

# Self-reported gagging in dentistry: prevalence, psycho-social correlates and oral health

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**SUMMARY** Although gagging has a profound effect on the delivery of dental care, it is a relatively under-investigated phenomenon. This study aimed to derive a prevalence estimate of gagging during dental treatment based on patient-reported information, to determine some socio-demographic and psychological correlates and to assess the relationship of gagging with self-reported oral health and avoidance of dental care. Data were collected with a survey among Dutch twin families ( $n = 11\,771$ ). Estimated overall prevalence of gagging during dental treatment was 8.2% (95% CI 7.7–8.7). Patients' self-report of gagging was found to be significantly associated with female sex, a lower level of education and higher levels of dental trait anxiety, gagging-

related fears (e.g. fear of objects in the mouth), anxious depression and neuroticism. Gagging also appeared to be significantly associated with untreated cavities, gingival bleeding and wearing full dentures, but not with avoidance of dental care. It can be concluded that individuals who report to gag during dental treatment are moderately dentally anxious, fear-specific situations that can trigger a gagging response and, albeit visiting the dentist equally frequently, report to have a poorer oral health compared to those who do not gag.

**KEYWORDS:** gagging, dentistry, dental anxiety, oral health

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## Introduction

The tendency to gag during dental treatment or even during tooth brushing can be debilitating and severely limit both the patient's ability to accept good quality dental care and the clinician's ability to deliver it. Yet, gagging is a relatively unexplored area in dental research. For example, reliable estimates of its prevalence and socio-demographic correlates in the general population are completely lacking.

There are indications that individuals who suffer from an excessive gag reflex are more anxious about the dental treatment than those without (1, 2), but the relationship of gagging with other psychological

variables (e.g. specific fears of stimuli involving the dental setting, anxious depression or underlying general personality traits, such as neuroticism) is largely unknown.

As gagging is considered to be a negative experience (3), it is conceivable that specific dental stimuli that trigger a gag reflex could easily become aversive stimuli leading to avoidance behaviour (4, 5), with negative consequences for oral health (5). However, besides one effort (6), the relation of gagging with dental attendance and oral health has hardly been investigated.

The purpose of this study was to bridge the gap in the existing information about gagging during dental

treatment. The first aim of this study was to derive a prevalence estimate of gagging during dental treatment in a large sample based on patient-reported information. The second aim was to investigate some socio-demographic (i.e. gender, age, country of birth and level of education) and psychological (i.e. dental trait anxiety, fear of dental objects and situations, anxious depression and neuroticism) correlates of gagging and the relationship between patients' self-report of gagging and oral health (i.e. having untreated cavities, bleeding of the gingiva and wearing full dentures), and avoidance of dental care. Finally, it was determined which combination of variables was most strongly related to gagging during dental treatment.

## Methods

### *Data collection and participants*

Data were collected among twin families registered with the Netherlands Twin Register (NTR) (7). Adult NTR participants ( $N = 27\,892$ ) received a written invitation to participate in the survey. From this group, 11 948 individuals completed the questionnaire [response rate 42.8%; see for a detailed description of the data collection and sample Ligthart *et al.* (8)]. Six individuals were excluded because they were younger than 18 years and 171 because they did not complete the question about gagging during dental treatment. This resulted in a sample of 11 771 individuals from 5277 families for analysis with a mean age ( $\pm$ s.d.) of 44.39 ( $\pm$ 15.67) years (age range 18.12–100.43 year), and with 61.8% being female.

### *Measures*

*Self-reported gagging during dental treatment.* The tendency to gag during dental treatment was assessed with the question 'Do you tend to gag during dental treatment? (yes/no)'.

*Socio-demographic variables.* The survey included questions about sex and age. Based on previous questionnaires (7), information on country of birth was available for 10 781 individuals (91.6%) and level of education was available for 8500 individuals (72.2%). These variables were dichotomised into the Netherlands versus other, and primary-low versus intermediate-high.

