Turk J Tob Control 2025;5(2):73-81
DOI: 10.12345/TJTC.2025.21

Research Article / Araştırma Makalesi

The relationship between oral health status and passive smoking and related factors in children aged 3–10 years

3-10 yaş arası çocuklarda ağız ve diş sağlığı durumu ile pasif sigara içiciliği ve ilişkili faktörler arasındaki ilişki

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ABSTRACT

Background: Passive smoking, or exposure to environmental tobacco smoke, remains a significant public health concern worldwide, particularly affecting children's systemic and oral health. Previous research has identified associations between passive smoking and increased dental caries risk, but local evidence integrating clinical and behavioral factors in Türkiye is limited. This study aimed to evaluate the relationship between passive smoking and oral health outcomes in children aged 3–10 years considering sociodemographic characteristics, oral hygiene behaviors, and fluoride use.

Methods: A descriptive cross-sectional study was conducted with 136 children attending the Department of Pediatric Dentistry, Gülhane Faculty of Dentistry, University of Health Sciences. The case group included children with smoking parents (n=72) and the control group children with non-smoking parents (n=72). Data were collected via structured parental questionnaires on demographics, smoking habits, and oral health-related behaviors, alongside clinical examinations assessing the decayed, missing, and filled teeth (DMFT/dmft), pulpal involvement, ulceration, fistula, abscess (PUFA/pufa), and Simplified Oral Hygiene Index (OHI-S) indices. Statistical analyses included Pearson's chi-square test, Fisher's exact test, Student's t-test, Mann–Whitney U test, and logistic regression to determine factors associated with high dmft scores ($p<0.05$).

Results: Children of smoking parents were 3.56 times more likely to have high dmft scores than those of non-smoking parents ($p=0.011$). High dmft prevalence was also associated with younger parental age (<40 years; OR=2.78, $p=0.025$), low toothbrushing frequency (never vs. twice daily; OR=6.68, $p=0.053$), and frequent sugar/chocolate consumption (several times/day vs. ≤once/week; OR=4.06, $p=0.012$). Protective factors included parental knowledge about fluoride ($p<0.001$), use of fluoride-containing toothpaste ($p=0.007$), and professional

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Received / Geliş tarihi: 09.07.2025 **Accepted / Kabul tarihi:** 31.08.2025 **Published / Yayın tarihi:** 04.09.2025

fluoride applications (p=0.042). No significant association was found between dmft levels and smoking in the child's immediate presence or in the car.

Conclusions: Passive smoking is strongly associated with increased dental caries prevalence among children aged 3–10 years. Modifiable behaviors—such as improving oral hygiene, reducing sugar intake, and promoting fluoride use—can mitigate the adverse impact of tobacco smoke exposure. These findings underscore the need for integrated public health interventions combining tobacco control with oral health promotion strategies targeting parents and caregivers.

Keywords: passive smoking, dental caries, oral health, fluoride, pediatric dentistry, Türkiye

ÖZ

Arka Plan: Pasif içicilik ya da çevresel tütün dumanına maruz kalma, özellikle çocukların genel sağlık ve ağız-diş sağlığını etkileyen önemli bir küresel halk sağlığı sorunu olmaya devam etmektedir. Önceki araştırmalar, pasif içicilik ile artmış diş çürüğü riski arasında ilişki olduğunu ortaya koymuştur, ancak Türkiye'de klinik ve davranışsal faktörleri birlikte ele alan yerel kanıtlar sınırlıdır. Bu çalışmanın amacı, 3–10 yaş arası çocuklarda pasif içicilik ile ağız ve diş sağlığı sonuçları arasındaki ilişkiyi; sosyodemografik özellikler, ağız hijyeni davranışları ve florür kullanımı göz önünde bulundurularak değerlendirmektir.

