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# Parental perceptions of antibiotic use in pediatric dentistry: a cross-sectional study using the PAPA scale

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## Abstract

**Background** Parental awareness regarding antibiotics might influence pediatric oral health. This study aimed to assess parents' knowledge of antibiotic use and its relationship with their children's oral health.

**Methods** This study included 805 children (ages 3–14 years) and their parents. A face-to-face questionnaire with 45 items was used to assess parental knowledge and attitudes using the PAPA (Parental Perceptions on Antibiotics) scale. Children's oral health was clinically evaluated using DMFT (decayed, missing, and filled teeth) and PUFA (pulpal involvement, ulceration, fistula, and abscess) indices. Statistical analyses included the Mann–Whitney U test, Kruskal–Wallis test, independent samples T-test, Spearman's rank correlation, and negative binomial regression.

**Results** There were significant negative correlations between parents' PAPA scores and their children's decayed teeth, DMFT, pulpal involvement, fistula formation, abscess, and PUFA scores ( $p < 0.05$ ). Children with previous antibiotic use for dental pain had significantly higher missing teeth, DMFT, pulpal involvement, fistula formation, abscess, and PUFA scores ( $p < 0.05$ ). Parents who sought professional care after symptoms in their children had subsided following antibiotic use had higher PAPA scores and better oral health outcomes in their children ( $p < 0.05$ ).

**Conclusions** Increased parental knowledge and positive attitudes toward antibiotic use were associated with improved oral health outcomes in their children.

**Trial registration** The trial protocol was registered under ClinicalTrials.gov (ID: NCT07112079) on August 7, 2025. Retrospectively registered.

**Keywords** Antibiotic, Oral health, Parents, Pediatric dentistry

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## Background

Antibiotics are essential for the management of bacterial infections and are regarded as lifesaving agents, particularly during early life [1]. However, inappropriate prescribing represents a major global threat, contributing to antimicrobial resistance and potentially resulting in serious complications in children, including severe infections, complex medical conditions, and even death [2]. Low-income countries are particularly vulnerable because of limited access to health care and the risk that existing antibiotics may lose their effectiveness, thereby accelerating the development of antimicrobial resistance. In addition, in many countries antibiotics remain available without prescription, which facilitates self-medication and increases the likelihood of inappropriate use, further contributing to antimicrobial resistance [3].

While certain microorganisms can become resistant to only a single antimicrobial drug, some can develop strains resistant to multiple drugs. To reduce the rate of resistance development, health-care professionals should use antibiotics carefully and judiciously [4]. One study highlighted that 80% of antibiotics prescribed before dental procedures are given unnecessarily, even when no risk factors are present [4, 5]. Given the increasing prevalence of antibiotic-resistant microorganisms, the American Academy of Pediatric Dentistry (AAPD) has published a guideline on antibiotic use. This guideline aims to provide clinicians with scientifically-based guidance on the effective and safe use of antibiotics in the management of childhood oral infections [4].

Parents' attitudes and behaviors regarding antibiotic use for their children can be influenced by various factors, such as their level of education, previous illness experiences, and the lack of knowledge on antibiotics [6]. Considering that parents are in a decision-making position regarding the procurement and use of medications on behalf of their children, understanding their preferences regarding antibiotic use is of great importance in determining the reasons for incorrect antibiotic use [7, 8].

There is the need for a valid measurement tool that can assess psychosocial factors related to antibiotic use and allows for the scientific examination of the use of antibiotics and the factors that lead to their unnecessary use. The Parental Perceptions of Antibiotics (PAPA) scale is a measurement tool developed to assess parents' knowledge, attitudes, and perceptions regarding antibiotic use [9]. This scale assesses the factors influencing parents' decisions regarding antibiotic use in their children.

A review of the literature indicated that, although numerous studies have investigated antibiotic use in various medical fields, research evaluating comparable parameters within the context of dentistry remains limited. In particular, few studies have examined parental

knowledge and approaches to antibiotic use in their children. Therefore, this study aimed to assess parents' knowledge and attitudes toward antibiotic use via the PAPA scale and to investigate the effects of these findings on their children's oral health.

## Material and methods

### Ethics approval

This study received approval from the Non-Interventional Clinical Research Ethics Committee of the Faculty of Medicine at Recep Tayyip Erdoğan University (decision no: 2024/181). Parents who voluntarily agreed to participate in the study gave their written informed consent. For participants under the age of 16, informed consent was obtained both from the participants themselves and from their parents or legal guardians.

### Study participants

This cross-sectional study included children aged 3–14 years who presented to the Department of Pedodontics at the Faculty of Dentistry, Recep Tayyip Erdoğan University, between July 2024 and December 2024. The parents of the participants were all literate in Turkish and had no communication problems. Children who presented with a relative other than their parents, had parents whose health status was inadequate to conduct the questionnaire, or children who had any mental illness and or their parents were excluded from the study.

The minimum sample size required for the study was calculated using the Raosoft Sample Size Calculator web-based tool. Based on a 99% confidence interval and an alpha error of 0.05, a minimum of 663 participants were calculated. In anticipation that participants might have completed the questionnaire incompletely, incorrectly, might not have completed it, or withdrawn from the study, a total of 805 participants were included.

