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Parents' Awareness of the Effects of Iron Supplementation on Tooth Staining and Dental Caries in Pediatric Populations

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ABSTRACT

Objectives: This study aimed to evaluate parents' knowledge and attitudes regarding the effects of iron supplementation on tooth staining and dental caries in children and to examine the influence of demographic factors on knowledge and behaviors.

Materials and Methods: This cross-sectional study was conducted in 2024 with a randomly selected group of 281 parents who visited the Department of Pediatric Dentistry at Inönü University Faculty of Dentistry. Data were collected using a structured 12-question survey consisting of three sections: demographic information, knowledge, and attitudes regarding iron supplementation. Responses were scored as 1 for correct answers and 0 for incorrect answers, with knowledge levels categorized as follows:>66.7% (adequate), 33.7–66.7% (moderate), and <33.7% (inadequate). Statistical analyses were performed using the Chi-square and Fisher's Exact tests, with a significance level set at $p<0.05$.

Results: Among the 140 parents who participated in the study, 49.8% reported using iron supplements for their children; however, only 50.4% adhered to a regular usage schedule. While 47.7% correctly identified the appropriate time to start supplementation, only 16% accurately stated that iron does not cause dental caries, and 35% associated iron supplementation with tooth staining. Although 60.9% of parents had a moderate level of knowledge, adherence to recommended practices was low, with only 16.3% demonstrating high adherence. Significant differences were observed between genders, with mothers displaying higher knowledge levels and adherence than fathers ($p<0.01$). Additionally, parental education level had a positive effect on knowledge and behavior.

Conclusions: This study revealed that parents' misconceptions and lack of knowledge regarding iron supplementation and oral health affect supplement use. Comprehensive educational programs are needed to address these misconceptions and promote proper supplementation practices among parents.

Keywords: iron supplementation, tooth staining, dental caries, parental awareness, pediatric oral health

Ebeveynlerin Çocuklarda Demir Takviyesinin Diş Lekelenmesi ve Çürük Üzerindeki Etkilerine Yönelik Farkındalığı

Araştırma Makalesi

Süreç

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ÖZET

Amaç: Bu çalışmada, ebeveynlerin çocuklarda demir takviyesinin diş lekelenmesi ve çürük üzerindeki etkilerine ilişkin bilgi ve tutumlarının değerlendirilmesi ve demografik faktörlerin bilgi ve davranışlar üzerindeki etkisinin incelenmesi amaçlanmıştır.

Gereç ve Yöntemler: Bu kesitsel çalışma, 2024 yılında İnönü Üniversitesi Diş Hekimliği Fakültesi Pedodonti Anabilim Dalı'na başvuran 281 ebeveyn üzerinde rastgele bir tasarımla gerçekleştirilmiştir. Veriler, demografik bilgiler ile demir takviyesine ilişkin bilgi ve tutumları değerlendiren üç bölümden oluşan 12 soruluk yapılandırılmış bir anket aracılığıyla toplanmıştır. Yanıtlar, doğru için 1, yanlış için 0 puanlanmış ve bilgi düzeyleri;>%66,7 (yeterli), %33,7–66,7 (orta) ve <%33,7 (yetersiz) olarak sınıflandırılmıştır. İstatistiksel analizler Chi-kare ve Fisher's Exact testleri ile gerçekleştirilmiş olup anlamlılık düzeyi $p<0,05$ olarak kabul edilmiştir.

Bulgular: Çalışmaya katılan 140 ebeveynin (%49,8) çocukları için demir takviyesi kullandığı belirlenmiş, ancak bunların yalnızca %50,4'ü düzenli kullanım programına uymuştur. Katılımcıların %47,7'si takviyeye başlanması gereken doğru zamanı bilirken, %16'sı demirin diş çürüğüne neden olmadığını doğru bilmiş ve %35'i demir takviyesini diş lekelenmesiyle ilişkilendirmiştir. Ebeveynlerin %60,9'u orta düzeyde bilgiye sahip olmasına rağmen, önerilen uygulamalara uyum oranı düşüktü ve yalnızca %16,3'ü yüksek uyum göstermiştir. Cinsiyetler arasında anlamlı farklılıklar gözlemlenmiş olup, anneler babalara kıyasla daha yüksek bilgi düzeyi ve uyum göstermiştir ($p<0,01$). Eğitim düzeyinin ebeveynlerin bilgi ve davranışları üzerinde olumlu bir etkisi olduğu belirlenmiştir.