### *Psychological variables*

*Dental trait anxiety.* Severity of dental trait anxiety was assessed with the Dental Anxiety Scale (DAS) (9). Responses are scored from 1 to 5, providing total scores ranging from 4 (not anxious at all) to 20 (extremely anxious). Dental Anxiety Scale scores of 13 or higher are considered indicative of the presence of a high level of dental fear (10). Internal consistency reliability (Cronbach's alpha) in this study was 0.90. The test-retest reliability of the DAS in a Dutch sample was 0.80 (intra-class correlation coefficient  $t$ ) (11). The DAS was chosen to assess dental trait anxiety because it is the most widely used questionnaire to assess dental anxiety; however, one critical review suggests that the validity of the DAS should be considered moderate (12).

*Fear of stimuli comprising the dental setting.* To assess fear of objects and situations related to the dental setting, a questionnaire with 25 stimuli was used. These 25 stimuli were the most prevalent among 67 stimuli found in a previous study (13). This questionnaire was supplemented with three additional stimuli (i.e. gagging, a sense of vomiting and fainting). The fear-provoking nature of each item was scored on a four-point scale, from 1 ('not at all fear provoking') to 4 ('extremely fear provoking'). Each of the variables was dichotomised into 'not or not extremely fear provoking' versus 'extremely fear provoking'.

*Anxious depression.* To index symptoms of anxiety and depression, the DSM-IV-oriented subscale for anxiety and depressive problems of the Adult Self Report (ASR) (14, 15) was used, consisting of 18 items. The responses are scored on a three-point scale (0 = not true, 1 = somewhat or sometimes true, 2 = very true or often true), providing total scores ranging from 0 to 36 and reflecting a quantitative measure of anxious depression. Higher scores indicate more symptoms of anxious depression (15). Internal consistency reliability (Cronbach's alpha) in this study was 0.90. The test-retest reliability of the subscale for anxiety and depression is 0.87 ( $P < 0.01$ ) (14). The ASR has demonstrated good content validity, criterion-related validity and construct validity (15), which was confirmed in two Dutch studies (16, 17).

*Neuroticism.* Neuroticism was assessed using the neuroticism subscale of the NEO Five Factor Inventory

(NEO-FFI) (18). The neuroticism subscale consists of twelve items. Responses are scored from 1 to 5, providing total scores ranging from 12 to 60. This questionnaire has been completed previously (7), and therefore, information was available for 9453 individuals. Internal consistency reliability (Cronbach's alpha) is 0.87. The test-retest reliability of the neuroticism subscale of the NEO-FFI is 0.89 (19). The validity of the neuroticism subscale is good (20).

#### *Self-reported oral health*

*Presence of cavities.* Presence of cavities was assessed using a question about self-reported health state of teeth. For this study, this variable was dichotomised into 'I have no cavities' versus 'I have few/ many cavities'.

*Presence of gingival bleeding.* Presence of gingival bleeding was assessed using a question about bleeding of the gingiva during tooth brushing. This variable was dichotomised into 'my gums never bleed/my gums used to bleed, but they don't anymore' versus 'my gums bleed occasionally or often'.

*Presence of complete dentures.* Whether someone had complete dentures was assessed with the following question: 'Do you still have one or more of your own teeth or molars?' with 'yes' or 'no, I have a complete set of false teeth' as possible answers.

#### *Avoidance of dental care*

In the Netherlands, regular dental attendance is described as the proportion of people who visit the dentist at least once a year (21). Individuals who reported to visit the dentist, dental hygienist or preventive assistant for a check-up and/or treatment once in a year or more during a five-year period were classified as regular attendees. Those visiting the dental care professional less than once a year during a five-year period were classified as avoiders of care.

#### *Statistical analyses*

First, descriptive statistics were obtained using IBM SPSS Statistics version 20\*. Linear (continuous mea-

asures) and logistic regression (categorical measures) analyses were produced using STATA 12.1<sup>†</sup>. STATA's robust cluster option was used to allow for the non-independence of family members. Univariate associations between patients' self-report of gagging during dental treatment on the one hand and socio-demographic variables, psychological variables, self-reported oral health and avoidance of dental care on the other were estimated by calculating odds ratios for categorical measures, or unstandardised regression coefficients (B) and their 95% confidence intervals (95% CI) for continuous measures. Next, multiple logistic regression analysis, with patients' self-report of gagging during dental treatment as a dependent variable and all variables reported in Tables 1 and 2 as independent variables, was used to determine which combination of variables was associated with gagging during dental treatment. For all statistical analyses, a *P*-value < 0.05 was considered statistically significant.

