

The prevalence and influencing factors of gag reflex in children aged 7–14 years in the dental setting

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Abstract

Background: Gag reflex may occur in patients of all ages and often considered having a multifactorial aetiology.

Objective: The aim of the study was to evaluate the prevalence and influencing factors of gag reflex in Turkish children aged 7–14 years in the dental setting.

Methods: This cross-sectional study was carried out among 320 children aged between 7 and 14 years. First, an anamnesis form which include sosyodemographic status, monthly level of income, children past medical and dental experiences was filled by mothers. Children's fear levels were evaluated using the Dental Subscale of Children's Fear Survey Schedule (CFSS-DS) while mother's anxiety levels using the Modified Dental Anxiety Scale (MDAS). The revised dentist section of gagging problem assessment questionnaire (GPA-R-de) was used for both children and mothers. Statistical analysis was done with SPSS program.

Results: The prevalence of gag reflex among children was 34.1%, among mothers was 20.3%. The association between child and mother gagging was found statistically significant ($\chi^2 = 53.121, p < 0.001$). When the mother of the child gagged, the risk of child gagging increases 6.83 times ($p < 0.001$). Higher CFSS-DS scores of children increase risk of gagging (OR = 1.052, $p = 0.023$). Children who were previously treated mostly in public hospitals significantly more likely to gag compared with private dental clinics (OR = 10.990, $p < 0.001$).

Conclusion: It was concluded that negative past dental experiences, previous dental treatments with local anaesthesia, history of hospital admission, number and place of previous dental visits, dental fear level of children, and low education level and gagging of mother have an influence on the gagging of children.

KEYWORDS

children, dentistry, gagging, mother

1 | INTRODUCTION

Gag reflex is an involuntary physiological response of a human body to eliminate foreign objects or noxious material from the pharynx, larynx or trachea.¹ It is controlled by nerve endings on the soft palate, the pharynx and the pharyngeal part of the tongue. It may be

an acquired reflex triggered by visual, olfactory, acoustic, psychical, toxic or chemical stimuli.²

Gag reflex may occur in patients of all ages and often considered having a multifactorial aetiology. Anatomic, psychologic, iatrogenic, local and systemic factors influence the gag reflex.³ It is difficult to distinguish somatogenic or psychogenic factors because physical

stimuli may also provoke gagging of psychogenic factors. Gagging can occur with classical or operating conditioning.² The gagging can also occur during various dental procedures, but particularly during impression of maxillary arch, intraoral radiographs, restorative treatments in posterior teeth, periodontal scaling, and placement of suction tubes or rubber dam.⁴ Van houtem et al.(2015) reported that 8.2% of the adult patients had gag reflex during dental procedures.⁵ In the study of Debs and Aboujaoude (2017), they found that moderate gagging occurred in 42.9% of children during impression taking.⁶ According to Katsouda et al.(2019), 28.5% of children aged 4–12 years gagged on the gagging problem assessment.⁷ The appearance of a gag reflex during dental treatment and even during tooth brushing can severely limit both the patient's ability to accept quality dental care and the clinician's ability to provide it.⁵

In previous studies, it was reported that dental fear and anxiety have been implicated in occurrence of gag reflex and severity of it.^{2,8,9} On the contrary, it has been reported that a positive association between children's dental anxiety and parental, especially maternal, factors.^{10,11}

In the accessible literature, prevalence of the gag reflex in children is limited and there was no study which evaluated both child and parental factors. The aim of the study was to evaluate the prevalence and influencing factors of gag reflex in Turkish children aged 7–14 years in the dental setting.

2 | MATERIALS AND METHODS

2.1 | Ethical approval and study sample

The local ethics committee approved the study (Approval no:2019/201), and the study was carried out in accordance with the guidelines of Helsinki Declaration. Written informed consents were obtained from all parents, and verbal assents were obtained from all children prior to participation after clearly explaining the purpose of the study.

This cross-sectional study was carried out among children aged between 7 and 14 years who were visiting the paediatric dentistry department for routine dental treatment. A power calculation was performed according to a previous similar study⁸ with a precision of 6%, $\alpha = 0.05$ and $\beta = 0.95$. Estimated sample size was found as 267. Considering possible dropouts, 320 children (153 female and 167 male) and their mothers who met the inclusion criteria were included in the study. Inclusion and exclusion criteria were tabularized in [Table 1](#).

