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The relationship between clinical outcomes of untreated dental caries with dental anxiety, health perceptions and Child-OIDP in primary school-aged children

Hulya Cerci Akcay^{1*}, Merve Sahin², Kadriye Peker³ and Arzu Pinar Erdem⁴

Abstract

Introduction This study aimed to investigate the relationship between the clinical consequences of untreated dental caries and children's sociodemographic characteristics, behavioral factors, perception of general/oral health, dental anxiety, and oral health-related quality of life (OHRQoL) and to identify the predictors of childrens' OHRQoL.

Methods This cross-sectional study was conducted in a convenience sample consisted of 200 children aged 8–10 years attending a pediatric dentistry clinic. Data were collected through clinical examinations and self-reported questionnaires. Caries severity was assessed using the dmft(t)/DMF(T) and pufa(t)/PUFA(T) indices. The questionnaire encompassed socio-demographic characteristics, the Modified Child Dental Anxiety Scale, oral health behaviours, self rated oral/general health, treatment need and satisfaction with teeth, the Child-Oral Impacts on Daily Performances index. Descriptive, bivariate, and multivariate statistics were performed for data analyses.

Results The sample consisted of 98 girls and 102 boys (mean age 9.1 ± 0.81 years). D component of DMFT was correlated with the dental anxiety ($p < 0.05$), but the PUFA/pufa and DMFT/dmft scores were not correlated. No significant differences were found in the OHRQoL and all domains regarding gender, age, school type and oral health behaviours. The OHRQoL was associated with dental anxiety, self perceived oral/general health, the number of self-reported oral problems, and satisfaction with teeth. Worse oral health self-rating and dissatisfaction with the appearance of teeth were important predictors of worse OHRQoL.

Conclusion Anxiety and children's subjective evaluation of oral health affect children's OHRQoL. As a part of needs assesment, dentists should consider these factors together with clinical parameters when planning treatment.

Keywords Child-OIDP, Dental anxiety, Dental caries, Self-rated oral health, Oral health behaviors

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Introduction

Dental caries can significantly impact children's general health, quality of life and well-being. Furthermore, if necessary preventive measures are not implemented, diagnosing and treating dental caries demand considerable time, personnel resources, and financial expenditures, making it a critical public health issue [1–3].

Although the World Health Organization set a 2020 target to reduce DMFT scores to ≤ 1.5 in 12-year-olds, this goal remains unmet in Turkish children [4]. Inadequate oral hygiene and limited access to dental care in pre and primary school children exacerbate the burden of untreated dental caries in Turkey [1, 5].

While the traditional DMFT index has been widely used over the past 70 years, it does not provide information on the clinical consequences of untreated decay. In contrast, the PUFA index captures advanced conditions such as pulpal involvement, ulceration, fistulas, and abscesses, offering a more comprehensive assessment of disease severity [6–8].

Dental caries is a complex multifactorial disease which is influenced by individual, biological, behavioral, socioeconomic and environmental factors [5, 9–12]. Recent Turkish National Oral Health Survey reported that the prevalence of dental caries associated with age, dental visiting pattern, and pain or discomfort history during the previous year. The mother's education level and living area are important sociodemographic factors related to caries prevalence in children [5].

Dental anxiety—another key factor—contributes to avoidance behaviors and deteriorating oral health, particularly in pediatric patients [13, 14]. Dental anxiety is more prevalent problem in school and preschool children than in adolescents worldwide [15].

Published evidences in Turkey and other countries showed that dental anxiety and fear are associated with untreated caries experience, oral health status, dental visiting pattern, oral health-related quality of life (OHRQoL), life satisfaction, parental anxiety, family socioeconomic factors, parental dental anxiety, gingival health, and oral hygiene status [14, 16–22].

Oral health has a multidimensional nature, as it affects the physical, psychological, social, and environmental domains of general health and quality of life. The consequences of oral diseases affect individuals' oral functioning, social life, and ability to perform everyday activities. OHRQoL which is a subjective and a patient-reported outcome is influenced by personal experiences, concerns, cultural beliefs and attitudes and social expectations. It provides an important adjunct to normative needs assessment evaluated by oral health professionals using clinical measures for determining patients' needs and planning person centered health care [23].

As clinical conditions, dental caries and irregular brushing associated with worse OHRQoL. Socioeconomic factors related to parental education, age, gender, socioeconomic status, access to health care and absence of siblings are important factors affecting childrens' OHRQoL [24].

There are small number of studies examining the complexity of dental anxiety and its association with the OHRQoL via a conceptual model in children and adolescents [3, 16, 21, 25, 26].

There is lack of studies on the relationships between dental anxiety and OHRQoL, oral health status, oral health behaviours and subjective evaluations of oral and general health among pediatric children aged 8–10 years according to the variables of previous conceptual model of dental anxiety. According to child psychology, children aged 8–10 years are homogenous in terms of children's cognitive, emotional, social, and language development. This age group have mixed dentition and may provide an opportunity for assessing the consequences of untreated dental caries in both primary and permanent dentitions [27, 28].

