Journal of
INTERNATIONAL
MEDICAL RESEARCH

Maternal anxiety, social status, and dental caries formation in children: a cross-sectional study

$SAGE

Zerrin Hatipoğlu[1] and Damla Akşit-Bıçak[2] (iD)

Abstract

Objective: We sought to evaluate the association of maternal anxiety and social status with caries formation in children.

Methods: Participants comprised 258 pairs of children and their mothers. We collected information regarding age, sex, birth order of children, and mothers' education and marital status using a questionnaire. The Spielberger Trait Anxiety Inventory was used to determine maternal trait anxiety levels. The children underwent oral examination. Total values for decayed, missing, filled, and total permanent/primary teeth (DMFT/dmft) were evaluated according to standards of the World Health Organization.

Results: No significant relationship was found between the mother's anxiety level and DMFT/dmft scores in their children. A negative correlation was observed between the child's age and dental caries in children. The sex of the child, mother's education level, and marital status of the mother showed a weak negative correlation with the number of dental caries observed in their children.

Conclusion: Although social, economic, and environmental factors might contribute substantially to the development of dental caries, we failed to demonstrate a clear relationship between maternal anxiety and social status and dental caries in children. We can therefore conclude that biological factors are decisive in the formation of dental caries among children.

[1]Yeditepe University, Faculty of Dentistry, Department of Pediatric Dentistry, İstanbul, Turkey
[2]Near East University, Faculty of Dentistry, Department of Pediatric Dentistry, Nicosia Mersin 10, Turkey

Corresponding author:
Damla Akşit-Bıçak, Near East University, Faculty of Dentistry, Department of Pediatric Dentistry, Near East Boulevard, 99138 Nicosia/TRNC Mersin 10, Turkey.
Email: damlaaksit@gmail.com

Introduction

Dental caries is one of the most common multifactorial chronic diseases affecting people of all ages worldwide and is caused by biological, social and psychological factors.[1] In addition to surgical and restorative treatment of carious lesions, determining the caries risk of individuals as a preventive approach has become extremely important in the management of dental caries.[2] Although many preventive and protective measures exist, dental caries remains a significant threat to the oral health-related quality life (OHRQoL) of individuals. Because young children do not have the skills and capabilities needed to administer their own health behaviors, parents are responsible for properly providing, modifying, and guiding their children's oral health care.[3] Parents' psychological status, behavior, and attitudes have many different effects on their children's general and oral health status. Children's oral and dental health is influenced by parental oral and dental health habits; thus, children acquire knowledge, attitudes, and habits related to oral health from their family. In the adoption of good oral health habits during childhood, the mother's attitude and behaviors are particularly important.[4] OHRQoL in children can be affected by many factors related to the mother. The mother's psychological state, in particular, can affect a child's entire life, including their general and oral health.[5] It has been shown that psychological problems, such as anxiety in the mother, may lead to insufficient support of the child's oral health care because such problems affect the general behavior of adults, impairing their functional level and changing their perception of oral health.[5–7]

Anxiety is apprehension and fear that is felt about a non-objective danger. Spielberger et al.[8] described two types of anxiety, state and trait anxiety. The type of anxiety that occurs when a dangerous but impermanent situation arises changes, according to the changing environment and situation, reflects a temporary mood called state anxiety. In some cases, however, people are continuously concerned about dangers in their environment. This type of anxiety is called trait anxiety. Trait anxiety is a permanent personality trait and a relatively stable characteristic in an individual, which can affect them psychologically and can strongly influence their academic and social life.[8–10]

There is published evidence that mothers who have neglected their oral health or treatment requirements do not give much importance to their child's oral health; thus, OHRQoL in these children is negatively affected.[11,12] Beljan et al.[13] found that children whose parents regularly encourage oral hygiene have better oral hygiene habits than children whose parents do not regularly encourage oral hygiene. Considering the relationship between the psychological state of parents and early childhood caries, it is important to emphasize that, in recent years, the focus of research has shifted to psychological and social factors associated with dental caries in children.[14–16] For example, parental education level is an important factor that affects the development of dental caries. A study conducted in Italy found that the child's development of dental caries increased as the level of maternal education decreased.[17] Investigators have also reported that the marital status of parents may affect development of dental caries in children.[18] According to this evidence, the aim of the present study was to evaluate the association of maternal anxiety and social status with caries formation in children.