TABLE 1 Inclusion and exclusion criteria of the study

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"> • Children aged 7–14 accompanied by their mother, who agreed to fill out the questionnaire and agreed to be examined. • Children/mothers can speak and understand the Turkish language • Children/mothers have at least one past dental procedure 	<ul style="list-style-type: none"> • Children/mothers with mental or physical disabilities • Diagnosed systemic diseases of children/mothers • Pregnant mothers • Children/mothers with a dental emergency • Children who had been to present clinic

2.2 | Questionnaire forms

The children and mothers were separately taken a waiting room to complete the questionnaires for the study, and a research assistant (M.T.) read the questions aloud. In the study, different questionnaire forms were created for children and their mothers. First, an anamnesis form which include sosyodemographic status, monthly level of income, children past medical and dental experiences was filled by mothers. Children's fear levels were evaluated using the Dental Subscale of Children's Fear Survey Schedule (CFSS-DS) while mother's anxiety levels using the Modified Dental Anxiety Scale (MDAS). The revised dentist section of gagging problem assessment questionnaire (GPA-R-de) was used for both children and mothers and children.

In this study, the CFSS-DS, a validity and reliability study of which was previously conducted for Turkish children, was used to measure children's dental fear.¹² It includes a 15-item measure of children's fear of dental treatment and equipment. The response scale ranges from 1 (I'm not afraid) to 5 (I'm scared). Total scores range between 15 and 75, and higher scores represent greater fear.

The MDAS was used for the assessment of dental anxiety of mothers. The MDAS is a quick and efficient questionnaire form for dental researchers which was found to be a reliable method of assessing dental anxiety of Turkish patients.^{13,14} It includes questions about dental treatments and additional question about a local anaesthetic injection. Each question has five scores ranging from 'not anxious', to 'extremely anxious', in an ascending order from 1 to 5. The values range from 5 (no anxiety) to 25 (high anxiety).¹⁴

2.3 | Dental examination for gagging

Children and mothers were separately taken to the clinic where there were no other patients. The dental examination of patients was conducted in a supine position with the aid of a standard dental mirror by another research assistant (S.B.F.) who was blinded about answers of previous questionnaire forms.

The validity of the original GPA-de scale was found reliable for Turkish patients by Akarslan et al.(2010) but this examination was done by touching various six sites in the oral cavity with a dental mirror.¹⁵ van Linden van den Heuvel et al. (2015) revised this scale (GPA-R-de) and added two sides for tongue examination.³ The revised version of dentist section of the gagging problem assessment questionnaire (GPA-R- de) was used for the gagging examination of mothers and children.³ The examination consisted of placing the

dental mirror at 8 different anatomical sites in the mouth. A patient was defined as a gagged if he/she gags at any of the 8 sites.³

For the calibration of the research assistant (S.B.F.), 10% of the patients (32 children and mothers) were re-invited in 2 week later and the intra-examiner coefficient was found near perfect agreement (Cohen's Kappa value was 0.96) for gagging.

2.4 | Statistical analysis

Data were analysed with the SPSS software package program (Version 23, IBM SPSS Statistics, IBM Corporation). The continuous data were presented as mean \pm SD and median (minimum-maximum) values; categorical data were presented as number (*n*) and percentage (%). Normality of the data was tested using the Kolmogorov-Smirnov test. Descriptive statistical analyses of continuous data were performed with Mann-Whitney *U*-test; categorical parameters were performed with a chi-square test. Spearman's rho was used for the correlations. Univariate and multivariate binary logistic regression (categorical measures as gagging or not gagging) analyses were done with the enter method. The level of significance was set at $p < 0.05$.

3 | RESULTS

In this study, 320 children (153 female, 167 male) and their mothers were included. The prevalence of gag reflex among children was 34.1%. This rate was 28.1% among females, while 39.5% among males, the difference was found statistically significant ($\chi^2 = 4.633$, $p = 0.034$). The descriptive statistics of variables were given in Table 2.

The mean age of the children was 9.71 ± 2.23 . The mean age of children who gagged was 9.51 ± 2.27 and who did not gagged was 9.81 ± 2.21 . The difference was not statistically significant ($U = 1.314$, $p > 0.05$).

The mean CFSS-DS score of children was 26.58 ± 9.16 . The difference between sex was not statistically significant ($U = 0.981$, $p > 0.05$). There was no correlation between age and the CFSS-DS score (Spearman's rho = -0.079 , $p > 0.05$). The children who gagged have higher CFSS-DS scores than those who did not gag ($U = 4.947$, $p < 0.001$). The CFSS-DS scores of children correlated with the MDAS scores of mothers (Spearman's rho = 0.347 , $p < 0.001$).

The prevalence of gag reflex among mothers was 20.3%. The association between child and mother gagging was found statistically significant ($\chi^2 = 53.121$, $p < 0.001$). Among the mothers who gagged, 72.3% of their children gagged, too.