Sonuçlar: Bu çalışma, ebeveynlerin demir takviyesi ve diş sağlığına ilişkin bilgi eksiklikleri ve yanlış inanışlarının takviye kullanımını etkilediğini ortaya koymuştur. Ebeveynlerin demir takviyesi hakkındaki yanlış inanışlarını gidermek ve doğru kullanım alışkanlıklarını teşvik etmek amacıyla kapsamlı eğitim programlarına ihtiyaç duyulmaktadır.

Anahtar Kelimeler: demir takviyesi, diş lekelenmesi, diş çürüğü, ebeveyn bilgisi, pediatrik ağız sağlığı

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Introduction

Dental deformities and discolorations are widely recognized for their negative impact on the psychological well-being of children and adolescents, often leading to a loss of self-confidence in social interactions. The growing emphasis on aesthetics, reinforced by advertisements and societal prioritization of visual appeal, has heightened parental concern regarding their children's appearance and amplified children's self-consciousness about their physical presentation. Different types of tooth discolorations, including those caused by genes, the environment, bacteria, medical conditions, and dental work, are grouped by where they are found and are called either extrinsic or intrinsic.[1,2]

Extrinsic discoloration results from the deposition of substances on the tooth surface or within the acquired pellicle. These compounds can impart stains either through their inherent coloration or via chemical reactions occurring on the tooth surface. Conversely, intrinsic discolorations arise from the incorporation of pigmented substances into the tooth structure during its development. Such intrinsic staining is associated with systemic or local factors. Conditions like phenylketonuria, porphyria, erythroblastosis fetalis, thalassemia, amelogenesis imperfecta, dentinogenesis imperfecta, fluorosis, age-related discoloration, and tetracycline staining are examples of systemic factors. Local factors, on the other hand, are mostly trauma and pulp necrosis.[1,3]

One of the most frequent concerns prompting parents to seek clinical consultation is the black discoloration of deciduous teeth. Interestingly, this happens a lot when kids take iron supplements because chromogenic bacteria become more active when iron is present. This makes the discolorations more common in those kids.[4]

Iron deficiency (ID) and iron deficiency anemia (IDA) are significant public health concerns in developing countries. The prevalence of IDA in a region is directly associated with the socioeconomic and cultural structure, as well as the development level of that region. [5] Turkey, as a developing country, exhibits notably high anemia rates, whereas this prevalence is considerably lower in developed countries. Iron deficiency is particularly common among individuals with chronic diseases and women of childbearing age, especially during periods of rapid growth, such as infancy. In communities with low socioeconomic status, malnutrition and infections are the primary factors contributing to an increased risk of anemia.[6]

Pediatricians in Turkey frequently recommend iron supplementation at an early age to address this issue and prevent iron deficiency.[7] These supplements are commonly prescribed in syrup or drop form. However, one of the most prevalent challenges associated with iron supplements, aside from their unpleasant taste, is their tendency to cause black stains on teeth following consumption. This staining is particularly pronounced on hypomineralized or calcium-deficient tooth surfaces. It is thought that the staining is caused by an insoluble ferric compound (like ferric sulfide) that is made when bacteria produce hydrogen sulfide and interact with Fe ions or parts of gingival fluid.[8]

Some parents mistakenly believe that iron supplements contribute to tooth decay, leading them to refuse their use in children.[9] However, research indicates that iron supplements do not cause tooth decay; rather, they may play a role in preventing enamel demineralization.[10-12]

The aim of this study was to assess the knowledge and attitudes of parents regarding the effects of iron supplementation on tooth staining and dental caries in children.