Materials and methods

Recruitment of participants

Study participants consisted of pairs of children and their mothers who attended the

pediatric dental clinic of Yeditepe University. The children were chosen from among those with no mental and/or physical diseases, no need for emergency treatment, and no previous dental treatment at any clinic. Of the total parents approached, 19 refused to participate. Quota sampling was used to satisfy at least 40% of either sex for the children, at least 10% for mother's education of a middle school diploma or less, and at least 10% for mother's education of a university diploma or more.

Data collection

Parents were informed about the study and written/signed informed consent was obtained from all participants. The study protocol was approved by the Sabancı University, Research Ethics Council (FASS-2019-07).

Information regarding age, sex, birth order of the children, and mothers' education and marital status were collected using a questionnaire. In addition, the Turkish version[10] of the Spielberger Trait Anxiety Inventory[8] was used to determine trait anxiety levels of mothers participating in the current study (Appendix 1). The form comprises 20 items rated on a four-point Likert-type scale, with total scores ranging from 20 to 80. Direct scores in the inventory express negative feelings, and reverse scores indicate positive feelings. After obtaining the total for direct- and reverse-scored items, the total score for reverse items was subtracted from the total score for direct items. A predetermined constant value was added to this number; the invariant value for the trait anxiety inventory was 35. The numerical value obtained by adding the invariant value is the individual's anxiety score.[10] Scores were evaluated as follows: 20 to 39 points indicates low trait anxiety, 40 to 59 points indicates medium trait anxiety, and 60 to 80 points indicates high trait anxiety.

Children underwent intraoral examination while seated in a dental chair. The teeth were air dried and examined using a dental mirror. The dmft values for primary teeth and DMFT values for permanent teeth (d,D: decayed, m,M: missing, f,F: filled, t,T: total) were evaluated according to standards determined by the World Health Organization.[19] The overall values of DMFT and dmft were evaluated separately and calculated, following the related literature.[20,21] Any teeth missing owing to dental trauma, hypomineralization, or agenesis were not included in the DMFT/dmft scoring. All dental examinations and surveys were administered by a single clinician with a PhD in pediatric dentistry.

Statistical analysis

We used Poisson and negative binomial regression models to test whether the mother's Spielberger Trait Anxiety Inventory score was significantly associated with the number of dental caries in the children.[22] Models 1 and 3 used the trait anxiety score as the sole explanatory variable to explain the number of caries, with Poisson and negative binomial regression models, respectively. In other words, models 1 and 3 yielded bivariate regression results. In models 2 and 4, age, sex, child's birth order, mother's education level, and mother's marital status were added to the respective models as control variables. In all four models, positive coefficients were associated with a higher number of expected caries counts. Results of the analyses were generated using the *poisson* and *nbreg* commands in Stata 15 (StataCorp., College Station, TX, USA).

In cases where the dependent variables are overdispersed, Poisson regression may give biased results, and in such cases, negative binomial regression is preferred.[23] As Models 1 and 2 indicated overdispersion (demonstrated by likelihood ratio tests of

ln(α) significant at p < 0.001), negative binomial regression analysis was used in Models 3 and 4.

Results

Among the 258 children included in the study, 44% (109) had one or more caries, with an average of 3.1 total caries (standard deviation (SD) = 4.3) per child. In terms of sex, 42% of the children were girls, and 51% were the first child born in the family. Children's ages ranged from 6 to 15 years; the average age was 9.3 (SD = 2.6) years. A total of 96% of mothers reported that they were married, and 83% reported that their educational level was high school or above. Descriptive statistics for the variables are presented in Table 1.

Using Model 1, we did not find a significant relationship between the mother's trait anxiety score and the number of dental caries in the child. When looking at the control variables added in Model 2,

Table 1. Descriptive statistics for the study population.