The median of the MDAS score of mothers whose children gagged was higher than whose children did not gag but the difference was not found statistically significant ($U = 1.872$, $p > 0.05$).

Univariate and multivariate binary logistic regression models were used for predicting gagging of children during dental treatment, and results were given in Table 3. It was found that gagging of

mother, education level of mother, past negative dental treatments, past invasive dental treatments, history of hospital admission, number and place of dental visits, and CFSS-DS scores have influence on gagging. In the presence of hospital admission history, we found a statistically significant risk of gagging (OR = 4.209, $p = 0.003$). The risk of gagging was increase 2.625 times in the children who have past negative dental experiences ($p = 0.006$). When the mother of the child gagged, the risk of child gagging increases 6.83 times ($p < 0.001$). Higher CFSS-DS scores of children increase risk of gagging (OR = 1.052, $p = 0.023$). Children who visited the dentist over 5 times were found to have a reduced risk of gagging compare to children who visited 1–3 times (OR = 0.019, $p = 0.028$). Children who were previously treated mostly in public or university hospitals were significantly more likely to gag compared with private dental clinics (OR = 10.990, 7.801, $p < 0.001$).

4 | DISCUSSION

In the accessible literature, studies on the prevalence of gag reflex are very limited, especially among children. Katsouda et al.(2017) reported prevalence of gagging as 6% among Greek children aged 8–14 years in school-based setting.⁸ Same authors reported prevalence of gag reflex as 28.5% among children aged 4–12 years in clinical setting, and they justify the increase of the prevalence in clinical conditions.⁷ The prevalence of gag reflex among Turkish children was examined in one study, and the prevalence was reported as 29.5% varying in severity from 1 to 3 in children aged between 6 and 14 years.¹⁶ In this present study, the prevalence of gag reflex among 7–14 years old Turkish children was found as 34.1%. The higher prevalence of this study is most likely because of differences between measurements of gagging. In the previous study among Turkish children, the Classification of Gagging Problem Index was used for severity of gagging.¹⁶ In the studies of Katsouda et al. (2017,2019), they examined gagging by the original version of dentist section of GPA which consist six sides.^{7,8} In the current study, the revised version of GPA (GPA-R-de) method was used to diagnose which included tongue examination for better accuracy in the GPA method and children coded as gagged if they gag any of the eight sites.³

In this study, the prevalence of gag reflex was higher in males than in females, similar to previous studies.^{7,16} However, the sex of the children was not found to be a risk factor for gagging. In previous studies, the results were inconsistent according to the relationship between age and gagging. In a randomised-controlled study among 6–12 years old children, a negative correlation between age and gagging was found in the control group, while no correlation was found in the treatment group.¹⁷ In another studies, younger children have a greater tendency to gag.^{7,16} Besides that, Katsouda et al.(2017) did not find any significant difference in children aged between 8 and 14 years.⁸ To give accurate answers to the questions asked in the current study, children between the ages of 7–14 were selected, and the difference between children who gagged or did not gag was not found statistically significant. Additionally, the age of the child was

TABLE 2 Descriptive statistics of different parameters according to gagging of children

Parameters	Children who gagged	Children who did not gagged
Age of children		
Mean \pm Standard deviation	9.51 \pm 2.27	9.81 \pm 2.21
Median (minimum–maximum)	9 (7–14)	10 (7–14)
Sex of children		
Female <i>n</i> (%)	43 (28.1%)	110 (71.9%)
Male <i>n</i> (%)	66 (39.5%)	101 (60.5%)
CFSS-DS scores of children		
Mean \pm Standard deviation	30.17 \pm 9.76	24.73 \pm 8.27
Median (minimum–maximum)	28 (17–52)	22 (15–49)
History of hospital admission		
Absent <i>n</i> (%)	78 (29.9%)	183 (70.1%)
Present <i>n</i> (%)	31 (57.5%)	28 (47.5%)
Past negative medical experience		
Absent <i>n</i> (%)	86(30.6%)	195 (69.4%)
Present <i>n</i> (%)	23(59%)	16 (41%)
Number of dental visits		
1–3 times <i>n</i> (%)	92 (39.3%)	142 (60.7%)
3–5 times <i>n</i> (%)	15 (22.7%)	51 (77.3%)
>5 times <i>n</i> (%)	2 (10%)	18 (90%)
Place of dental visit		
Private clinic/ hospital <i>n</i> (%)	13 (16.7%)	65 (83.3%)
Public hospital <i>n</i> (%)	61 (42.7%)	82 (57.3%)
University hospital <i>n</i> (%)	35 (35.4%)	64 (64.6%)
Past negative dental experience		
Absent <i>n</i> (%)	48 (28.2%)	122 (71.8%)
Present <i>n</i> (%)	61 (40.7%)	89 (59.3%)
Past dental treatments		
Non-invasive treatments without local anaesthesia	76 (42.9%)	101 (57.1%)
Invasive treatments with local anaesthesia	33 (23.1%)	110 (76.9%)
Age of mother		
Mean \pm Standard deviation	35.51 \pm 5.46	37.07 \pm 5.48
Median (minimum–maximum)	35 (24–48)	37 (28–61)
Education level of mother		
Primary school <i>n</i> (%)	70 (39.3%)	108 (60.7%)