### Data collection

Data were collected by a trained clinician (ŞL) by clinical examination and self-reported questionnaire.

### Self-reported data

In the first phase of the study, a face-to-face questionnaire consisting of four sections and 45 items was presented to the parents [9]. The first part of the questionnaire asked five questions about the child's health and sociodemographic characteristics (eg, sex, age, presence of chronic disease, number of children in the family, and frequency of antibiotic use in the past year). Chronic illness was defined as any physician-diagnosed long-term medical condition requiring ongoing monitoring or treatment, such as asthma, diabetes, congenital heart disease, or other chronic systemic disorders reported by the parents. The second part asked for answers to five

questions about the parents' sociodemographic information (eg, sex, age, monthly income and educational level, and if trained in a health-related field). The third section comprised four questions designed to assess the parents' attitudes toward antibiotic use during their children's dental treatment process. The fourth section used the PAPA scale [9]. The first three sections were developed by the research team to obtain descriptive and contextual information, whereas the fourth section comprised the validated PAPA scale.

#### Parental Perceptions on Antibiotics (PAPA) scale

The original instrument, developed by Alumran et al. in 2014 [9], consists of 31 items grouped into five factors. The PAPA scale evaluates parental perceptions regarding antibiotic use across the following sub-dimensions: (1) knowledge and beliefs, (2) behavior, (3) information seeking, (4) adherence, and (5) awareness of antibiotic resistance. Items are scored on a 5-point Likert-type scale ranging from 1 (totally disagree) to 5 (totally agree).

Among the 31 items, four (items 3, 7, 8, and 9) are scored directly, whereas the remaining 27 items are reverse scored. After reverse scoring, the overall PAPA score is calculated by summing responses to all items, yielding a possible range of 31–155. The scale is continuous and has no specific cutoff point; higher scores indicate greater awareness and more appropriate perceptions regarding antibiotic use.

The PAPA scale was originally developed through a structured expert-based process in which candidate items derived from the literature were evaluated using a multi-round Delphi method involving specialists from relevant health and social science disciplines, thereby establishing the content and face validity of the instrument [9].

The Turkish version of the PAPA scale—Anne ve Babaların Antibiyotik Algıları (ABANA) Ölçeği—was validated by Özdemir and Ergin in 2023 [10]. The validation study reported acceptable internal consistency, with a Cronbach's alpha of 0.79. The Turkish version was used in the present study [10], and the full questionnaire is provided in Supplementary File 1.

#### Clinical data

In the second phase of the study, intraoral examinations of the children were performed by a pediatric dentist (ŞL) who had 3 years of clinical experience [11]. For each participating child, decayed (*D*), missing (*M*), and filled (*F*) tooth scores for primary and permanent teeth were recorded individually and as a combined DMFT value based on the criteria outlined by the World Health Organization [11]. Additionally, PUFA scores were calculated to assess the oral health status caused by untreated caries, including pulpal involvement (*P*), ulceration (*U*), fistula formation (*F*<sup>l</sup>) and abscess (*A*) [12]. The assessment

was performed visually, without any instruments, and only one point was assigned to each tooth. PUFA scores were recorded separately from the DMFT score.

#### Pulpal involvement (*P*)

*P* was recorded when the pulp chamber was visibly opened or when the coronal structures were destroyed by caries, leaving only the root or root fragments. No probe was used during this assessment.

#### Ulceration (*U*)

*U* was recorded when the sharp edges of the pulp-involved tooth caused traumatic ulceration of the surrounding soft tissues, such as the tongue or buccal mucosa.

#### Fistula formation (*F*<sup>l</sup>)

*F*<sup>l</sup> was recorded when a sinus tract was connected to a pulp-involved tooth.

#### Abscess (*A*)

*A* was evaluated when swelling was observed related to a pulp-involved tooth. Total *P*, *U*, *F*<sup>l</sup>, *A*, and PUFA scores for the primary and permanent teeth were recorded for each child, and the PUFA score was calculated cumulatively, as with the DMFT [12].

#### Statistical analysis

The data were analyzed using IBM SPSS Statistics 29.0 software. Descriptive data are presented as percentages and number distributions. When parametric test assumptions were met, the T-test was used for independent two-group comparisons. When parametric assumptions were not met, the Mann–Whitney U test was used for paired groups, and the Kruskal–Wallis test was used for more than two groups. The Spearman's rank correlation test was used to establish nonlinear relationships between variables.

Negative binomial regression analyses were conducted using NCSS 11 software (NCSS, LLC, Kaysville, UT, USA). As DMFT and PUFA variables represent count data and may exhibit variance greater than the mean (overdispersion), negative binomial regression models were preferred over Poisson regression. Separate models were constructed for each dependent variable. Model adequacy was assessed using the overdispersion parameter (alpha), and a statistically significant alpha indicated the appropriateness of the negative binomial model. Results were reported as unstandardized beta coefficients ( $\beta^1$ ) with 95% confidence intervals (CIs). Incidence rate ratios (IRRs) and their 95% CIs were obtained by exponentiating the  $\beta$  coefficients ( $IRR = \exp[\beta]$ ). Categorical variables were included in the models using appropriate reference categories. Model fit and comparability were