Materials and Methods

This randomized, cross-sectional study was conducted in 2024 among the parents of 281 children who visited the Department of Pediatric Dentistry at the Faculty of Dentistry, Inönü University. Ethics approval for the study was obtained from the Inönü University Non-Interventional Clinical Research Ethics Committee (Decision Number: 2024/6729).

Participants were asked to complete a structured questionnaire consisting of 12 questions, divided into three sections. The first section collected demographic information, including the parents' age, education level, employment status, and gender. The second and third sections focused on evaluating parents' knowledge and attitudes regarding the effects of iron supplementation on dental caries and tooth staining in children *(Table 1).* [13]

Responses were scored as 1 for correct answers and 0 for incorrect answers. Based on the percentages of correct answers, knowledge levels were categorized as follows:>66.7% (Adequate), 33.7–66.7% (Fair), and <33.7% (Poor). The reliability of the questionnaire was assessed using the Cronbach's Alpha method, following a pilot distribution of the questionnaire to 20 parents.

Before participation, all parents were provided with detailed information about the study and asked to sign informed consent forms. The questionnaires were completed in a quiet and distraction-free environment to ensure the accuracy and reliability of responses.

Statistical Method

The data were analyzed using IBM SPSS Statistics 25.0. Chi-square and Fisher's Exact tests were employed to compare categorical variables across groups. Categorical data were presented as frequencies and percentages. A significance level of $p < 0.05$ was considered for all statistical analyses. Knowledge and behavior scores were calculated based on the total responses, and statistical evaluations were conducted accordingly.

Table 1: Survey questions

Category	Questions/Options
Parent Information	
Parent's Role	☐ Mother ☐ Father
Age Group	☐ 18–24 ☐ 25–34 ☐ 35–54 ☐ 55 and over
Education Level	☐ None ☐ Primary School ☐ Secondary School ☐ High School ☐ University and above
Employment Status	☐ Working ☐ Not working
Iron Supplement Use	
Did/do you use iron supplements for your child?	☐ Yes ☐ No ☐ Don't remember
If yes, how frequently did/do you use it?	☐ Every day regularly ☐ Several times a week ☐ Several times a month
Should iron supplements be used 4 months after birth?	☐ Yes ☐ No ☐ Don't know
Does iron supplementation cause tooth decay?	☐ Yes ☐ No ☐ Don't know
Does iron supplementation cause tooth staining?	☐ Yes ☐ No ☐ Don't know
Administration of Iron Supplements	
Do you combine iron supplements with water or juice?	☐ Yes ☐ No
Do you use iron supplements after brushing your child's teeth?	☐ Yes ☐ No
Which part of your child's mouth do you use iron supplements for?	☐ I drip it from the front of the mouth ☐ I try to drip it in the back of the mouth ☐ I do not pay attention

Results

A total of 140 participants (49.8%) reported using iron supplements for their children. Among these, 50.4% adhered to a regular usage interval, while the remaining participants administered supplements inconsistently. Regarding the recommended timing of iron supplementation, 47.7% of parents correctly identified that it should begin at four months of age, indicating a partial awareness but also highlighting the need for further education. When evaluating parental perceptions of iron supplementation and its effects on oral health, only 16% of participants correctly recognized that iron does not cause dental caries, while 35% acknowledged its role in tooth staining. Furthermore, 25.3% of parents reported mixing iron supplements with water or fruit juice, whereas 89.3% administered them after brushing their child's teeth. Only 19.6% applied the supplement toward the back of the mouth, a recommended practice to minimize staining (*Table 2).*

Parental knowledge about iron supplementation was categorized into three levels: low, moderate, and high. Among participants, 60.9% demonstrated a moderate level of knowledge, 29.2% exhibited a high level, and 10% had low knowledge. Similarly, parental behaviors related to iron supplementation followed the same pattern, with 79.0% displaying moderate behavior, 16.3% high behavior, and 4.6% low behavior *(Table 3).*

A statistically significant difference was found between mothers and fathers in terms of knowledge levels. Among mothers, 59.0% had a moderate level of knowledge, 32.9% had a high level, and 8.1% had a low level. In contrast, 66.2% of fathers exhibited moderate knowledge, 18.3% had high knowledge, and 15.5% had low knowledge.