Descriptive statistics	N (%)	min	max	range
Patient age (y)		6	15	12
Patient sex				
1 = Female	108 (42%)	1		
0 = Male	150 (58%)			
Mother's education level				
1 = Middle school or less	42 (17%)	1	3	2
2 = High school	156 (60%)			
3 = University	60 (23%)			
Mother's marital status				
0 = Married	247 (96%)			
1 = Single/divorced	11 (4%)			1
Child's birth order				
1 = First child	131 (51%)	1	4	3
2 = Second child	102 (40%)			
3 = Third child	17 (6%)			
4 = Fourth child or younger	8 (3%)			
N = 258				

child's age, female child, child with older siblings, mother's education level, and married status of the mother were inversely related to the number of dental caries. Model 1 and 2 regressions both showed overdispersion (χ^2 = 1590, p ≤ 0.000; χ^2 = 1338, p ≤ 0.000). In Models 3 and 4 with negative binomial regression estimators, no significant relationship was found between mother's trait anxiety score and the number of dental caries in their children. In these models, the age of the child remained statistically significant; the significance level of the children's sex (p = 0.090) and mother's education level (p = 0.076) decreased; and the child's birth order lost statistical significance (Table 2). These decreases in significance levels were expected as Poisson regressions run on overdispersed data and often underestimate standard errors. Nonetheless, our findings consistently showed that female sex and older age of children, and higher education level of the mother, significantly decreased the expected caries count.

Discussion

Limited studies have debated whether anxiety in the mother may lead to insufficient support of oral health care in their child, leading to the formation of dental caries in children. Gavic et al.[24] conducted a study to assess the level of depression, anxiety, and stress among parents whose children had early-childhood caries. The results of that study showed a significant relationship between dental caries and parental anxiety. In southern Brazil, Costa et al.[5] also investigated the influence of depressive and anxiety symptoms among young mothers on their children's OHRQoL. The results from that study showed that poorer OHRQoL in children was associated with maternal depression and anxiety symptoms. The results of the studies by Gavic et al.[24] and Costa et al.[5] contradict

Table 2. Relationship between values of decayed, missing, filled, and total permanent/primary teeth (DMFT/dmft), maternal Trait Anxiety Inventory (TAI) scores, age, sex, education level, maternal marital status, and child's birth order among study participants.

	Model 1	Model 2	Model 3	Model 4
Maternal TAI	−0.0041	−0.0077	−0.0039	−0.0232
	(0.0053)	(0.0059)	(0.0183)	(0.0192)
Age		−0.128***		−0.212***
		(0.015)		(0.064)
Sex		−0.336***		−0.443[†]
(female=1)		(0.077)		(0.261)
Child's birth order		−0.160**		−0.132
		(0.054)		(0.178)
Educational level		−0.312***		−0.369[†]
(1=middle school or		(0.059)		(0.208)
less, 2=high school,				
3=university)				
Marital status		0.645***		0.558
(single/divorced=1)		(0.156)		(0.660)
Constant	1.365***	3.641***	1.352	5.254***
	(0.254)	(0.364)	(0.885)	(1.449)
ln(α)			1.324***	1.227***
			(0.128)	(0.137)
N	265	249	265	249
Estimator	Poisson regression	Poisson regression	Negative binomial regression	Negative binomial regression

[†]$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. Dependent variable = DMFT/dmft.
Beta coefficients shown; respective standard errors in parentheses.

those obtained in our study, in which no significant relationship was found between the mother's anxiety level and children's DMFT/dmft scores. However, the present study results are in accordance with those obtained in research carried out by Gichu et al.,[25] who determined the influence of parental anxiety on children's behavior during treatment in relation to caries development in children age 3 to 5 years in Nairobi. The researchers found no association between parental/guardian anxiety and the children's behavior or dental caries formation in the child. The reason for the differing results may be owing to the performance (i.e., functioning) improving with a certain level of anxiety. If anxiety continues to increase, performance begins to decline.[26] It can thus be concluded that

when anxiety is excessive or inappropriate, performance may decrease. Based on these results, we cannot say that anxiety will only lead to negative outcomes. Certain types of anxiety may cause mothers to provide better oral care for their children. In addition, as caries is a multifactorial disease, many factors such as the presence of cryogenic bacteria, diet, socioeconomic factors, and behavioral characteristics play a role in its development. Caries risk indicators are not directly involved in caries formation. Socioeconomic and epidemiological factors as well as behavioral characteristics are examples of other influencing factors in caries development.[27]