Yöntemler: Tanımlayıcı kesitsel tipte bu çalışma, Sağlık Bilimleri Üniversitesi Gülhane Diş Hekimliği Fakültesi Çocuk Diş Hekimliği Anabilim Dalı'na başvuran 136 çocuk ile yürütülmüştür. Olgu grubunu sigara içen ebeveynlere sahip çocuklar (n=72), kontrol grubunu ise sigara içmeyen ebeveynlere sahip çocuklar (n=72) oluşturmuştur. Veriler; demografik bilgiler, sigara alışkanlıkları ve ağız-diş sağlığıyla ilişkili davranışlara yönelik yapılandırılmış ebeveyn anketleri ile toplanmış, klinik muayenelerde ise çürük, çekilmiş ve dolgulu dişler (DMFT/dmft), pulpa tutulumu, ülserasyon, fistül, apse (PUFA/pufa) ve Basitleştirilmiş Ağız Hijyeni İndeksi (OHI-S) değerlendirilmiştir. İstatistiksel analizlerde Pearson ki-kare testi, Fisher kesin testi, Student t-testi, Mann–Whitney U testi ve yüksek dmft skorlarıyla ilişkili faktörleri belirlemek için lojistik regresyon kullanılmıştır (p<0,05).

Bulgular: Sigara içen ebeveynlere sahip çocukların, sigara içmeyen ebeveynlere sahip çocuklara kıyasla yüksek dmft skoruna sahip olma olasılığı 3,56 kat daha fazladır (p=0,011). Yüksek dmft prevalansı ayrıca daha genç ebeveyn yaşı (<40 yıl; OR=2,78, p=0,025), düşük fırçalama sıklığı (hiç vs. günde iki kez; OR=6,68, p=0,053) ve sık şeker/çikolata tüketimi (günde birkaç kez vs. ≤haftada bir; OR=4,06, p=0,012) ile ilişkili bulunmuştur. Koruyucu faktörler arasında ebeveynlerin florür hakkında bilgi sahibi olması (p<0,001), florür içeren diş macunu kullanımı (p=0,007) ve profesyonel florür uygulamaları (p=0,042) yer almıştır. Çocuğun doğrudan yanında ya da araç içinde sigara içilmesi ile dmft düzeyleri arasında anlamlı bir ilişki bulunmamıştır.

Sonuçlar: Pasif içicilik, 3–10 yaş arası çocuklarda artmış diş çürüğü prevalansı ile güçlü biçimde ilişkilidir. Ağız hijyeninin iyileştirilmesi, şeker tüketiminin azaltılması ve florür kullanımının teşvik edilmesi gibi değiştirilebilir davranışlar, tütün dumanı maruziyetinin olumsuz etkilerini azaltabilir. Bulgular, ebeveyn ve bakım verenleri hedefleyen tütün kontrolü ile ağız ve diş sağlığı geliştirme stratejilerini birleştiren bütüncül halk sağlığı müdahalelerinin gerekliliğini vurgulamaktadır.

Anahtar Kelimeler: pasif içicilik, diş çürüğü, ağız ve diş sağlığı, florür, çocuk diş hekimliği, Türkiye

Introduction

Passive smoking, also known as exposure to environmental tobacco smoke, is a major public health problem that affects nearly half of children worldwide and has documented negative effects not only on systemic health but also on oral health.[1-3] Numerous studies have shown that children exposed to tobacco smoke are at higher risk for dental problems, particularly dental caries and poor oral hygiene.[3-10]

International evidence supports this association. For example, in Japan, caries prevalence was 35% among children with smoking fathers and exceeded 45% among children with smoking mothers, with maternal smoking increasing the risk of caries 2.3-fold.[4] Similarly, in the United States, deciduous tooth caries was significantly more prevalent among 4–11-year-old children with smoking parents.[8] A comprehensive systematic review and meta-analysis published in 2023 confirmed that 94% of studies reported a significant association between passive smoking and caries prevalence in children.[3]

Several biological mechanisms explain this relationship. Passive smoking has been linked to increased colonization of cariogenic bacteria such as *Streptococcus mutans*, reduced salivary flow, decreased salivary IgA levels, and suppression of local immune responses[10]. These pathways suggest that passive smoking may contribute not only to the initiation of caries but also to its progression and complications.