The aims of this study were to examine the clinical outcomes of untreated dental caries and their association with sociodemographic factors, subjective oral health evaluations, behavioural factors, dental anxiety and OHRQoL and to identify the predictors of childrens' OHRQoL among primary school children aged 8–10.

The null hypothesis (H_0) of this study is that clinical outcomes of untreated dental caries, dental anxiety, sociodemographic and behavioral factors, and health perception variables are not significantly associated with children's OHRQoL.

Methods

Study design and sample

This cross-sectional study was conducted on a convenience sample of 200 children aged 8–10 attending the Istanbul University Faculty of Dentistry, Clinics of Pedodontics between September 2020 and May 2021.

The reporting of this study was guided by the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) Statement Checklist for cross-sectional studies to ensure compliance with standardized reporting criteria.

The minimum sample size was determined to be 114 using an online sample size calculator, with a correlation coefficient of 0.29 between the PUFA(T) index and OHRQoL obtained from a published study, with a power of 80%, a significance level of 0.05, and a 20% dropout rate [2, 29].

Additionally, in consideration of the planned multivariate analyses, the study sample size for regression analysis was calculated using Green's formula: $N \geq 50 + 8m$ (where

m refers to the number of predictors in the model) [30]. The required sample size for regression analysis was estimated to be 186 participants considering the 17 independent variables used in this study.

The inclusion criteria were: [1] children aged 8–10 years; [2] having a signed parental consent form; and [3] child willingness to participate in research. The exclusion criteria were having any systemic, neurological disease and disabilities, lack of cooperation during the clinical examination and the inability to read, write, or speak Turkish.

Ethical considerations

The study was approved by the Ethics Committee of Istanbul University (Approval number: 2015/75) and was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all parents or legal guardians of the participating children, and verbal assent was obtained from the children.

Data collection

Data were collected via clinical examinations and self-reported questionnaires. The self-reported questionnaire was administrated under researcher supervision to ensure clarity and understanding in a waiting room before the clinical examination.

The first section of survey include the following socio-demographic variables: child's gender (male vs. female), child's age (years), the number of siblings, school type (private /public), grade of the school, the educational level of mother and father (primary/middle school/high school/ university).

The second part consisted of questions regarding oral health behaviors, subjective rated oral health and the Turkish versions of the Child Oral Impacts on Daily Performances (C-OIDP) index and the Modified Child Dental Anxiety Scale (MCDAS).

In this study, some exogenous and endogenous factors related to dental anxiety which found in previous studies and were previously proposed conceptual models for dental anxiety and OHRQoL in pediatric populations were used [16, 21, 26, 31].

The oral health behaviors of children including the frequency of tooth brushing ($\geq$ twice a day vs. $\leq$ once a day), dental visiting pattern (regular dental check-up at least once a year vs. symptom-oriented), and daily between-meal frequency of sugar intake ($<$ three a day vs. $\geq$ three a day) were evaluated using self-reported questionnaires and dichotomized for data analysis [32–34].

The following questions were used to measure subjective rated oral health of children: satisfaction with dental appearance (yes vs. no), perceived dental treatment need (yes vs. no/don't know), self-rated oral and general health (answer ranging from excellent to poor) [35, 36].

To measure the dental anxiety levels of children, the Turkish version of the MCDAS, translated and psychometrically validated by Güngör et al., was used [37]. This scale consisted of eight items rated on 5-point smiley face scale ranging from “relaxed/not worried” [1] to “very worried” [5] related to dental procedures. Total scores ranged from 8 to 40, with higher scores indicating greater dental anxiety.

The Turkish version of the C-OIDP index was used to assess the OHRQoL of children [36]. This index developed by Gherunpong et al., consisted of 17 oral health problems experienced in the past 3 month and eight daily performances: eating, speaking, cleaning the mouth, relaxing, smiling, studying, emotion, and social contact [38]. The frequency (1- being once or twice a month, 2- three or more times a month, or once or twice a week, three or more times a week) and severity (1- little effect, 2 - moderate effect, 3 - severe effect) of impacts for each daily performances were scored on a 3 point Likert scale. Each performance score was obtained by multiplying the frequency score by the severity score. The total C-OIDP score was calculated as the sum of the 8 performance scores (ranging from 0 to 72) multiplied by 100 and divided by 72.

Dental examinations

The numbers of decayed, missing, and filled teeth in primary (dmft) and permanent dentition (DMFT) was used to assess caries severity [39]. The PUFA/pufa index (P/p=visible pulpal involvement; U/u=ulceration of the oral mucosa due to root fragments; F/f=fistula; A/a=abscess) was used to the clinical assessment of the consequences of untreated caries lesions [40]. The clinical examinations were performed by calibrated final year dental student in accordance with WHO criteria and PUFA index guidelines to ensure diagnostic consistency. After the theoretical-practical training session, student's assessments were subsequently evaluated by a senior faculty member. Inter-examiner reliability was assessed in 20 children who didn't participate the main study using Cohen's kappa coefficient, with values exceeding 0.8, indicating excellent agreement and reproducibility of the clinical measurements [41].