The other aim of the present study was to evaluate the effect of social status on caries formation in children. The results of

our study showed that DMFT/dmft scores among children whose mothers were married were decreased, but this relationship was not found to be statistically significant. On the contrary, Bolin et al.[28] revealed a relationship between high caries formation and unmarried status of the mother. Alm et al.[29] demonstrated a relationship between high caries prevalence among 15-year-old children and factors such as "being a single mother when the child was 1 year old" and "the mother feeling she has sole responsibility for the child". Plutzer et al.[30] stated that single mothers, especially those with professional obligations, may be less effective in managing their children's oral health.

Cianetti et al.[17] showed that low family income and low education levels in parents may lead to the presence of dental caries in their children. Bolin et al.[28] found a relationship between high dental caries prevalence in preschool children and low education levels among their parents. Young mothers and caregivers and low education levels can lead to poor dental health. Kılınç et al.[31] showed that the number of dental caries decreased as the level of maternal education increased. Younger and less educated parents may not be aware of the necessity of good oral and dental health.[32] Similarly, we found that the number of dental caries in children decreased as the level of education of the mother increased, although this relationship was not statistically significant.

Sex differences in dental caries formation have also been widely observed, with many studies showing that females are at higher risk of developing caries lesions than males.[33,34] Some reports in the literature have demonstrated the opposite finding,[35–36] with the prevalence of caries found to be higher in boys than in girls. In line with reports by Saravanan et al.[35] and Zerfowski et al.,[36] we found that girls had lower DMFT/dmft scores than boys,

but this relationship was not significant. The cause of higher caries prevalence in boys may be owing to early eruption of the primary teeth, and thus, that boys' teeth remain in the oral cavity for a longer period than girls' teeth.[35]

An important limitation of our study is its limited geographical scope. Whereas quota sampling was used to ensure inclusion of a sufficient number of mothers with lower educational (hence, socioeconomic) backgrounds, emulation may cause these mothers to adopt "best practices" from their better educated peers. However, such emulation would constitute a conservative bias and make it more difficult to find a negative relationship between the mother's education level and caries incidence in the child. Nevertheless, our results consistently showed such a negative effect. Another limitation is that we included ages involving mixed dentition. Primary teeth are more susceptible to caries than permanent teeth and during the mixed dentition phase, the teeth are at relatively high risk of caries.[37] In addition, research in developmental psychology has demonstrated that parental behavior has a potent effect on children's oral health during the ages with mixed dentition.[38] Therefore, our findings contribute to literature in this respect.

Conclusion

Although social, economic, and environmental factors contribute significantly to the development of dental caries, we failed to demonstrate a clear relationship between maternal anxiety and social status and dental caries. We can thus conclude that biological factors are decisive in the formation of dental caries in children. Today, it is accepted that the mother's attitudes and behaviors affect her child's quality of life, as well as general and oral health. Therefore, we suggest that it is crucial to educate and provide information about

the importance and consequences of child-hood caries, to raise awareness among mothers. Furthermore, parents should receive support with respect to social issues, to further improve the physical and psychological health of their family.

Finally, an important extension to this study might be to look at the relationship between state (immediate) anxiety levels in the mother and caries incidence in the child. Such a study would require panel data with repeated measurements made every 3 or 6 months over a 5-year period.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