Similar findings have been reported in Türkiye. Akyüz et al. showed that children exposed to passive smoking had higher decayed, missing, and filled teeth (DMFT/dmft) scores, poorer oral hygiene, and less frequent dental visits.[2] A retrospective study involving 900 Turkish children found that passive smoking was more prevalent in middle-income families and significantly associated with higher DMFT/dmft scores.[9] Another national review emphasized both biological mechanisms and socioeconomic influences, highlighting that passive smoking increases susceptibility to caries in multiple ways.[10]

Dental caries, if untreated, may lead to pulp involvement, abscesses, and systemic complications. Therefore, indices such as pulpal involvement, ulceration, fistula, abscess (PUFA/pufa), which assess clinical consequences of untreated caries, and Simplified Oral Hygiene Index (OHI-S), which objectively evaluates oral hygiene, are important tools in understanding the broader effects of passive smoking on children's oral health.[11,12]

The aim of this study was therefore to investigate the relationship between passive smoking, sociodemographic and behavioral risk factors, and oral health status in Turkish children aged 3–10 years, using DMFT/dmft, PUFA/pufa, and OHI-S indices.

Materials and Methods

Study design and participants

This study was an analytical cross-sectional study conducted to evaluate the oral health status of children aged 3–10 years attending the Department of Pediatric Dentistry at the Gülhane Faculty of Dentistry, University of Health Sciences, and to investigate its association with passive smoking (exposure to environmental tobacco smoke) and related factors. The sample size was calculated using G*Power 3.1 software, with 80% power, an effect size of 0.5, and a 5% margin of error, yielding a minimum sample size of 128 participants. The case group consisted of 64 children with smoking parents, while the control group included 64–76 children with non-smoking parents. Children were categorized into two groups according to their dmft scores: those with values at or above the median were defined as the 'high dmft' group, while those below the median were categorized as the 'low–moderate dmft' group.

Data collection process

Data were collected in two stages after obtaining parental consent:

1. **Questionnaire:** The first part of the questionnaire assessed parents' demographic characteristics (age, education level, socioeconomic status, etc.), smoking habits, and their children's oral health-related behaviors (frequency of tooth brushing, dietary habits, regular dental visits, etc.).

2. **Clinical Examination:** Clinical oral examinations were performed by a trained dentist at the faculty clinic, and the following indices were used for evaluation:

- **DMFT/dmft Index:** A classical epidemiological measure showing the number of decayed, missing, and filled permanent and deciduous teeth.
- **PUFA/pufa Index:** Used to detect complications (pulpal involvement, ulceration, fistula, and abscess) resulting from untreated caries reaching the pulp.
- **OHI-S Index:** Developed by Greene and Vermillion, this index objectively evaluates oral hygiene based on plaque and calculus accumulation.[12]

Ethical approval

The study was approved by Gazi University Ethics Committee (date: 10.07.2025, number: E-77082166-604.01-1283460). Written informed consent was obtained from all parents.

Statistical analysis

Data analysis was performed using SPSS 26.0 (IBM Corp., Armonk, NY, USA). Categorical variables were presented as frequencies and percentages. Pearson's chi-square test and Fisher's exact test were used for comparisons between groups where appropriate. Variables with a p-value below 0.25 in the chi-square analysis, along with those considered appropriate, were incorporated into the multiple logistic regression model. A p-value < 0.05 was considered statistically significant.

Results

A total of 136 children were included in the study. Their sociodemographic characteristics are summarized in Table 1.

As shown in Table 2, several parental sociodemographic factors were significantly associated with children's caries experience.