**Table 1** Sociodemographic characteristics of the study participants

	Variables	n (%)
Children	Sex	
	Female	442 (54.9)
	Male	363 (45.1)
	Chronic illness	
	Yes	99 (12.3)
	No	706 (87.7)
	Antibiotic usage per year	
	Never	155 (19.3)
Parents	Once	261 (32.4)
	Many times	389 (48.3)
	Variables	n (%)
	Sex	
	Female	595 (73.9)
	Male	210 (26.1)
	Educational level	
	Primary or junior high school	269 (33.4)
	High school	304 (37.8)
	Diploma or bachelor degree	232 (28.8)
Trained in a health-related field		
Yes	20 (2.5)	
No	785 (97.5)	
Monthly income level		
Minimum wage and less	270 (33.5)	
Above minimum wage	535 (66.5)	

evaluated using Deviance, Akaike Information Criterion (AIC), and Pseudo R<sup>2</sup> values. A *p* < 0.05 level of significance was considered statistically significant for all analyses.

The researcher (ŞL) repeated the DMFT and PUFA indices assessments 10 days apart and used the Kappa test to assess consistency between the scoring. The analysis yielded a statistically strong agreement between the two measurements (Kappa: 0.820) [13].

**Results**

The study included 805 children and their parents. The mean age of the children was 9.09 ± 2.76 years. The mean age of the parents was 39.47 ± 6.15 years and the mean number of children per family was 2.53 ± 0.95. Sociodemographic data of participants and their parents are presented in Table 1. When comparing the parents' attitudes toward antibiotic use and their average scores on the PAPA scale, no significant difference was found (*p* > 0.05; Table 2). The PAPA scores of parents of children with chronic illnesses (*p* = 0.027) and those who had not used antibiotics within the past year (*p* < 0.001) were significantly higher (Table 3). As parents' level of education increased, PAPA scores also increased significantly (*p* < 0.001). Significant differences were observed between parents who were primary or junior high school graduates and high school graduates (*p* = 0.002), between

**Table 2** The relationship between parents' attitudes toward antibiotic use and their average scores on the PAPA scale

Variables	PAPA score	
	Mean ± SD	Median (min–max)
Has your child ever taken antibiotics for a toothache?		
Yes	113.43 ± 14.9	113 (62–155)
No	113.32 ± 14.57	112 (72–155)
<i>p</i> value	0.702 <sup>1</sup>	
In the case where there is swelling in the gums, can the tooth be extracted or treated without using antibiotics?		
Yes	116.08 ± 18.08	116 (80–155)
No	113.62 ± 13.93	113 (70–155)
I don't know	111.08 ± 15.43	112 (62–149)
<i>p</i> value	0.179 <sup>2</sup>	
If there is a general swelling in the face accompanied by symptoms, such as fever and fatigue, can the relevant tooth be treated or extracted without using antibiotics?		
Yes	111.42 ± 17.67	113.5 (65–148)
No	113.71 ± 14.26	113 (70–155)
I don't know	111.96 ± 15.78	111.5 (62–151)
<i>p</i> value	0.623 <sup>2</sup>	

SD standard deviation, Min minimum, Max maximum, PAPA Parental Perceptions on Antibiotics

*p* < 0.05 was considered statistically significant

<sup>1</sup>Mann–Whitney U test

<sup>2</sup>Kruskal–Wallis test

**Table 3** The relationship between the average scores parents received from the PAPA scale and their children's data

Variables	PAPA score	
	Mean ± SD	Median (min–max)
Does your child have a chronic illness?		
Yes	116.40 ± 14.9	115 (82–155)
No	112.93 ± 14.61	112 (62–155)
<i>p</i> value	<b>0.027<sup>1*</sup></b>	
How many times has your child used antibiotics in the last year?		
Never	117.87 ± 12.90	117 (92–155)
Once	113.40 ± 14.29	113 (62–149)
Many times	111.53 ± 15.24	111 (65–155)
<i>p</i> value	<b>&lt; 0.001<sup>2*</sup></b>	

SD standard deviation, Min minimum, Max maximum, PAPA Parental Perceptions on Antibiotics

\**p* < 0.05 was considered statistically significant

<sup>1</sup>Mann–Whitney U test

<sup>2</sup>Kruskal–Wallis test

primary or junior high school graduates and diploma or bachelor degree graduates ( $p < 0.001$ ), and between high school graduates and diploma or bachelor degree graduates ( $p < 0.001$ ). The PAPA scores of parents who were health-care professionals were significantly higher compared with those who were not ( $p < 0.001$ ). Parents with lower income levels had significantly lower PAPA scores ( $p < 0.001$ ; Table 4). A significant and negative correlation was found between the number of children in the family and the PAPA score ( $r = -0.107, p = 0.002$ ). When the relationship between the parents' PAPA scores and oral health indicators was evaluated, a significant and negative correlation was found between the PAPA score and  $D$  ( $r = -0.149, p < 0.001$ ),  $DMFT$  ( $r = -0.118, p < 0.001$ ),  $P$  ( $r = -0.176, p < 0.001$ ),  $F^I$  ( $r = -0.092, p = 0.009$ ),  $A$  ( $r = -0.089, p = 0.011$ ), and PUFA total score ( $r = -0.195, p < 0.001$ ; Table 5). Children who had used antibiotics due to toothache showed significantly higher values for several oral health indices compared with those who had not. Specifically, missing teeth, DMFT scores, pulpal involvement, fistula formation, abscess, and total PUFA scores were significantly higher in this group (all  $p < 0.05$ ; Table 6). No significant differences were observed for decayed, filled, or ulceration scores.