ORCID iD

Damla Akşit-Bıçak https://orcid.org/0000-0002-0375-9026

References

1. Zemaitiene M, Grigalauskiene R, Andruskeviciene V, et al. Dental caries risk indicators in early childhood and their association with caries polarization in adolescence: a cross-sectional study. *BMC Oral Health* 2017; 17: 2.
2. Suneja ES, Suneja B, Tandon B, et al. An overview of caries risk assessment: rationale, risk indicators, risk assessment methods, and risk based caries management protocols. *Indian J Dent Sci* 2017; 9: 210–214.
3. Togoo RA, Luqman M, Al-Hammadi AA, et al. Caregivers' knowledge, attitudes, and oral health practices for infants attending day-care centers in two cities in southern Saudi Arabia. *Gulf Med J* 2017; 6: 35–41.
4. Castilho AR, Mialhe FL, Barbosa T de S, et al. Influence of family environment on children's oral health: a systematic review. *J Pediatr* 2013; 89: 116–123.
5. Costa FDS, Azevedo MS, Ardenghi TM, et al. Do maternal depression and anxiety influence children's oral health-related quality of life? *Community Dent Oral Epidemiol* 2017; 45: 398–406.
6. Wright KD, Reiser SJ and Delparte CA. The relationship between childhood health anxiety, parent health anxiety, and associated constructs. *J Health Psychol* 2017; 22: 617–626.
7. Tomar B, Bhatia NK, Kumar P, et al. The psychiatric and dental interrelationship. *Delhi Psychiatry J* 2011; 14: 138–142.
8. Spielberger CD, Gorsuch RL and Lushene RE. *Manual for the state-trait anxiety inventory*. Palo Alto, California: Consulting Psychologists Press, 1970.
9. Tovilović S, Novović Z, Mihić L, et al. The role of trait anxiety in induction of state anxiety. *Psihologija* 2009; 42: 491–504.
10. Öner N and Le Compte A. *Durumluk-sürekli kaygı envanteri el kitabı*. 2nd ed. İstanbul: Boğaziçi University Press, 1985.
11. Lourenço CB, Saintrain MV and Vieira AP. Child, neglect and oral health. *BMC Pediatr* 2013; 13: 188.
12. Goettems ML, Ardenghi TM, Romano AR, et al. Influence of maternal dental anxiety on the child's dental caries experience. *Caries Res* 2012; 46: 3–8.
13. Beljan M, Puharić Z, Žulec M, et al. Parent's and children's behavior and knowledge about oral health. *Acta Med Croatica* 2016; 70: 165–171.
14. Wigen TI and Wang NJ. Parental influences on dental caries development in preschool children. An overview with emphasis on recent Norwegian research. *Norsk Epidemiologi* 2012; 22: 13–19.
15. Delgado-Angulo EK, Sabbah W, Suominen AL, et al. The association of depression and anxiety with dental caries and periodontal disease among Finnish adults. *Community Dent Oral Epidemiol* 2015; 43: 540–549.

16. Poutanen R, Lahti S, Tolvanen M, et al. Parental influence on children's oral health-related behavior. *Acta Odontol Scand* 2006; 64: 286–292.

17. Cianetti S, Lombardo G, Lupatelli E, et al. Dental caries, parents educational level, family income and dental service attendance among children in Italy. *Eur J Paediatr Dent* 2017; 18: 15–18.

18. Piva F, Pereira JT, Luz PB, et al. A longitudinal study of early childhood caries and associated factors in Brazilian children. *Braz Dent J* 2017; 28: 241–248.

19. World Health Organization. *Oral health survey basic methods*. 4th ed. Geneva: WHO, 1997.

20. Akhter R, Hassan NM, Martin EF, et al. Risk factors for dental caries among children with cerebral palsy in a low-resource setting. *Dev Med Child Neurol* 2017; 59: 538–543.

21. Supriatna A, Fadillah RPN and Nawawi AP. Description of dental caries on mixed dentition stage of elementary school students in Cibeber Community Health Center. *Padjadjaran Jour of Dent* 2017; 29: 153–157.

22. Long JS. *Regression models for categorical and limited dependent variables*. USA: SAGE Publications, 1997.

23. Long JS and Freese J. *Regression models for categorical dependent variables using Stata*. College Station, TX: Stata press, 2006.

24. Gavic L, Tadin A, Mihanovic I, et al. The role of parental anxiety, depression, and psychological stress level on the development of early-childhood caries in children. *Int J Paediatr Dent* 2018; 28: 616–623.