Table 1. Distribution of parents' sociodemographic characteristics

	n	(%)*
Parental age (n=136)		
18-39	62	45.6
39-49	64	47.1
≥50	10	7.4
Parental gender (n=136)		
Male	36	26.5
Female	100	73.5
Marital status (n=136)		
Married	126	92.6
Single	10	7.4
Education level (n=136)		
Middle school or below	22	16.2
High school	39	28.7
University or above	75	55.1
Employment status (n=136)		
Employed	82	60.3
Retired	6	4.4
Homemaker	46	33.8
Unemployed	2	1.5
Number of children in family (n=136)		
1	26	19.1
2	72	52.9
≥3	38	27.9

* Column percentage

Children of parents younger than 40 years had a markedly higher prevalence of high dmft compared to those of older parents (p = 0.001). Similarly, parental education was an important determinant: children of high school graduates showed significantly higher dmft scores than those of parents with university education (p = 0.004). Employment status also demonstrated a significant effect, with children of non-working parents more likely to present with high dmft than those of working parents (p = 0.009).

Table 3 examined whether dmft frequency differed between children of smoking and non-smoking parents and according to parental smoking behaviors. Only the prevalence of high dmft was significantly higher among children of

Table 2. Evaluation of children's dmft levels according to parents' sociodemographic characteristics

	dmft	
	Low-moderate dmft	**High dmft**
	n (%)*	**n (%)***
Age (n=136)		
<40 years (n=62)	24 (38.7)	38 (61.3)
≥40 years (n=74)	50 (67.6)	24 (32.4)
	x^2 =11.326	**p=0.001****
Education level (n=136)		
Middle school or below (n=22)	16 (72.7)	6 (27.3)
High school (n=39)	13 (33.3)	26 (66.7)
University (n=75)	45 (60.0)	30 (40.0)
	x^2 =10.905	**p=0.004****
Employment status (n=136)		
Employed (n=82)	52 (63.4)	30 (36.6)
Unemployed (n=54)	22 (40.7)	32 (59.3)
	x^2=6.748	**p=0.009****
Number of children (n=136)		
1 child (n=26)	12(46.2)	14 (53.8)
2 children (n=72)	36 (50.0)	36 (50.0)
≥3 (n=38)	26 (68.4)	12 (31.6)
	x^2=4.286	p=0.117**

* Row percentage
** Pearson Chi-square test

Table 3. Evaluation of children's dmft levels according to parents' smoking habits

	dmft	
	Low-moderate dmft	**High dmft**
	n (%)*	**n (%)***
Parental smoking status (n=136)		
Yes (n=68)	26 (38.2)	42 (61.8)
No (n=68)	48 (70.6)	20 (29.4)
	x^2=14.347	**p<0.001****
Smoking in presence of child (n=136)		
Yes (n=16)	8 (50.0)	8 (50.0)
No (n=120)	66 (55.0)	54 (45.0)
	x^2=0.142	p=0.706**
Smoking in car (n=136)		
Yes (n=14)	6 (42.9)	8 (57.1)
No (n=122)	68 (55.7)	54 (44.3)
	x^2=0.840	p=0.359**

* Row percentage
** Pearson Chi-square test

smoking parents (61.8%) compared to children of non-smoking parents (29.4%) (p < 0.001). No other parameters showed significant differences.

Children's oral health behaviors and parental knowledge of fluoride also showed strong associations (Table 4). Toothbrushing frequency was a key protective factor, as children who brushed more frequently had significantly lower dmft levels (p = 0.009). Parental knowledge about fluoride was highly protective (p < 0.001), and children using fluoride-containing toothpaste (p = 0.007) or having received professional fluoride applications (p = 0.042) had significantly lower caries experience.

Multivariable logistic regression analysis confirmed the strongest predictors of high dmft (Table 5). Children of parents younger than 40 years had a 2.8-fold higher risk (p = 0.025), and those with smoking parents had a 3.6-fold higher risk (p = 0.011). Frequent sugar consumption was also a strong predictor, with children consuming sugary products several times a day having a fourfold higher risk compared to those consuming them once a week or less (p = 0.012). Toothbrushing frequency showed a strong protective trend, with children who never brushed having a markedly increased risk compared to regular brushers (p = 0.053).