Similarly, parental behavior levels also showed significant differences *($p<0.01$) (Table 4).* Among mothers, 73.8% exhibited moderate behavior, 21.0% high behavior, and 5.2% low behavior. In comparison, 94.4% of fathers demonstrated moderate behavior, while only 2.8% exhibited high behavior and another 2.8% showed low behavior.

Table 2: Distribution of parents' answers about iron supplements for their children

Survey Questions	Correct Answers (n/%)
Did/do you use iron supplements for your child?	140 (49.8%)
If yes, in which range did/do you use it?	65 (50.4%)
Should iron supplements be used 4 months after birth?	134 (47.7%)
Does iron supplementation cause tooth decay?	45 (16.0%)
Does iron supplementation cause tooth staining?	101 (35.0%)
Do you combine iron supplements with water or juice?	71 (25.3%)
Do you use iron supplements after your child brushes their teeth?	251 (89.3%)
In which part of your child's mouth do you use iron supplements?	55 (19.6%)

* Frequency distributions of correct answers given by parents to knowledge and behavior questions

Table 3: Distribution of parental knowledge and behavior levels about iron supplementation for their children

	Level of knowledge		Level of behavior	
	N	***%***	***N***	***%***
Poor	28	10.0	13	4,6
Moderate	171	60.9	222	79.0
Sufficient	82	29.2	46	16,3
Total	281	100.0	281	100.0

Table 4: Comparison of knowledge and behaviors of parents

Category	Low (N/%)	Middle (N/%)	High (N/%)	Chi-Square	p-value
Knowledge					
Mother	17 (8.1%)	124 (59.0%)	69 (32.9%)	7.208	***0.027***
Father	11 (15.5%)	47 (66.2%)	13 (18.3%)		
Behavior					
Mother	11 (5.2%)	155 (73.8%)	44 (21.0%)	14.171	***0.001***
Father	2 (2.8%)	67 (94.4%)	2 (2.8%)		

Discussion

This study assessed parents' knowledge and behaviors regarding iron supplementation in children, focusing on common misconceptions and knowledge gaps. The findings indicate that 49.8% of parents used iron supplements for their children, but only 50.4% adhered to a regular usage schedule. This inconsistency highlights the need for more structured education on supplement administration and adherence to recommended guidelines.

Regarding the initiation of iron supplementation, 47.7% of parents correctly identified that it should begin at four months of age. However, more than half of the participants either had incorrect information or were unaware of the correct initiation period. These findings emphasize the necessity of raising parental awareness on this issue.

When evaluating parental concerns about the effects of iron supplementation on oral health, only 16% correctly recognized that iron does not cause dental caries, while 35% associated iron supplementation with tooth staining. These results suggest that misconceptions about iron and oral health may lead to a decline in supplement use. Talebi et al., reported a similar observation, finding that parental misconceptions significantly restricted iron supplement use.[14]

Contrary to these misconceptions, extensive research highlights the protective effects of iron on enamel health. The results show that iron ions stop demineralization and help build a protective enamel layer, which makes teeth more resistant to acid.[10-12,15,16] However, many parents mistakenly believe that iron causes cavities, contradicting scientific findings and potentially leading to unnecessary discontinuation of supplementation.

Behavioral findings also reveal improper administration practices. Only 25.3% of parents combined iron supplements with water or fruit juice, a method known to reduce staining. Additionally, 89.3% administered supplements after brushing their child's teeth, which may increase the risk of discoloration. Furthermore, only 19.6% of parents applied the supplement toward the back of the mouth, an effective technique for minimizing staining.[17] These results highlight the need for better parental guidance on the proper administration of iron supplements.