Statistical analysis

The internal consistency of both the C-OIDP and MCDAS was assessed using Cronbach's alpha coefficient. with a value > 0.70 considered acceptable [42]. After testing the normality of the data using the Kolmogorov–Smirnov test, descriptive statistics, Mann–Whitney U tests, Spearman's correlation coefficients, and multiple linear regression analysis were used to analyze the data. The strength of Spearman correlation coefficient was classified as follows: $r \leq 0.49$ = weak relationship,

$0.50 \leq r \leq 0.74$ = moderate relationship and $r \geq 0.75$ = strong relationship [43]. To identify the important predictors of children's OHRQoL, a backward stepwise multiple linear regression was performed with the total C-OIDP score as the dependent variable. Socio-demographic characteristics, clinical indices, oral health behaviors, subjective evaluations of oral/general health, self perceived treatment need and satisfaction with the appearance of teeth, the number of self-reported oral impacts, and MCDAS score were used as independent variables. Variables with $P < 0.10$ in bivariate analyses were entered into the model. The R^2 statistic was used to determine the proportion of the variance in OHRQoL explained by independent variables. Standardized β coefficients were calculated for all variables. $P < 0.05$ was considered to indicate significance in all analyses. Statistical analyses were performed using IBM SPSS Statistics 21.0 (IBM SPSS, Turkey).

Results

Sociodemographic and oral Health-Related characteristics
Participants were aged between 8 and 10 years, with a mean age of 9.1 ± 0.81 years. Most of them had between two and four siblings (88%) and were enrolled in public schools (95%). 52.3% of mothers and 38.5% fathers had completed a primary education (Table 1).
Oral health behaviours revealed that 78% of children visited the dentist even in the absence of symptoms. While only 22% brushed their teeth twice or more daily, 10.5% reported consuming sugar-added products three or more times between meals, and 13% used dental floss. In terms of self-perception, 63.5% of children expressed satisfaction with the appearance of their teeth and mouth. Nonetheless, 66.5% believed they needed dental treatment, and only 8.5% reported having no oral health problems.

The most commonly reported oral health impacts were dental caries (67.5%), interdental spacing (60%),

and dental pain (56.5%). Other frequently cited issues included erupting teeth, gingival bleeding, and tooth mobility or recent extractions (ranged from 48 to 51%). Less frequently reported problems included sensitivity, calculus, halitosis, malocclusion, and discoloration (from 34.5 to 42.5%). Periodontal issues, dental fractures, oral ulcers, structural deformities, and permanent tooth loss were less common (<31%).

Permanent dentition: DMF(T) and PUFA(T) findings

The mean DMF(T) score was 1.60 ± 1.43 , comprising decayed (D: 1.24 ± 1.31), missing (M: 0.04 ± 0.24), and filled (F: 0.33 ± 0.72) components. For the PUFA(T) index, the mean score was 0.12 ± 0.48 , with pulp involvement (P: 0.12 ± 0.48) being the only notable finding; no ulceration, fistula, or abscess was observed.

Significant weakly positive correlations were found between DMF(T) and PUFA(T) scores ($r = 0.320$; $p < 0.01$), and between the D and P components ($r = 0.353$; $p < 0.01$), suggesting that an increase in decayed permanent teeth is associated with more severe clinical outcomes such as pulp involvement.

DMF(T) scores were positively correlated with grade level ($r = 0.240$; $p < 0.01$), indicating a progressive increase with age. D component of DMFT was correlated with the MCDAS scores ($r = 0.139$; $p < 0.05$).

Furthermore, the A component of PUFA(T) showed a weak correlation with speech difficulties ($r = 0.183$; $p < 0.01$), suggesting an impact of untreated abscesses on oral function. The PUFA and DMFT were not correlated with the scores of the MCDAS and Child-OIDP (Table 2).

Primary dentition: dmf(t) and pufa(t) findings

The mean dmf(t) score was 4.97 ± 2.68 , consisting of decayed (d: 3.08 ± 2.47), missing (m: 0.78 ± 1.32), and filled (f: 1.11 ± 1.68) teeth. The corresponding pufa(t) score was 0.44 ± 1.07 , with pulp involvement (p: 0.39 ± 0.98), fistula (f: 0.01 ± 0.10), and abscess (a: 0.03 ± 0.17) being reported. Ulceration was not observed.

There was a weak correlation between the d component of dmf(t) and the p component of pufa(t) ($r = 0.42$; $p < 0.01$), indicating that higher caries prevalence in primary teeth is associated with increased risk of pulp involvement. The total pufa(t) index also showed significant correlations with the dmf(t) index ($r = 0.29$; $p < 0.01$), and specifically with its d component ($r = 0.41$; $p < 0.01$). Moreover, the a component was positively associated with pulp involvement ($r = 0.29$; $p < 0.01$), suggesting progression from untreated decay to abscess formation.