(Continues)

TABLE 2 (Continued)

Parameters	Children who gagged	Children who did not gagged
High school <i>n</i> (%)	24 (29.6%)	57 (70.4%)
University <i>n</i> (%)	15 (24.6%)	46 (75.4%)
Level of income		
Low <i>n</i> (%)	23 (21.1%)	35 (16.6%)
Medium <i>n</i> (%)	59 (54.1%)	132 (62.6%)
High <i>n</i> (%)	27 (24.8%)	44 (20.9%)
Gagging of mother		
Absent <i>n</i> (%)	62 (24.3%)	193 (75.7%)
Present <i>n</i> (%)	47 (72.3%)	18 (27.7%)
MDAS scores of mother		
Mean \pm Standard deviation	9.39 \pm 4.17	8.45 \pm 3.63
Median (minimum–maximum)	9 (5–24)	8 (5–24)

not found as a risk factor for gagging in this study. The different results were related to varied sampling age, sample size, different measurements and ethnicity.

In the clinical examination, it was found that higher dental fear scores increase the risk of gag reflex. The results were consistent with previous studies.^{5,7,15,16,18} Dental anxiety of children is mostly related to a family history of dental anxiety.^{19,20} But, in the present study, dental anxiety levels of mothers correlated with child dental fears but did not influence the children gagging. In a study, it was stated that dental anxiety gradually decreased when paediatric patients visited the dentist at regular intervals.²¹ In the current study, that children who visit the dentist more frequently have less gagging also proves the accuracy of the relation between anxiety and gagging. In line with these findings, not only dental anxiety but also the gag reflex will be managed with a correct behaviour management technique to be applied to the child patient.

Parental factors such as age, level of income and anxiety were not associated with gag reflex of children. Despite that, gagging of the mother and education level of the mother were associated with child gagging. The gagging of the mother can be explained because neutral stimuli are closely related to the gag reflex and the results of studies reporting that gagging can occur with conditioning by different mechanisms. The functional component of a condition may be strongly influenced by an individual's reaction to stressful events, which is referred to as learning history.²² Bassi et al. (2004) gave the example of a patient who inadvertently gagged and learned to associate this with temporary suspension of dental treatment.² Authors interpreted that gagging may be thought to be a more socially acceptable reason for not having dental treatment than admitting to being dentally anxious. Based on this fact for the present study, it is thought that children with gag reflex may have been affected by seeing their mothers gag before or by their mothers discussing their gag history. Children were more likely to develop a reflection and similar attitude, thus

TABLE 3 Univariate and multivariate logistic regression models with influencing factors for children's gagging

		Multivariate		Univariate	
		OR (95% CI)	p value	OR (95% CI)	p value
Age of children		0.973 (0.831–1.140)	0.737	0.941 (0.848–1.046)	0.260
Sex of children (Ref. female)	Male	0.971 (0.498–1.896)	0.386	1.672 (1.045–2.673)	0.032*
CFSS-DS scores of children		1.056 (1.016–1.098)	0.006*	1.067 (1.04–1.096)	<0.001**
History of hospital admission (Ref. absent)	Present	3.609 (1.557–8.364)	0.003*	2.598 (1.461–4.619)	0.001*
Past negative medical experience (Ref. absent)	Present	2.083 (0.691–6.275)	0.192	3.259 (1.64–6.477)	0.001*
Number of dental visits (Ref. 1–3 times)	3–5 times	0.615 (0.253–1.499)	0.285	0.454 (0.241–0.855)	0.020*
	>5 times	0.107 (0.015–0.763)	0.026*	0.171 (0.39–0.757)	0.224
Place of dental visit (Ref. Private clinic)	Public hospital	7.332 (2.791–19.262)	<0.001**	3.72 (1.882–7.353)	<0.001**
	University hospital	4.966 (1.886–13.071)	0.001*	2.734 (1.325–5.641)	0.006*
Past negative dental experience (Ref. absent)	Present	2.625 (1.317–5.232)	0.006*	1.742 (1.093–2.778)	0.020*
Past dental treatments (Ref. invasive treatments with local anaesthesia)	Non-invasive treatments	0.476 (0.227–1.001)	0.050*	0.399 (0.244–0.651)	<0.001**
Age of mother		0.959 (0.898–1.024)	0.214	0.946 (0.904–0.990)	0.017*
Education level of mother (Ref. Primary school)	High school	0.383 (0.168–0.868)	0.022*	1.988 (1.032–3.830)	0.040*
	University	0.476 (0.193–1.178)	0.108	1.291 (0.608–2.742)	0.506
Level of income (Ref. low)	Medium	0.738 (0.316–1.721)	0.482	0.680 (0.370–1.251)	0.215
	High	0.835 (0.295–2.366)	0.735	0.934 (0.458–1.902)	0.850
Gagging of mother (Ref. absent)	Present	9.686 (4.325–21.689)	<0.001**	8.128 (4.399–15.019)	<0.001**
MDAS scores of mothers		0.950 (0.867–1.040)	0.263	1.065 (1.003–1.130)	0.038
Constant			0.198		