Discussion

This study evaluated the association between passive smoking and oral health status in children aged 3–10 years, with a particular focus on caries experience (dmft), complication development (PUFA/pufa), and oral hygiene (OHI-S). The findings revealed that factors such as parental smoking habits, parental age, the child's toothbrushing frequency, and dietary habits were significantly associated with high dmft levels in children.

The results indicated that children of smoking parents were approximately 3.5 times more likely

Table 4. Evaluation of children's dmft levels according to parental knowledge about fluoride and children's oral health behaviors

	dmft	
	Low-moderate dmft	**High dmft**
	n (%)*	**n (%)***
Child's daily toothbrushing frequency (n=136)		
None (n=12)	2 (16.7)	10 (83.3)
Once/day (n=58)	30 (51.7)	28 (48.3)
Twice/day (n=66)	42 (63.6)	24 (36.4)
	x^2=9.325	**p=0.009****
Parental knowledge about fluoride (n=136)		
Yes (n=94)	62 (66.0)	32 (34.0)
No (n=42)	12 (28.6)	30 (71.4)
	x^2=16,357	**p<0,001****
Child's use of fluoride-containing toothpaste (n=136)		
Yes (n=74)	48 (64.9)	26 (35.1)
No (n=62)	26 (41.9)	36 (58.1)
	x^2=4.147	**p=0.042****
Child's last dental visit (n=136)		
≤6 months (n=114)	60 (52.6)	54 (47.4)
≥1 year (n=22)	14 (63.6)	8 (36.4)
	x^2=0.900	p=0.343**
Child's frequency of sugary/chocolate consumption (n=136)		
Several times/day (n=66)	32 (48.5)	34 (51.5)
Once/day (n=30)	16 (53.3)	14 (46.7)
≤Once/week (n=40)	26 (65.0)	14 (35.0)
	x^2=2.757	p=0.252**

* Row percentage
** Pearson Chi-square test

to have high dmft compared to children of non-smoking parents. This finding is consistent with those of Hanioka et al.[4] and Dantham et al.[6], who reported that parental smoking significantly increases the risk of childhood caries. Moreover, a systematic review conducted by Uthayakumar et al.[1] found a positive and significant relationship between passive smoking and deciduous tooth caries in 94% of the studies analyzed. These results suggest that exposure to passive tobacco smoke may not only promote the initiation of caries but also accelerate their progression and increase the risk of complications.

In our study, children of parents under 40 years of age had a 2.8-fold higher risk of high dmft compared to those of parents aged 40 years and above. This may indicate that younger parents have less experience in implementing preventive oral health practices or that health-related behaviors within the family may not yet be fully established.

Toothbrushing frequency was strongly associated with caries experience. Children who never brushed their teeth had a 6.7-fold higher risk of high dmft compared to those who brushed twice daily, clearly demonstrating the protective effect of regular brushing. Similarly, children consuming sugary products several times a day had a fourfold higher risk of high dmft compared to those consuming them once a week or less. This finding further supports the key role of dietary habits in caries etiology, aligning with the results of Aligne et al.[8] and Mosharrafian et al.[5], who reported that high sugar consumption, when combined with passive smoking, synergistically increases caries risk.

Fluoride awareness also emerged as an important protective factor. High dmft rates were significantly higher among children whose parents lacked knowledge about fluoride. The use of fluoride-containing toothpaste at home and clinical fluoride applications were also found to reduce caries experience. This finding is in line with numerous randomized controlled trials demonstrating the effectiveness of fluoride products in preventing caries in children.

An important observation from our study was that passive smoking was associated not only with direct exposure (smoking in the presence of the child) but also with general household smoking habits. The lack of statistical significance for variables such as smoking in the car may be