Contrary to parental concerns, previous studies suggest that iron supplementation may have a protective effect against dental caries. Miguel et al. reported that the combination of iron and fluoride reduces the incidence of caries.[12] Similarly, Rezende et al., conducted a meta-analysis and found that people whose teeth turned black from taking iron supplements had a lower incidence of cavities. This was probably because iron makes teeth stronger.[18] However, a study conducted in 2015 reported that iron and multivitamin supplements could also have negative effects on tooth enamel.[13] In particular, iron and multivitamin drops with low pH levels have been suggested to reduce enamel surface hardness, leading to erosion. These findings indicate that iron supplements may have a dual effect on enamel health. While they can play a protective role against caries formation, low-pH formulations may contribute to enamel softening, increasing the risk of erosion. Therefore, special attention should be given to oral hygiene when using iron and multivitamin drops, and preventive measures such as rinsing the mouth with water after consumption or using a straw are recommended.

When analyzing parental knowledge and behavior levels, 60.9% demonstrated a moderate level of knowledge, while 29.2% had high knowledge. However, behavioral adherence was lower, with only 16.3% of parents exhibiting high adherence and 4.6% demonstrating weak compliance.[19] These findings indicate that while parents generally understand the importance of iron supplementation, they often struggle with proper administration.

Statistically significant gender-based differences were observed in both knowledge and behavior. Among mothers, 59.0% had moderate knowledge, 32.9% had high knowledge, and 8.1% had low knowledge. In contrast, 66.2% of fathers exhibited moderate knowledge, 18.3% had high knowledge, and 15.5% had low knowledge. Previous studies indicate that mothers are typically more involved in child healthcare than fathers, suggesting that increasing fathers' participation in pediatric health education could help reduce this knowledge gap.[10-12,15]

Similarly, behavioral adherence also differed significantly between mothers and fathers (*$p<0.01$).* Among mothers, 73.8% exhibited moderate behavior, 21.0% high behavior, and 5.2% low behavior. In contrast, 94.4% of fathers demonstrated moderate behavior, while only 2.8% exhibited high behavior and another 2.8% showed low behavior. These findings suggest that mothers are more likely to follow recommended practices for iron supplementation, highlighting the need for

targeted educational programs for fathers. Demographic factors also influenced knowledge and behavior. No significant differences were observed based on maternal employment status. However, working parents generally displayed more informed attitudes and behaviors, likely due to increased exposure to health-related information. Also, parents with higher levels of education were significantly more knowledgeable about and consistent with supplementation practices. Parents with lower levels of education, on the other hand, were less sure about how to use supplements correctly. These findings align with previous research highlighting the positive relationship between parental education and health-related behaviors.[19] Similarly, studies on general oral hygiene habits have also demonstrated the decisive role of education level in oral health. For example, Karaaslan et al. reported that individuals with lower education levels had a lower frequency of tooth brushing and a significantly lower rate of regular dental visits. In our study, it was also observed that as parental education levels increased, their knowledge of iron supplementation and correct application rates improved. These findings highlight the impact of parental education not only on general oral health habits but also on children's use of iron supplements.[20] A similar finding was reported in a study by Demircan et al., which indicated that parents lacked sufficient knowledge regarding the impact of oral habits on malocclusions. That study also found a significant correlation between the level of education and the level of knowledge. In our study, when evaluating parents' knowledge and behaviors concerning iron supplementation, similar gaps in knowledge were identified, highlighting the necessity of parental education.[21]

A study conducted by Onur et al., which investigated risk factors for caries prevalence among children in Turkey, found a significant association between parental education level and the development of caries in children—a result consistent with our study findings.[22] These results emphasize the crucial role of parental education in improving knowledge, attitudes, and behaviors regarding both iron supplementation and pediatric oral health.

Conclusions

This study highlights the need for targeted parental education programs that address misconceptions about iron supplementation, ensure proper administration practices, and promote adherence to recommended guidelines. Future research should focus on assessing the long-term impact of structured educational interventions on parental knowledge and behavior, as well as children's overall oral and systemic health outcomes.

Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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