that the mothers' reports regarding the fluoride content of the toothpaste used by their children may not have accurately reflected the actual content.

The precise dosage of fluoride administered during each application is of paramount importance, as it is essential to ensure optimal efficacy in preventing caries while simultaneously minimizing the risk of excessive ingestion associated with tooth brushing [23]. Current recommendations from the EAPD specify the following as appropriate amounts of toothpaste for children: from the eruption of the first tooth to two years of age, an amount equivalent to the size of a grain of rice; for children aged two to six years, an amount the size of a pea; and for those aged six years and above, an amount covering the full length of the toothbrush [6]. In the study conducted by Ilisulu *et al*. [13], 50.8% of the surveyed mothers correctly identified the recommended amount of toothpaste for their children. Similarly, in the study by Dagon *et al*. [23], 74.0% of mothers accurately reported the recommended amount. However, in these studies, parents were not asked to demonstrate the amount of toothpaste applied to the toothbrush. A subsequent investigation found that only 18.5% of children aged two to six, or their parents, applied a pea-sized amount of toothpaste. Survey findings further indicated that 4.4% of children under six years of age used an excessive amount of toothpaste during brushing [21]. In a study involving preschool children, 43.7% of parents reported applying a pea-sized amount of toothpaste [10]. In a separate study, parents of children aged 3 to 6 years from three different countries were asked a series of questions regarding the recommended amount of toothpaste for their children. They were also requested to demonstrate the actual amount of toothpaste they applied to their children's toothbrushes. The study found that parents across all three countries tended to use more toothpaste than recommended [24]. In this study, the amount of toothpaste used by the children was applied to the toothbrush by their mothers and was observed and recorded by the pediatric dentist. The findings revealed that 58.7% of the mothers correctly applied an appropriate amount of toothpaste for their children, a rate consistent with the existing literature. These results indicate that more than half of the parents lack sufficient knowledge regarding the appropriate amount of toothpaste to use when brushing their children's teeth. It is important to note that inadequate fluoride intake may result in suboptimal oral and dental health in children, while excessive fluoride intake—particularly among young children who have not yet developed an effective expectoration reflex—may lead to fluoride ingestion and increase the risk of fluoride toxicity [25]. Therefore, it is essential to educate parents on the appropriate amount of toothpaste to be used when brushing their children's teeth.

An examination of findings from studies in the literature reveals that parents tend to report healthier behaviors in response to survey questions, potentially reflecting a social desirability bias [11, 14, 21]. In such studies, parents—particularly mothers—may experience confusion regarding their own behaviors and beliefs. In families with multiple children, mothers may also inadvertently conflate information pertaining to different children. These issues can similarly arise in epidemiological studies, potentially affecting the accuracy of self-reported data [26].

Numerous studies have been conducted to explore parents' perspectives on fluoride [6, 11, 13, 27]. In this study, the fluoride content of the toothpastes used by parents for their children was investigated. To minimize social desirability bias, mothers were asked a single neutral question in the survey: "Does the toothpaste you use for your child contain fluoride"? As in similar studies, this study did not assess whether mothers' preferences for fluoride-containing toothpaste were associated with their level of education, income or number of children. In line with the study's objective, the mothers' responses were compared with those of the pediatric dentist, and the potential relationship between these results and maternal education level, income and number of children was examined. No statistically significant association was found ($p > 0.05$).

The objective of this study was to evaluate pediatric dentists' observations of the toothpastes used by children, independent

of the responses provided by their mothers. It is recommended that pediatric dentists routinely inquire about the toothpaste used by parents for their children and provide appropriate guidance on this issue.

5. Limitations

This study has several limitations. First, as in similar research, mothers' responses may have been influenced by social desirability bias, leading them to provide socially acceptable answers rather than accurately reflecting their actual beliefs or practices. Additionally, the cross-sectional design limits the ability to draw causal inferences, and the study's regional focus restricts the generalizability of the findings to the broader population. Furthermore, the study did not account for potential confounding factors such as maternal oral health literacy, cultural influences or previous dental education.

The primary strength of this study lies in the comparison of mothers' self-reported responses with their observed knowledge and behaviors, as well as the use of neutral language in the survey questions. These two methodological approaches were intended to minimize the influence of social desirability bias among the mothers.

Future studies could be conducted with larger populations using methodologies specifically designed to minimize or eliminate social desirability bias, such as anonymous online surveys incorporating indirect questioning techniques.

6. Conclusions

In conclusion, this study found poor agreement between mothers' reports on the fluoride content of the toothpastes used by their children and the pediatric dentist's observations. These findings highlight the need for dentists, particularly pediatric dentists, to provide parents with accurate information regarding oral and dental health products. It is essential that parents consider this guidance when selecting toothpaste for their children.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during this study are available from the corresponding author upon reasonable request.

AUTHOR CONTRIBUTIONS

ZŞG—designed the methods of the study; prepared the questionnaires and analyzed the data. ZŞG and ŞMY—recruited the sample; organized the ideas and wrote the initial draft; wrote and edited the final version of the manuscript. Both authors revised and verified the last version of the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval for this study was provided by the Non-Interventional Clinical Research Ethics Committee of Inonu University, Turkey (Ethic vote: 2023/4799) and the study was conducted in accordance with all the principles stated in the Declaration of Helsinki. Informed consent was obtained before completing.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

SUPPLEMENTARY MATERIAL

Supplementary material associated with this article can be found, in the online version, at https://oss.jocpd.com/files/article/1985222105812090880/attachment/Supplementary%20material.docx.

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