In terms of OHRQoL, the d component of dmf(t) was positively associated with difficulty in eating ($r = 0.19$; $p < 0.01$) and speaking ($r = 0.142$, $p < 0.05$). The a component of pufa(t) was linked to challenges in maintaining

Table 1 Sociodemographic distribution of participants

Number (n) (%)	Number (n) (%)
Gender	Grade of the school
Female 98 (%49)	2. grade 48 (%24)
Male 102 (%51)	3. grade 45 (%22.5)
Age	4. grade 107 (% 53.5)
8 years old 55 (%27.5)	Mother's educational level
9 years old 63 (%31.5)	Primary school 112 (%56)
10 years old 82 (%41)	Middle school 34 (%17)
Siblings	High school 35 (%17.5)
No sibling 17 (%8.5)	University 19 (%9.5)
2–4 siblings 176 (%88)	Father's educational level
More than 4 siblings 7 (%3.5)	Primary school 77 (%38.5)
School	Middle school 48 (%24)
Public 190 (%95)	High school 51 (%26.5)
Private 10 (%5)	University 24 (%12)

Table 2 The association between quality of life scores, sociodemographic and clinical variables

Variables	Child-OIDP -TOTAL Mean ± SD	Child-OIDP SOCIAL CONTACT Mean ± SD	Child-OIDP STUDYING Mean ± SD	Child- OIDP EMOTION Mean ± SD	Child- OIDP SMILING Mean ± SD	Child- OIDP RELAXING Mean ± SD	Child- OIDP CLEANING Mean ± SD	Child- OIDP SPEAKING Mean ± SD	Child- OIDP EATING Mean ± SD
Gender									
Female	12.51 ± 5.86	1.35 ± 1.16	1.45 ± 1.05	1.75 ± 1.43	1.24 ± 0.82	1.42 ± 1.22	1.74 ± 1.29	1.48 ± 1.11	2.03 ± 1.80
Male	11.87 ± 5.81	1.30 ± 0.89	1.35 ± 0.97	1.68 ± 1.54	1.40 ± 1.20	1.45 ± 1.23	1.48 ± 1.25	1.32 ± 1.11	1.87 ± 1.62
<i>p</i> value	0.268	0.930	0.296	0.394	0.387	0.789	0.084	0.172	0.523
School									
Public	12.18 ± 5.91	1.34 ± 1.06	1.42 ± 1.03	1.74 ± 1.51	1.34 ± 1.06	1.41 ± 1.21	1.58 ± 1.27	1.42 ± 1.14	1.91 ± 1.72
Private	12.10 ± 4.14	1.00 ± 0.00	1.00 ± 0.00	1.30 ± 0.94	1.00 ± 0.00	2.00 ± 1.41	2.00 ± 1.41	1.10 ± 0.31	2.70 ± 1.41
<i>p</i> value	0.524	0.268	0.183	0.334	0.281	0.20	0.152	0.683	0.011
Mother's educational level									
<i>r</i> value	0.074	-0.018	-0.069	-0.005	-0.096	-0.029	-0.021	-0.144	-0.082
Father's educational level									
<i>r</i> value	0.039	0.024	0.024	-0.10	-0.034	-0.058	-0.026	-0.004	0.04
Age									
<i>r</i> value	-0.02	-0.03	0.09	-0.10	0.004	0.08	-0.004	-0.05	-0.03
DMF(T)									
<i>r</i> value	0.007	-0.04	0.06	0.03	-0.01	0.07	-0.009	-0.04	0.10
dmf(t)									
<i>r</i> value	0.09	-0.04	0.004	0.06	-0.04	0.05	0.04	0.03	0.17*
PUFA(T)									
<i>r</i> value	0.03	-0.02	0.001	0.08	0.04	0.06	-0.03	-0.04	0.04
pufa(t)									
<i>r</i> value	0.082	0.041	0.000	0.057	0.028	0.122	0.050	0.116	0.031

r: Spearman's rank correlation coefficient; * $p < 0.05$; ** $p < 0.01$; SD = Standard Deviation; Child-OIDP: Child Oral Impact on Daily Performances