Children of parents who took their child to the dentist after symptoms subsided following antibiotic use had significantly lower  $D$  ( $p = 0.003$ ),  $P$  ( $p = 0.005$ ), and PUFA ( $p = 0.006$ ) scores, and significantly higher  $F$  ( $p = 0.034$ ) scores compared with those who did not (Table 7). The mean PAPA score ( $114.56 \pm 14.74$ ) was significantly higher for parents who took their children to the dentist ( $108.83 \pm 14.79$ ) than for those who did not ( $p = 0.005$ ).

According to the results of the negative binomial regression analysis, the effects of the independent variables on the DMFT variable were evaluated simultaneously (Table 8). The overdispersion parameter of the model was  $\alpha = 0.306$  and was statistically significant ( $p < 0.001$ ), indicating the presence of overdispersion in the DMFT data and confirming the appropriateness of the negative binomial model. The model fit indices were obtained as Deviance = 531.320, AIC = 4365.601, and Pseudo  $R^2 = 0.061$ . Among the examined variables, the PAPA score showed a negative association with DMFT ( $\beta = -0.004$ ; 95% CI:  $-0.007-0.000$ ;  $p = 0.045$ ). Accordingly, each one-unit increase in the PAPA score was associated with an approximately 0.4% decrease in the expected value of DMFT (IRR = 0.996; 95% CI: 0.993–1.000). Age also showed a statistically significant negative effect on DMFT ( $\beta = -0.032$ ; 95% CI:  $-0.051-0.014$ ;  $p = 0.001$ ). Each one-unit increase in age was associated with an approximately 3.2% decrease in the expected value of DMFT (IRR = 0.968; 95% CI: 0.950–0.986). In contrast, parental age, child's sex, presence of chronic disease, frequency of antibiotic use within the last year,

**Table 4** The relationship between parents' average score on the PAPA scale and their demographic data

Variables	PAPA score	
	Mean $\pm$ SD	Median (min–max)
Sex		
Female	113.16 $\pm$ 14.59	112 (62–155)
Male	113.91 $\pm$ 14.95	112 (70–155)
$p$ value	0.813 <sup>1</sup>	
Educational level		
Primary or junior high school	107.74 $\pm$ 13.92	108 (62–149)
High school	112.25 $\pm$ 12.93	112 (79–151)
Diploma or bachelor degree	121.32 $\pm$ 14.28	122 (73–155)
$p$ value	< 0.001 <sup>2*</sup>	
Trained in a health-related field		
Yes	134.00 $\pm$ 12.91	135 (110–155)
No	112.83 $\pm$ 14.35	112 (62–151)
$p$ value	< 0.001 <sup>1*</sup>	
Monthly income level		
Minimum wage and less	108.48 $\pm$ 14.45	108 (62–148)
Above minimum wage	115.82 $\pm$ 14.18	115 (73–155)
$p$ value	< 0.001 <sup>1*</sup>	

SD standard deviation, Min minimum, Max maximum, PAPA Parental Perceptions on Antibiotics

\* $p < 0.05$  was considered statistically significant

<sup>1</sup>Mann–Whitney U test

<sup>2</sup>Kruskal–Wallis test

**Table 5** The relationship between parents' average scores on the PAPA scale and their children's oral health indices

PAPA score	r	$p$ value
$D$	-0.149	< 0.001*
$M$	-0.058	0.102
$F$	-0.008	0.816
DMFT	-0.118	< 0.001*
$P$	-0.176	< 0.001*
$U$	-0.017	0.635
$F^I$	-0.092	0.009*
$A$	-0.089	0.011*
PUFA	-0.195	< 0.001*

$r$  Spearman's rank correlation coefficient,  $D$  decayed teeth;  $M$  missing teeth;  $F$  filled teeth; DMFT total number of decayed, missing, and filled teeth in primary and permanent dentition;  $P$  pulp involvement;  $U$ : ulceration;  $F^I$  fistula formation;  $A$  abscess; PUFA total number of teeth with pulp involvement, ulceration, fistula formation, or abscess in primary and permanent dentition

\* $p < 0.05$  was considered statistically significant

parental sex, educational level, occupation, and monthly income were not significantly associated with DMFT ( $p > 0.05$ ).