Table 5. Factors associated with high dmft scores in children (including parental sociodemographic and knowledge variables as well as children's oral health behaviors)

		p value	OR	%95 CI
Parental age	<40 years	**0.025**	**2.782**	**(1.139-6.792)**
	≥40 years	Reference		
Education level	High school or below	0.325	0.572	(0.188-1.738)
	University	Reference		
Employment status	Not employed	Reference		
	Employed	0.967	0.976	(0.317-3.011)
Parental smoking status	Smoker	Reference		
	Non-smoker	**0.011**	**3.569**	**(1.339-9.511)**
Child's toothbrushing frequency	None	0.053	6.684	(0.977-45.751)
	Once/day	0.603	1.275	(0.510-3.190)
	Twice/day	Reference		
Frequency of sugary/chocolate consumption	Several times/day	**0.012**	**4.060**	**(1.358-12.137)**
	Once/day	0.204	2.242	(0.644-7.803)
	≤Once/week	Reference		
Knowledge about fluoride	No	Reference		
	Yes	0.097	2.826	(0.828-9.649)
Toothpaste contains fluoride	Yes	Reference		
	No	0.705	1.277	(0.427-3.526)
Fluoride application to child	Yes	Reference		
	No	0.613	1.286	(0.486-3.406)

due to sample size limitations or reporting bias. However, the literature indicates that even short-term exposure to smoke in enclosed environments poses serious health risks due to high particulate concentrations and toxic compound levels.

This study has several limitations that should be considered when interpreting the results. First, its cross-sectional design does not allow the establishment of causal relationships between passive smoking and oral health outcomes. The associations observed indicate correlation rather than causation, and longitudinal studies are needed to confirm whether passive smoking directly contributes to the development and progression of dental caries. Second, information on smoking habits and some behavioral variables was obtained through parental self-report, which may be subject to recall or reporting bias. Finally, while the sample size was adequate, this was not a population-based study, and thus the findings cannot be generalized to broader populations. These limitations should be taken into account, and future research incorporating biomarker-based exposure assessment and multivariable modeling is warranted.

This study, conducted in Ankara, Türkiye, using a cross-sectional design and integrating both clinical examination and questionnaire data, provides a valuable contribution to the limited number of local studies on this subject. However, the cross-sectional design limits the ability to establish causality. Future research could benefit from longitudinal follow-up and biomarker-based exposure assessment to provide stronger evidence.

This study demonstrated that passive smoking is significantly associated with the prevalence of dental caries in children aged 3–10 years. Factors such as parental smoking habits, parental age,

the child's toothbrushing frequency, and sugar consumption frequency were strongly associated with high dmft levels. In contrast, parental knowledge about fluoride, the use of fluoride-containing toothpaste, and regular toothbrushing habits showed a protective effect. The findings highlight that passive smoking should be considered in strategies aimed at protecting and improving children's oral health. Public health interventions such as smoking cessation programs for parents, oral hygiene education, and the promotion of fluoride use may effectively reduce the caries burden in children.

Ethical approval

This study has been approved by the Gazi University (approval date: 10.07.2025, number: E-77082166-604.01-1283460). Written informed consent was obtained from the participants.

Author contribution

Study conception and design: NK, SÖ; data collection: NK, NÇG; analysis and interpretation of results: NK, KSY, SÖ; draft manuscript preparation: NK, NÇG, KSY, SÖ. The authors reviewed the results and approved the final version of the article.

Source of funding

The authors declare the study received no funding.

Conflict of interest

The authors declare that there is no conflict of interest.

Etik kurul onayı

Bu çalışma Gazi Üniversitesi Etik Kurulu tarafından onaylanmıştır (onay tarihi: 10.07.2025, numarası: E-77082166-604.01-1283460). Çalışmaya katılan tüm katılımcılardan yazılı bilgilendirilmiş onam alınmıştır.

Yazarlık katkısı

Çalışma konsepti ve tasarımı: NK, SÖ; veri toplama: NK, NÇG; sonuçların analizi ve yorumlanması: NK, KSY, SÖ; makaleyi hazırlama: NK, NÇG, KSY, SÖ. Yazarlar sonuçları gözden geçirmiş ve makalenin son halini onaylamıştır.

Finansman

Yazarlar, çalışmanın herhangi bir finansal destek almadığını beyan etmiştir.

Çıkar çatışması

Yazarlar herhangi bir çıkar çatışması olmadığını beyan etmiştir.

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