Table 3 Distribution of responses to the modified dental anxiety scale

Question	Very Happy	Happy	Neutral	Sad	Very Sad
1- How do you feel when you go to the dentist?	90 (%45)	33 (%16.5)	41 (%20.5)	21 (%10.5)	15 (%7.5)
2- How do you feel when your teeth are looked at?	78 (%39)	61 (%30.5)	41 (%20.5)	21 (%10.5)	8 (%4)
3- How do you feel when your teeth are cleaned?	142 (%71)	38 (%19)	15 (%7.5)	2 (%1)	3 (%1.5)
4- How do you feel when you get an injection in your gums?	27 (%13.5)	36 (%18.5)	35 (%17.5)	29 (%14.5)	72 (%36)
5- How do you feel when you get a filling in your tooth?	54 (%27)	54 (%27)	43 (%21.5)	21 (%10.5)	28 (%14)
6- How do you feel when you have a tooth extraction?	36 (%16.5)	40 (%20)	29 (%14.5)	39 (%19.5)	59 (%29.5)
7- How do you feel if you are put to sleep during treatment?	47 (%23.5)	36 (%18)	38 (%19)	47 (%23.5)	32 (%16)
8- How do you feel if you are given a mixture of gas and air to relax without being put to sleep during treatment?	101 (%50.5)	44 (%22)	22 (%11)	15 (%7.5)	18 (%9)

oral hygiene ($r = 0.189$; $p < 0.01$), emphasizing the clinical burden of untreated primary tooth decay.

Dental anxiety was not associated with the dmft and pufa scores.

Relationships with OHRQoL and dental anxiety, subjective evaluations, oral health behaviours and sociodemographic factors

Children's dental anxiety levels, assessed using the MCDAS, varied notably depending on the procedure type. As detailed in Table 3, anxiety was lowest during routine visits and cleanings, and highest for injections

and extractions. Sedation-related responses were mixed, although nitrous oxide was generally well tolerated. These findings underscore the procedure-specific nature of dental anxiety in children.

The Cronbach's alpha coefficient for the Child-OIDP index and MCDAS was found to be 0.72 and 0.78, respectively.

As shown in Table 3, the total Child-OIDP ($r = 0.238$; $p < 0.01$) scores and its domain scores of relaxing ($r = 0.192$; $p < 0.01$) and cleaning ($r = 0.219$; $p < 0.01$) were weakly and positively correlated with total MCDAS scores.

Significant positive correlations were observed between poor oral health perception and the total Child-OIDP score ($r=0.25$; $p<0.01$), along with the domains of schoolwork ($r=0.20$; $p<0.05$), relaxing ($r=0.22$; $p<0.01$), eating ($r=0.21$; $p<0.01$), social contact ($r=0.14$; $p<0.05$), and cleaning ($r=0.16$; $p<0.05$).

Perceived oral health was positively correlated with dental anxiety levels ($r=0.241$; $p<0.01$) and the number of decayed primary teeth ($r=0.19$; $p<0.01$), indicating a link between subjective oral health perception, psychological distress, and clinical oral status.

General health perceptions were significantly associated with the total Child-OIDP score ($r=0.17$; $p<0.05$) and its domains of studying ($r=0.15$; $p<0.05$) and eating ($r=0.162$; $p<0.05$). Moreover, a positive association was observed between oral and general health perceptions ($r=0.30$; $p<0.01$).

No significant differences were found in the total Child-OIDP and all domain scores regarding gender, age, school type and oral health behaviours (Table 4).

Children dissatisfied with their dental appearance reported poor overall OHRQoL ($p=0.013$), and its domains of relaxing ($p<0.001$), smiling ($p=0.006$), and social contact ($p=0.044$).

Children who believed they needed treatment had worse scores on the total Child-OIDP ($p=0.002$) and its domains of social contact ($p=0.049$), studying ($p=0.043$), and cleaning ($p=0.044$).

The predictors of OHRQoL

As shown in Table 5, the final regression model explained 9% of the variance of the total Child-OIDP score (adjusted $R^2=0.090$, $P<0.001$). Worse oral health self-rating ($\beta=0.219$, $p=0.002$) and dissatisfaction with the appearance of teeth ($\beta=0.149$, $p=0.038$) were found to be important predictors of worse OHRQoL in children aged 8–10 years.

Discussion

In Turkey, untreated dental caries are a public health problem in children population [5]. Although there are some studies on dental anxiety and its relationships with parental dental anxiety, dental visiting pattern, dental caries, gingival health, and oral hygiene status, to our knowledge, only one study provided a valid demonstrable path of relationship between parental socio-economic status, dental anxiety, childhood dental anxiety, oral health behaviours, and OHRQoL [16–18].

Based on the previous conceptual model on the link between dental anxiety and OHRQoL, we used the important endogenous and exogenous factors including behavioural, subjective, clinical and socio-demographic in this study [16, 21, 26].

The widely used dmf(t)/DMF(T) index measures caries prevalence but fails to reflect the clinical severity of untreated lesions. The PUFA index was introduced to overcome this limitation, providing a more comprehensive understanding by recording clinical consequences such as pulp involvement, ulceration, fistula, and abscess formation [44].

In the current study, our results align with previous findings reporting higher dmf(t) scores in younger children and an increase in DMF(T) scores with age. This shift corresponds to the transition from primary to permanent dentition and is likely influenced by oral hygiene behaviors—specifically inadequate brushing and lack of interdental cleaning. As previously documented, pulpal involvement was the most frequently observed clinical outcome, underscoring the need for early preventive care to avoid irreversible damage [40, 45]. Consistent with existing literature, pulpal involvement (“p/P”) emerged as the most prevalent sequela of untreated caries, highlighting the critical need for early detection and timely intervention to prevent irreversible damage and associated complications [44–47].