According to the negative binomial regression analysis, the effects of the independent variables on the PUFA variable were also evaluated simultaneously (Table 8). The overdispersion parameter of the model was  $\alpha = 0.538$  and was statistically significant ( $p < 0.001$ ), indicating the presence of overdispersion in the PUFA data and supporting the use of the negative binomial

**Table 6** The association between antibiotic administration for toothache in children and their oral health indices

	Yes		No		p value
	Mean ± SD	Median (min–max)	Mean ± SD	Median (min–max)	
D	4.8 ± 3.27	4 (0–20)	4.35 ± 3.04	4 (0–18)	0.072
M	0.67 ± 1.03	0 (0–5)	0.42 ± 0.82	0 (0–4)	< 0.001*
F	1.95 ± 2.39	1 (0–12)	1.94 ± 2.24	1 (0–11)	0.588
DMFT	7.43 ± 3.43	7 (0–24)	6.72 ± 3.32	7 (0–21)	0.026*
P	1.71 ± 1.53	1 (0–7)	1.44 ± 1.47	1 (0–7)	0.011*
U	0.00 ± 0.08	0 (0–1)	0.01 ± 0.12	0 (0–2)	0.713
F <sup>1</sup>	0.07 ± 0.42	0 (0–6)	0.03 ± 0.21	0 (0–3)	0.045*
A	0.19 ± 0.42	0 (0–2)	0.08 ± 0.28	0 (0–1)	< 0.001*
PUFA	1.98 ± 1.81	2 (0–7)	1.57 ± 1.62	1 (0–8)	0.001*

Mann–Whitney U test was used for group comparisons; SD standard deviation; Min minimum; Max maximum; D decayed teeth; M missing teeth; F filled teeth; DMFT total number of decayed, missing, and filled teeth in primary and permanent dentition; P pulp involvement; U ulceration; F<sup>1</sup> fistula formation; A abscess; PUFA total number of teeth with pulp involvement, ulceration, fistula formation, or abscess in primary and permanent dentition

\*p < 0.05 was considered statistically significant

**Table 7** The relationship between parents' taking their children to the dentist when complaints subside after antibiotic use and children's oral health indices

	Yes		No		p value
	Mean ± SD	Median (min–max)	Mean ± SD	Median (min–max)	
D	4.53 ± 3.2	4 (0–20)	5.89 ± 3.37	5 (0–18)	0.003*
M	0.65 ± 0.99	0 (0–5)	0.78 ± 1.21	0 (0–5)	0.804
F	2.11 ± 2.49	1 (0–12)	1.32 ± 1.80	0 (0–8)	0.034*
DMFT	7.29 ± 3.49	7 (0–24)	8 ± 3.16	7.5 (1–18)	0.123
P	1.57 ± 1.46	1 (0–6)	2.25 ± 1.71	2 (0–7)	0.005*
U	0.00 ± 0.06	0 (0–1)	0.01 ± 0.13	0 (0–1)	0.283
F <sup>1</sup>	0.07 ± 0.44	0 (0–6)	0.08 ± 0.28	0 (0–1)	0.319
A	0.17 ± 0.4	0 (0–2)	0.28 ± 0.49	0 (0–2)	0.069
PUFA	1.82 ± 1.72	2 (0–7)	2.64 ± 2.04	2.5 (0–7)	0.006*

Mann–Whitney U test was used for group comparisons; SD standard deviation; Min minimum; Max maximum; D decayed teeth; M missing teeth; F filled teeth; DMFT total number of decayed, missing, and filled teeth in primary and permanent dentition; P pulp involvement; U ulceration; F<sup>1</sup> fistula formation; A abscess; PUFA total number of teeth with pulp involvement, ulceration, fistula formation, or abscess in primary and permanent dentition

\*p < 0.05 was considered statistically significant

model. The model fit indices were Deviance = 768.074, AIC = 2754.797, and Pseudo R<sup>2</sup> = 0.128. When the variables were examined, the PAPA score showed a statistically significant negative association with PUFA (β = -0.011; 95% CI: -0.016 – -0.005; p < 0.001). Accordingly, each one-unit increase in the PAPA score was associated with an approximately 1.1% decrease in the expected value of PUFA (IRR = 0.989; 95% CI: 0.984–0.995). Age

also demonstrated a negative association with PUFA (β = -0.115; 95% CI: -0.146 – -0.085; p < 0.001). Each one-unit increase in age was associated with an approximately 10.9% decrease in the expected value of PUFA (IRR = 0.891; 95% CI: 0.864–0.919). Regarding antibiotic use, multiple antibiotic use within the last year (reference: none) showed a positive and statistically significant association with PUFA (β = 0.266; 95% CI: 0.046–0.486; p = 0.018). Accordingly, children who used antibiotics more than once had an approximately 30.5% higher expected PUFA value compared with those who did not use antibiotics (IRR = 1.305; 95% CI: 1.048–1.626). However, single antibiotic use was not statistically significant (p = 0.155). In terms of educational level, having a college/university degree (reference: primary/secondary school) was negatively and significantly associated with PUFA (β = -0.272; 95% CI: -0.499 – -0.046; p = 0.018). Accordingly, the expected PUFA value was approximately 23.8% lower among children whose parents had a college/university education compared with the reference group (IRR = 0.762; 95% CI: 0.607–0.955). Having a high school education was not statistically significant (p = 0.270). No statistically significant associations were found between PUFA and parental age, child's sex, presence of chronic disease, parental sex, occupation, or monthly income (p > 0.05).

### Discussion

The unnecessary and inappropriate use of antibiotics in childhood is closely linked to both health-care professionals' prescribing trends and parents' usage behaviors [14, 15]. Parents' tendency to use antibiotics without consulting a physician and their inadequate adherence to clinical treatment guidelines are among the key determinants of this problem [15, 16]. In this context, raising awareness among clinicians and parents, who are primary caregivers, about the appropriate and responsible use of antibiotics could be an effective approach to combating antibiotic resistance [16]. This study assessed parents' knowledge and attitudes toward antibiotic use. Furthermore, the effect of parents' knowledge and behavior regarding antibiotic use on their children's oral health was analyzed using DMFT and PUFA indices.