25. Gichu N. *Influence of parental anxiety on children's behaviour during dental treatment about the caries experience among 3-5-year-olds in three public dental clinics in Nairobi*. MDS Thesis, University of Nairobi, Kenya. 2009.

26. James IM. Les etats d'anxietes. *Psychologie médicale* 1984; 16: 2555–2557.

27. Shaffer JR, Polk DE, Feingold E, et al. Demographic, socioeconomic, and behavioral factors affecting patterns of tooth decay in the permanent dentition: principal components and factor analyses. *Community Dent Oral Epidemiol* 2013; 41: 364–373.

28. Bolin AK, Bolin A, Jansson L, et al. Children's dental health in Europe. *Swed Dent J* 1997; 21: 25–40.

29. Alm A, Wendt LK, Koch G, et al. Oral hygiene and parent-related factors during early childhood in relation to approximal caries at 15 years of age. *Caries Res* 2008; 42: 28–36.

30. Plutzer K and Keirse MJ. Influence of first-time mothers' early employment on severe early childhood caries in their child. *Int J Pediatr* 2012; 2012: 820680.

31. Kılınç G. Tooth decay in children and the assessment of associated factors. *DEÜ Tıp Fakültesi Dergisi* 2018; 32: 219–226.

32. LaValle PS, Glaros A, Bohaty B, et al. The effect of parental stress on the oral health of children. *J Clin Psychol Med Settings* 2000; 7: 197–201.

33. Martinez-Mier EA and Zandona AF. The impact of gender on caries prevalence and risk assessment. *Dent Clin North Am* 2013; 57: 301–315.

34. Shaffer JR, Leslie EJ, Feingold E, et al. Caries experience differs between females and males across age groups in Northern Appalachia. *Int J Dent* 2015; 2015: 938213.

35. Saravanan S, Madivanan I, Subashini B, et al. Prevalence pattern of dental caries in the primary dentition among school children. *Indian J Dent Res* 2005; 16: 140–146.

36. Zerfowski M, Koch ML Niekusb U, et al. Caries prevalence and treatment needs of 7 to 10 - year-old school children in South western Germany. *Community Dent Oral Epidemiol* 1997: 25: 348–351.

37. Lynch RJ. The primary and mixed dentition, post-eruptive enamel maturation and dental caries: a review. *Int Dent J* 2013; 63: 3–13.

38. Saied-Moallemi Z, Virtanen JI, Ghofranipour F, et al. Influence of mothers' oral health knowledge and attitudes on their children's dental health. *Eur Arch Paediatr Dent* 2008; 9: 79–83.

Appendix 1: Trait Anxiety Inventory (TAI)

TRAIT ANXIETY INVENTORY (TAI)

Date: ....   Name: ....   Age: ....

DIRECTIONS: A number of statements that people use to describe themselves are given below. Read each statement and then circle the appropriate response to the right of the statement to indicate how you generally feel. There are no right and wrong answers. Do not spend too much time on any one statement but give the answer that seems to best describes your general feelings.

S. No.		Almost never	Sometimes	Often	Almost always
1.	I feel well	1	2	3	4
2.	I feel nervous and restless	1	2	3	4
3.	I feel satisfied with myself	1	2	3	4
4.	I wish I could be as happy as others seem to be	1	2	3	4
5.	I feel like a failure	1	2	3	4
6.	I feel rested	1	2	3	4
7.	I am "calm, cool, and collected"	1	2	3	4
8.	I feel that difficulties are piling up and that I cannot overcome them	1	2	3	4
9.	I worry too much over things that really don't matter	1	2	3	4
10.	I am happy	1	2	3	4
11.	I have disturbing thoughts	1	2	3	4
12.	I lack self-confidence	1	2	3	4
13.	I feel secure	1	2	3	4
14.	I make decisions easily	1	2	3	4
15.	I feel inadequate	1	2	3	4
16.	I am content	1	2	3	4
17.	Unimportant thoughts run through my mind and bother me	1	2	3	4
18.	I take disappointments so keenly that I can't put them out of my mind	1	2	3	4
19.	I am a steady person	1	2	3	4
20.	I get into a state of tension or turmoil as I think over my concerns and interests	1	2	3	4