The rarity of ulceration and fistulization in both dentitions suggests that such advanced clinical complications are uncommon among school-aged children [47]. Previous studies have emphasized that these severe clinical signs typically manifest only in late-stage, neglected cases [47, 48]. In light of their rarity, several studies have suggested that ulceration (“u/U”) and fistulization (“f/F”) or abscesses (“a/A”) may be analyzed in combination to enhance the interpretability of these less frequent outcomes [46, 49–51]. This reinforces the clinical importance of identifying early signs of pulpal pathology and implementing timely interventions before more severe outcomes occur.

The Cronbach’s α values for both the Child-OIDP index and MCDAS used in this study, > 0.70 , indicating good internal reliability.

Interestingly, bivariate analyses revealed that the total PUFA(T) and DMF(T) scores were not related to dental anxiety and overall OHRQoL in Turkish children. The observing correlation between the A component of PUFA(T) and the speaking domain of Child-OIDP suggest an impact of untreated abscesses on oral function. Dental caries and dental abscess in primary dentition lead to adverse effects on children’s OHRQoL in the domains of eating, speaking, and cleaning. Untreated dental caries experiences in primary dentition found to be not related dental anxiety.

While some previous research has reported positive correlations between these variables, several other studies have similarly found no significant relationship between dental anxiety and caries experience as measured by DMF(T) [52–55]. These inconsistencies across

Table 4 The association between quality of life scores, oral health behaviours, and subjective evaluation of oral health

Variables	Child- OIDP -TOTAL Mean ± SD	Child-OIDP SOCIAL CONTACT Mean ± SD	Child-OIDP STUDY- ING Mean ± SD	Child- OIDP EMOTION Mean ± SD	Child- OIDP SMILING Mean ± SD	Child-OIDP RELAXING Mean ± SD	Child- OIDP CLEANING Mean ± SD	Child- OIDP SPEAKING Mean ± SD	Child- OIDP EATING Mean ± SD		
Dental Check-Ups											
Goes	12.18 ± 6.03	1.35 ± 1.10	1.39 ± 1.00	1.44 ± 1.05	1.62 ± 1.41	1.33 ± 1.08	1.49 ± 1.32	1.25 ± 0.78	1.59 ± 1.29	1.39 ± 1.13	1.97 ± 1.73
Does not go	12.20 ± 5.18	1.23 ± 0.78	0.736		2.00 ± 1.70	1.27 ± 0.88	0.526		1.67 ± 1.22	1.44 ± 1.05	1.88 ± 1.65
<i>p</i> -value	0.404	0.721			0.077	0.845			0.433	0.522	0.988
Tooth Brushing Frequency											
≥ Twice a Day	11.84 ± 5.40	1.27 ± 0.87	1.34 ± 0.96		1.52 ± 1.50	1.27 ± 0.87	1.22 ± 0.77		1.63 ± 1.22	1.45 ± 1.45	2.11 ± 2.21
< Twice a Day	12.28 ± 5.96	1.34 ± 1.08	1.42 ± 1.02		1.77 ± 1.48	1.33 ± 1.08	1.50 ± 1.32		1.60 ± 1.29	1.39 ± 1.00	1.90 ± 1.54
<i>p</i> -value	0.457	0.731	0.528		0.134	0.812	0.266		0.711	0.763	0.967
Floss Usage											
Uses	11.65 ± 4.11	1.11 ± 0.58	1.34 ± 0.97		1.46 ± 1.10	1.34 ± 0.97	1.34 ± 0.97		1.69 ± 1.28	1.53 ± 1.72	1.80 ± 1.83
Does not use	12.26 ± 6.05	1.36 ± 1.08	1.36 ± 1.08		1.75 ± 1.53	1.32 ± 1.04	1.45 ± 1.26		1.59 ± 1.28	1.38 ± 1.00	1.97 ± 1.69
<i>p</i> -value	0.941	0.237	0.666		0.355	0.788	0.706		0.705	0.874	0.500
Daily between meals frequency of sugar intake											
< 3 Times a Day	11.97 ± 5.41	1.32 ± 1.05	1.39 ± 1.00		1.65 ± 1.40	1.26 ± 0.85	1.37 ± 1.09		1.56 ± 1.16	1.41 ± 1.14	1.94 ± 1.68
≥ 3 Times a Day	14.00 ± 8.58	1.33 ± 0.91	1.47 ± 1.07		2.23 ± 2.07	1.80 ± 1.96	1.95 ± 2.01		1.95 ± 2.01	1.28 ± 0.90	1.95 ± 2.01
<i>p</i> -value	0.366	0.602	0.570		0.173	0.129	0.143		0.595	0.618	0.699
Satisfaction with the appearance of teeth											
Satisfied	11.22 ± 4.44	1.21 ± 0.77	1.33 ± 0.94		1.57 ± 1.30	1.16 ± 0.68	1.17 ± 0.69		1.53 ± 1.14	1.44 ± 1.21	1.78 ± 1.53
Not satisfied	13.82 ± 7.39	1.52 ± 1.35	1.52 ± 1.11		1.97 ± 1.74	1.59 ± 1.41	1.89 ± 1.71		1.74 ± 1.48	1.33 ± 0.94	2.22 ± 1.95
<i>p</i> -value	0.013*	0.044*	0.092		0.062	0.006**	0.000**		0.312	0.746	0.095
Need for treatment											
Yes	12.85 ± 6.04	1.42 ± 1.18	1.51 ± 1.11		1.81 ± 1.53	1.36 ± 0.97	1.51 ± 1.24		1.69 ± 1.25	1.47 ± 1.22	2.05 ± 1.71
No	10.85 ± 5.19	1.13 ± 0.62	1.19 ± 0.72		1.52 ± 1.38	1.25 ± 1.14	1.29 ± 1.19		1.43 ± 1.31	1.26 ± 0.86	1.74 ± 1.69
<i>p</i> -value	0.002*	0.049*	0.043*		0.083	0.192	0.069		0.044*	0.229	0.103
Problems with teeth											
No	10.11 ± 3.47	1.17 ± 0.72	1.17 ± 0.72		1.52 ± 1.17	1.00 ± 0.00	1.35 ± 0.99		1.17 ± 0.72	1.17 ± 0.72	1.52 ± 1.17
Yes	12.37 ± 5.97	1.34 ± 1.06	1.42 ± 1.03		1.73 ± 1.51	1.35 ± 1.07	1.44 ± 1.24		1.65 ± 1.31	1.42 ± 1.14	1.98 ± 1.75
<i>p</i> -value	0.085	0.517	0.298		0.619	0.152	0.788		0.122	0.363	0.297
Perceived General Health											
<i>r</i> value	0.17*	0.08	0.15*		0.04	0.12	0.07		0.03	0.12	0.162*