In a study using the PAPA scale, developed by Alurran et al. to assess parents' knowledge, attitudes, and behaviors toward antibiotics, parents were asked about their opinions on antibiotic use when their children had a cold [9]. Thirty-six percent of participants indicated that antibiotics were appropriate in this situation, and nearly half believed that antibiotics would heal the common cold more quickly. However, 56% of parents stated that they always expected a prescription (including antibiotics) when taking their children to the doctor for a cold [9]. Another study using the PAPA scale reported that

**Table 8** Negative binomial regression analysis of the effects of independent variables on DMFT and PUFA

Dependent variables	Independent variables	$\beta^1$ (95% CI)	Standard Error	Test Statistics	p	IRR (95% CI)
DMFT	Alpha	0,306 (0,297: 0,314)	0,004	69,500	< 0,001*	
	Constant	2,650 (1,989: 3,311)	0,337	7,860	< 0,001*	
	PAPA Score	-0,004 (-0,007: 0,000)	0,002	-2,010	<b>0,045*</b>	0,996 (0,993: 1,000)
	Age	-0,032 (-0,051: -0,014)	0,010	-3,390	<b>0,001*</b>	0,968 (0,950: 0,986)
	Parental age	-0,003 (-0,012: 0,006)	0,004	-0,680	0,494	0,997 (0,988: 1,006)
	Child's sex (Male)	-0,013 (-0,107: 0,081)	0,048	-0,260	0,792	0,987 (0,899: 1,085)
	Chronic illness (No)	-0,013 (-0,156: 0,130)	0,073	-0,180	0,860	0,987 (0,856: 1,139)
	Child's frequency of antibiotic use within the last year (Reference: Never)					
	Once	-0,003 (-0,140: 0,134)	0,070	-0,040	0,966	0,997 (0,870: 1,143)
	Many times	0,030 (-0,101: 0,160)	0,067	0,440	0,657	1,030 (0,904: 1,174)
	Parental sex (Male)	-0,034 (-0,147: 0,079)	0,058	-0,600	0,552	0,966 (0,863: 1,082)
	Educational level (Reference: Primary or junior high school)					
	High school	-0,065 (-0,182: 0,052)	0,060	-1,090	0,278	0,937 (0,834: 1,054)
	Diploma or bachelor degree	-0,069 (-0,209: 0,071)	0,071	-0,970	0,332	0,933 (0,811: 1,073)
	Trained in a health-related field (No)	0,180 (-0,139: 0,499)	0,163	1,100	0,269	1,197 (0,870: 1,647)
	Monthly income level (Above minimum wage)	-0,008 (-0,118: 0,101)	0,056	-0,150	0,882	0,992 (0,889: 1,106)
	PUFA	Alpha	0,538 (0,514: 0,561)	0,012	45,350	< 0,001*
Constant		1,944 (0,839: 3,050)	0,564	3,450	<b>0,001*</b>	
PAPA Score		-0,011 (-0,016: -0,005)	0,003	-3,640	< 0,001*	0,989 (0,984: 0,995)
Age		-0,115 (-0,146: -0,085)	0,016	-7,420	< 0,001*	0,891 (0,864: 0,919)
Parental age		0,009 (-0,005: 0,022)	0,007	1,280	0,200	1,009 (0,995: 1,023)
Child's sex (Male)		-0,010 (-0,160: 0,141)	0,077	-0,130	0,899	0,990 (0,852: 1,151)
Chronic illness (No)		-0,150 (-0,375: 0,076)	0,115	-1,300	0,194	0,861 (0,687: 1,079)
Child's frequency of antibiotic use within the last year (Reference: Never)						
Once		0,168 (-0,063: 0,399)	0,118	1,420	0,155	1,183 (0,939: 1,491)
Many times		0,266 (0,046: 0,486)	0,112	2,370	<b>0,018*</b>	1,305 (1,048: 1,626)
Parental sex (Male)		0,001 (-0,179: 0,182)	0,092	0,020	0,987	1,001 (0,836: 1,200)
Educational level (Reference: Primary or junior high school)						
High school		-0,104 (-0,290: 0,081)	0,095	-1,100	0,270	0,901 (0,748: 1,084)
Diploma or bachelor degree		-0,272 (-0,499: -0,046)	0,116	-2,360	<b>0,018*</b>	0,762 (0,607: 0,955)
Trained in a health-related field (No)		0,510 (-0,086: 1,106)	0,304	1,680	0,094	1,665 (0,918: 3,022)
Monthly income level (Above minimum wage)		0,000 (-0,174: 0,174)	0,089	0,000	0,999	1,000 (0,840: 1,190)

For DMFT (Deviance = 531.320; AIC(1) = 4365.601; Pseudo R<sup>2</sup> = 0.061); for PUFA (Deviance = 768.074; AIC(1) = 2754.797; Pseudo R<sup>2</sup> = 0.128);  $\beta^1$  (95% CI): Unstandardized beta coefficient (95% confidence interval); IRR (95% CI): Expected count rate (95% confidence interval)