Note: Cox & Snell R^2 : 0.340, Nagelkerke R^2 : 0.470, Accuracy: 79.1%.

Abbreviations: CI, confidence level; OR, odds ratio; Ref., reference.

* $p \leq 0.05$; ** $p < 0.001$.

resulting in the development of gagging.²³ The lower education level of mother was also found as a risk factor for child gagging in the study. The result is consistent with the study which reported that the adult patients who reported to gag reflex have a lower level of education than those who did not report gagging during dental treatment.⁵

Having knowledge about past dental experience is an important point in helping to develop cooperation with paediatric patients, choosing appropriate behavioural management techniques, and easing possible dental anxiety.^{24,25} In the current study, negative past dental experiences, previous dental treatments with local anaesthesia and history of hospitalisation increase the risk of gagging. The results were in line with studies which reported that gagging can be stimulated by changes related to the children's cognitions about their past dental experiences.^{26,27} In addition, in children with a history of hospitalisation, anxiety and gagging may be triggered due to painful procedures, exposure to bad smells, separation from parents, restricted movements.²⁸

Number of dental visits also associated with gagging; children who visited the dentist more were found to have a reduced risk of gag. The result was consistent with the fact that the children's

experiences with the dentist helped them learn to cope with having instruments in their mouth and gagging.¹⁸ Another findings of the present study were the risk of gagging in children who were previously treated mostly in private clinics was found to be lower than in public or university hospitals. In Turkey, public or university hospitals are overcrowded than private clinics. So, this result can be related to the reduction of the dentist's chair time for a patient, long waits in the waiting room, behaviour of the dentist, type of treatments or environmental factors such as noise which increases the anxiety or gag reflex.^{5,22,29}

Although the present study contains results that will form a stepping stone for future studies in many ways, it has few limitations. Mothers were included in the study as it was thought to be more closely related to child care. However, not knowing the gagging status of the fathers or other family members is one of the limitations of the study, so more studies are needed to reach more definitive conclusions on this issue. Another limitation was that the study focused solely on a subjective measure of the child's dental fear and the mother's dental anxiety. In future studies, objective measures of anxiety, such as heart rate, can also correlate with gagging. In the study, gagging was only grouped as present or absent, but not

graded according to severity. The effect of factors that may be related to the severity of gagging is also thought to be one issue that should be evaluated.

5 | CONCLUSION

The prevalence of gagging among a group of Turkish children aged between 7 and 14 was found as 34.1%. Besides the limitations of this study, it was concluded that negative past dental experiences, previous dental treatments with local anaesthesia, history of hospital admission, number and place of previous dental visits, and level of dental fear have an influence on the gag reflex of child patients. Also, low education level and gagging of mother were found as a risk factors for child gagging. The knowledge of risk factors of gag reflex and its management is essential for a successful dental treatment. Since most of the influencing factors are associated with dental anxiety, dentists can both reduce anxiety and prevent the formation of iatrogenic gag reflex with appropriate behavioural management. Future longitudinal studies are needed to evaluate the causal factors of gag reflex in children.

AUTHOR CONTRIBUTIONS

B.G.T. conceptualised and designed the study, carried out the analyses and wrote the manuscript, critically reviewed and revised the manuscript; S.B.F. conceptualised and designed the study, collected the data of the study; M.T. collected the data of the study and wrote the manuscript; T.Y. critically reviewed and revised the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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