Table 4 (continued)

Variables	Child-OIDP -TOTAL Mean ± SD	Child-OIDP SOCIAL CONTACT Mean ± SD	Child-OIDP STUDY- ING Mean ± SD	Child-OIDP EMOTION Mean ± SD	Child-OIDP SMILING Mean ± SD	Child-OIDP RELAXING Mean ± SD	Child-OIDP CLEANING Mean ± SD	Child-OIDP SPEAKING Mean ± SD	Child-OIDP EATING Mean ± SD
Perceived Oral Health									
<i>r value</i>	0.25**	0.14*	0.20*	0.09	0.12	0.22**	0.16*	0.06	0.21**
Anxiety									
<i>r value</i>	0.238**	0.129	0.119	0.084	0.110	0.192**	0.219**	0.067	0.091

r: Spearman's rank correlation coefficient; * $p < 0.05$; ** $p < 0.01$; SD = Standard Deviation; Child-OIDP: Child Oral Impact on Daily Performances

Table 5 Predictors of the total Child-OIDP score in backward Stepwise multiple linear regression analysis

Variable	B	SE	β	P value
Perceived oral health ^a	1.339	0.436	0.219	0.002
Satisfaction with the appearance of teeth ^b	1.794	0.861	0.149	0.038

Child-OIDP: Child Oral Impact on Daily Performances; B, Unstandardized regression coefficient; SE, standard error; β , standardized regression coefficient;

^aContinuous variable; ^bDichotomized variable: Satisfaction with the appearance of teeth (1 = No vs. 0 = Yes)

the literature may be attributed to variations in study populations, age groups, anxiety assessment instruments, or differences in methodological design. Additionally, the limitations inherent in cross-sectional designs—such as the inability to capture behavioral patterns like long-term dental avoidance—may further explain the lack of observed association. Moreover, at this developmental stage, the involvement of parents in initiating and managing dental visits may serve as a protective factor, reducing the direct behavioral impact of anxiety on caries progression. Additionally, our findings revealed specific associations between clinical PUFA components and functional impairments in daily life. Abscesses in the primary dentition can impair a child's ability to maintain oral cleanliness, whereas similar lesions in permanent teeth may affect speech articulation—both of which can substantially lower quality of life. This further underscores the multifaceted impact of advanced untreated carious lesions, extending beyond clinical symptoms to disrupt essential activities of daily living.

Supporting this, recent studies have demonstrated that untreated dental caries, assessed via dmft and pufa indices, negatively impact the OHRQoL of both children and their parents [2], with dental anxiety acting as a mediating factor. Likewise, elevated DMFT scores in adolescents have been linked to functional limitations and diminished well-being [56].

In consistent with previous studies, Turkish children who had higher level of dental anxiety reported worse OHRQoL and experienced negative impacts on daily life, especially in relaxing and cleaning [14, 22].