CI Confidence interval, IRR Incidence rate ratio

\*p < 0.05 was considered statistically significant

32% of parents agreed with the clinically correct statement: “Antibiotics do not relieve cold symptoms” [6]. These studies reveal that parents tend to use antibiotics even when the infection is viral and have this expectation in their clinic visits. According to the current AAPD guidelines, if a child exhibits symptoms of acute pulpitis, treatment (eg, pulpotomy, pulpectomy, or extraction) should be performed [4]. The guidelines also state that antibiotic therapy is neither indicated or effective when the tooth infection is within the pulp tissue or the immediately surrounding tissue. Furthermore, the guidelines also state that for odontogenic infections accompanied by non-localized swelling and systemic symptoms (eg., fever and difficulty breathing or swallowing), prompt surgical intervention and medical management combined

with antibiotic therapy can contribute to rapid recovery. Dental studies assessing parental attitudes and behaviors toward odontogenic infections in children remain scarce. In our study, 71.8% of parents felt that treatment would not be possible without antibiotics in cases of localized infections, such as confined gingival swelling, while 81.6% expressed the same belief for cases involving diffuse facial swelling accompanied by systemic symptoms. In a study conducted by Domínguez-Domínguez, 34.6% of the 514 patients reported that they used antibiotics before endodontic treatment, 49.4% did so after endodontic treatment regardless of clinical symptoms, and 44% believed that antibiotics were necessary even in the presence of dental pain [17]. In another study of patients requiring tooth extraction, 76.6% reported expecting the dentist to

prescribe antibiotics after the procedure, and nearly half (45%) stated that they would personally request antibiotics if they were not prescribed [18]. Although antibiotic use is not required in every case of odontogenic infection, previous studies report that many participants perceive antibiotics as necessary either to recover from dental pain and infection, or to prevent infection following dental procedures. The widespread belief that dental interventions cannot be performed without the use of antibiotics could be attributed not only to a lack of knowledge, but also to misperceptions shaped by patients' previous health-care experiences. However, in our study, no significant association was found between parents' attitudes toward administering antibiotics to their children in the presence of an odontogenic infection and their scores on the PAPA scale. This finding might be because the questions on the PAPA scale were not specific to dental infections.

In a study by Hämeen-Anttila et al., factors associated with the use of nonprescription medications for children younger than age 12 years were examined, with the parents of children with chronic illnesses reporting less frequent use of over-the-counter drugs compared with those of healthy children [19]. Similarly, in a study by Çiğdem et al., parents of children with chronic conditions exhibited more positive attitudes toward medication use than those whose children had no health issues [20]. Supporting the findings of these studies, our study also revealed that parents of children with chronic diseases had better knowledge and more favorable attitudes regarding antibiotic use. These results might be attributed to the fact that such parents tend to be more informed about medication use and act with greater caution and diligence because they consider the potential risks to their children's health.

The frequency of antibiotic use increases during childhood, a period characterized by high susceptibility to infections. Therefore, the role of parents, who serve as the primary decision makers in obtaining and administering medications, is crucial for the appropriate use of antibiotics [8]. In a related study, 37.3% of parents administered antibiotics to their children approximately once per year, and 50.3% used antibiotics already available at home. The same study found that parents who reported using antibiotics more than six times per year had lower levels of perception regarding antibiotic use compared with those who used them less frequently [21]. Similarly, in our study, parents who had not administered antibiotics to their children in the past year had higher perception scores than those who had done so one or more times. These findings suggest that as parents' perception levels regarding antibiotics increase, they tend to avoid unnecessary use more effectively, indicating that perception might influence the frequency of antibiotic administration. Consistent with this interpretation,

the regression findings also indicated that children who had used antibiotics more than once within the previous year had significantly higher PUFA scores compared with those who had not used antibiotics. This association may reflect the tendency of parents to rely on antibiotic therapy as a temporary solution for dental pain or infection instead of seeking definitive dental treatment. Such behavior may contribute to the progression of untreated carious lesions toward pulpal involvement and more severe oral conditions.

Studies evaluating parental perceptions of antibiotic use in children frequently emphasize the influence of sociodemographic characteristics on these perceptions [6, 22]. In a study by Kutrani et al. using the PAPA scale, mothers were found to exhibit higher levels of knowledge, beliefs, and behaviors regarding antibiotic use compared with fathers. Moreover, as the educational level of parents increased, the likelihood of having accurate knowledge about antibiotics grew significantly [6]. Similarly, Wang et al. identified that parents with lower income and educational levels had insufficient knowledge concerning antibiotic use [22]. Another study by Awad & Aboud also revealed that individuals working in the health-care field possessed greater knowledge about antibiotics and had more favorable attitudes [23]. In our study, no significant difference was observed between parents' sex and their knowledge and attitudes regarding antibiotic use. However, knowledge levels regarding antibiotic use increased significantly as educational level and monthly income increased. Also, parents who were health-care professionals had a higher perception of antibiotics. Our study findings suggest that parents' knowledge, beliefs, and attitudes toward antibiotic use can be influenced by various sociodemographic characteristics, such as educational level, income, and training in a health-related profession. Furthermore, factors, such as the ability to access accurate information and access to health-care institutions and information sources, are thought to influence parents' awareness of antibiotics. Similarly, the regression analysis revealed that children whose parents had a college or university education exhibited significantly lower PUFA scores compared with those whose parents had lower educational levels. This finding is consistent with previous studies indicating that higher educational attainment is associated with greater health literacy, more appropriate health-seeking behaviors, and improved oral health outcomes in children.