In this study, poor oral health perception found to be related to higher levels of dental anxiety, higher dental caries experience in primary teeth, worse overall OHRQoL and more negative impacts in the domains of

schoolwork, relaxing, eating, social contact, and cleaning. These findings suggest that self perceived oral health may be a powerful indicator in Turkish children for assessing OHRQoL because there is a link between subjective oral health perception, psychological distress, clinical oral health condition and OHRQoL.

Findings on the associations between self perceived general and oral health and OHRQoL and between worse self rating of general health and negative oral health impacts on studying and eating in daily life support the importance of oral health as an integral part of general health [57].

Sociodemographic variables including gender, age, school type and oral health behaviours were not associated with OHRQoL. This may be related to the characteristics of study sample.

Children who believed they needed treatment reported worse OHRQoL and they experienced more oral impacts on social contact, studying, and cleaning mouth.

Satisfaction with dental appearance which is the other self reported measure of subjective evaluations found to be important predictors of OHRQoL, especially in domains relaxing, smiling, and social contact.

In this study, worse oral health self-rating and dissatisfaction with the appearance of teeth were found to be important predictors of worse OHRQoL in children aged 8–10 years.

Nonetheless, several limitations of this study must be acknowledged. This hospital-based and cross-sectional study restricts the ability to establish causal relationships, limiting interpretations to observed relationships. The study sample, drawn from a single urban locality, may not reflect the broader pediatric population, thereby affecting the generalizability of the findings. Longitudinal and comparative studies are needed to investigate the

cause-and-effect relationships and to better elucidate the temporal dynamics among dental anxiety, caries progression, and quality of life outcomes in diverse populations.

Additionally, self-reported data on oral hygiene behaviors and health perceptions may be subject to bias, including recall inaccuracies and social desirability effects, particularly among younger respondents. New studies using social desirability scales may provide an opportunity to evaluate the social desirability in the self-reported data [58].

Future multicenter collaborative studies performing in diverse geographic regions and socioeconomic strata would enhance external validity. Furthermore, new studies using Path analysis or structural equation modeling are needed to test the conceptual model of associations between dental anxiety and OHRQoL. Future studies used the condition-specific Child-OIDP attributed to dental caries may be more efficient to test the conceptual model. All correlations found in this study were weak strengths and explained the variance of the total Child-OIDP score was low (9%), therefore the variables affecting dental anxiety and OHRQoL should be extended in further studies.

The strengths of this study include its use of validated and reliable measures to assess the dental anxiety and OHRQoL of children. This study used the additional subjective measures which found to be more important predictors of OHRQoL than the clinical, behavioural and socio-demographic factors. Integration of these subjective measures into the conceptual model may provide comprehensive evaluation of the link between dental anxiety and OHRQoL. Despite the limitations, this study's findings may provide pediatric dentists with valuable information regarding the factors influencing OHRQoL and dental anxiety and identifying the vulnerable children as well as for preparing programs to reduce children's dental anxiety.

Conclusion

This study aimed to examine the associations between the clinical consequences of untreated dental caries, dental anxiety, sociodemographic and behavioral factors, subjective oral health evaluations, and oral health-related quality of life (OHRQoL) in children aged 8–10 years. The findings of this research partially supported the proposed associations, indicating that while some expected links were observed, others were not statistically significant.

Worse oral health self-rating and dissatisfaction with the appearance of teeth were important predictors of worse OHRQoL. Anxiety and children's subjective evaluation of oral health affect children's OHRQoL. As a part of needs assessment, dentists should consider these factors together with clinical parameters when planning

treatment. High dmft(t)/DMF(T) values were observed, primarily driven by the “d/D” components, while the PUFA index emerged as a valuable tool not only for assessing clinical consequences of untreated dental caries but also for reflecting their impact on children's daily life and well-being.

Abbreviations

C-OIDP	Child-Oral Impacts on Daily Performances
DMF(T)	Decayed, Missing, and Filled Permanent Teeth
dmft(t)	decayed, missing, and filled primary teeth
PUFA(T)	Pulpal involvement, Ulceration, Fistula, Abscess in Permanent Teeth
pufa(t)	pulpal involvement, ulceration, fistula, abscess in primary teeth
OHRQoL	Oral Health-Related Quality of Life
MCDAS	Modified Child Dental Anxiety Scale

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

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Not applicable.

Author contributions

HÇA and MS conceptualized the study and contributed to the study design. KP contributed to the statistical analysis and interpretation of the data. KP and APE also supervised the clinical data collection and provided methodological input. HÇA, APE and KP drafted the manuscript. All authors critically revised the manuscript and approved the final version.

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Data availability

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

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Istanbul University (Approval number: 2015/75) and conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from the participants' parents, and verbal assent was obtained from the children prior to data collection.

Consent for publication

Not applicable. The manuscript does not contain any individual personal data.

Competing interests

The authors declare no competing interests.

Clinical trial registration

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