A study in Lebanon found that parents with more than two children were less aware of medication use than parents with two or fewer [24]. A study by Kuloğlu & Ekici found that parents with only one child had significantly higher knowledge of rational medication use than those with two or three children [25]. Our study found that parents' knowledge of antibiotic use decreased as the

number of children increased. This finding suggests that environmental factors related to family structure, such as the number of siblings and birth order, and parenting experiences, could also influence parental medication use and that parents in large families tend to neglect their children's oral and general health.

Families play a crucial role in protecting their children's oral and dental health. Regularly informing and guiding parents increases the effectiveness of preventive approaches [26]. The literature consistently shows a significant inverse association between parental educational level and income and the oral health status of their children [27, 28]. In our study, as parents' educational level and income increase, their perception of antibiotics also increased. However, the children of parents with higher perceptions of antibiotics had lower DMFT and PUFA scores. Taken together, these findings suggest that knowledge and attitudes toward antibiotic use could be an important factor influenced by parents' socioeconomic circumstances, and that this behavioral indicator might play a role in children's oral health. In addition, the regression analysis performed in the present study supported this relationship by demonstrating that higher parental awareness regarding antibiotic use was significantly associated with lower DMFT and PUFA scores in children. Specifically, each one-unit increase in the PAPA score was associated with a reduction in the expected DMFT and PUFA values. This finding suggests that parents with greater awareness of appropriate antibiotic use may also be more attentive to their children's overall health, including oral health, and may seek timely dental care rather than relying on antibiotics to manage dental symptoms. Consequently, improved parental awareness regarding rational antibiotic use may indirectly contribute to better oral health outcomes in children.

The AAPD emphasizes that initiating dental care at an early age is crucial for preventing the progression of oral diseases and ensuring a more effective care process [26]. Timely access to dental services reduces the need for extensive treatment and contributes to the maintenance of oral health [26]. In a study by Mbawalla et al., the rate of delayed dental visits among children was reported to be 68.6%. Notably, 45.2% of parents stated that they postponed seeking dental care for at least 1 month after noticing an oral or dental problem in their child. Clinical evaluations from the same study revealed that the most common diagnosis was dental caries that had progressed to the pulp, highlighting the adverse effect of delayed dental visits on treatment outcomes [29]. According to BaniHani et al., 65.9% of parents have delayed their children's dental treatment. The poor oral health status of most children (99.2%) was associated with delays in seeking dental care [30]. In our study, untreated carious lesions involving the pulp were more prevalent among

children who had been prescribed antibiotics for dental pain, but were not taken to the dentist after their symptoms subsided. Additionally, parents who did not seek dental care following the resolution of symptoms had lower levels of perception regarding antibiotics. Failing to pursue treatment after the disappearance of symptoms leads to delayed intervention and, consequently, negatively affects oral health.

Among the limitations of this study is that the sample was restricted to patients presenting at a university hospital, which may have limited representation of individuals from more diverse sociodemographic backgrounds. Furthermore, data were collected from only one parent per child, although treatment decisions within families may be made jointly or influenced by either parent. In addition, several key variables, including prior antibiotic use and parental attitudes, were assessed using self-reported questionnaires. Consequently, the findings may be subject to recall bias and social desirability bias, particularly given the face-to-face interview format. These potential sources of bias may have influenced both PAPA scores and the observed associations with children's oral health outcomes. Despite these limitations, the study has several strengths, including its large sample size, the use of face-to-face interviews, and the application of the validated PAPA scale, which enabled a multidimensional assessment of antibiotic awareness. Moreover, to our knowledge, this study is among the first to examine the relationship between parental attitudes toward antibiotic use and children's oral health, thereby contributing valuable evidence to the pediatric dentistry literature.

## Conclusion

This study demonstrated that higher parental knowledge and positive attitudes toward antibiotic use are significantly associated with better oral health outcomes in children. These findings highlight the importance of educating parents about the rational use of antibiotics as part of preventive pediatric dental care. Future studies should focus on developing and evaluating targeted educational interventions to enhance parental awareness and ultimately improve children's oral health.

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12903-026-08273-y>.

Supplementary Material 1.

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## Authors' contributions

ŞLÇ performed the data collection. SA and DNG participated in the writing and analysis of the article. ŞLÇ, DNG and SA planned the study.

**Data availability**

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

**Declarations****Ethics approval and consent to participate**

Ethical approval was obtained from the Non-Invasive Clinical Research Ethics Committee of Recep Tayyip Erdoğan University (Decision no: 2024/181). The study was conducted in accordance with the Declaration of Helsinki of 1975, as revised in 2013. Written informed consent to participate was obtained from all participants. For participants under the age of 16, informed consent was obtained both from the participants themselves and from their parents or legal guardians, in accordance with institutional and national ethical guidelines.

**Consent for publication**

Not applicable.

**Competing interests**

The authors declare no competing interests.

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