## Results

#### *Prevalence and socio-demographic characteristics*

Table 1 presents data on the estimated prevalence of gagging and socio-demographic characteristics of individuals with and without gagging during dental treatment. Overall, 8.2% (95% CI 7.7–8.7) of the participants (*n* = 970) reported to gag during dental treatment. Women were significantly more likely to gag than men, in general, and in the age groups of 18–24 and 35–64 years, but not in the age group of 25–34 and ≥65 years. Participants who reported to gag had a significantly higher mean age and were more likely to have a lower level of education than those who did not report gagging during dental treatment.

#### *Psychological variables*

Participants who indicated to gag during dental treatment scored significantly higher on all psychological variables, including dental trait anxiety, anxious depression and neuroticism, compared with non-gagging participants (Table 1). Furthermore, the gagging participants (16.4%) were significantly more likely to

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**Table 1.** Prevalence, socio-demographic characteristics, psychological variables, self-reported oral health and avoidance of dental care in individuals who reported to gag and those who reported not to gag during dental treatment

Variable	Gagging		No gagging		Wald $\chi^2$	OR	95% CI	P-value
	N	Proportion (%)	N	Proportion (%)				
Overall	970	8.2	10 801	91.8				
Male	285	6.3	4216	93.7				
Female	685	9.4	6585	90.6	33.61	1.54	1.33–1.78	<0.001
<i>By age group</i>								
18–24 years	135	6.2	2034	93.8				
Male	32	4.2	726	95.8				
Female	103	7.3	1308	92.7	7.62	1.79	1.18–2.70	0.006
25–34 years	109	7.4	1373	92.6				
Male	29	6.2	441	93.8				
Female	80	7.8	932	92.1	1.34	1.31	0.83–2.05	0.25
35–44 years	188	8.0	2149	92.0				
Male	56	6.5	810	93.5				
Female	132	9.0	1339	91.0	4.39	1.43	1.02–1.99	0.036
45–54 years	233	10.0	2095	90.0				
Male	48	6.0	747	94.0				
Female	185	12.1	1348	87.9	20.16	2.14	1.53–2.97	<0.001
55–64 years	200	9.6	2083	90.4				
Male	75	7.2	965	92.8				
Female	145	11.5	1118	88.5	12.00	1.67	1.25–2.23	<0.001
≥65 years	85	7.4	1067	92.6				
Male	45	7.9	527	92.1				
Female	40	6.9	540	93.1	0.39	0.87	0.56–1.35	0.53
<i>Socio-demographic characteristics</i>								
	N	Mean ( $\pm$ s.d.)	N	Mean ( $\pm$ s.d.)	F	B	95% CI	P-value
Mean age (years $\pm$ s.d.)	970	46.02 (14.94)	10 801	44.24 (15.73)	12.05	1.78	0.77–2.78	<0.001
Male	285	48.73 (15.69)	4216	46.12 (16.10)	7.47	2.61	0.74–4.48	0.006
Female	685	44.90 (14.48)	6585	43.03 (15.37)	9.53	1.86	0.68–3.04	0.002
<i>Country of birth</i>								
	N	Proportion (%)	N	Proportion (%)	Wald $\chi^2$	OR	95% CI	P-value
Country of birth	881		9900					
Other country	17	1.9	208	2.1				
The Netherlands	864	98.1	9.692	97.9	0.12	0.92	0.56–1.50	0.73
<i>Education level</i>								
	N	Proportion (%)	N	Proportion (%)	Wald $\chi^2$	OR	95% CI	P-value
Education level	742		7758					
Primary-Low	178	24.0	1551	20.0				
Intermediate-High	564	76.0	6207	80.0	6.83	0.79	0.66–0.94	0.009
<i>Psychological variables</i>								
	N	Mean ( $\pm$ s.d.)	N	Mean ( $\pm$ s.d.)	F	B	95% CI	P-value
Dental trait anxiety (DAS 4–20)								
Overall	955	9.32 (3.46)	10 617	7.29 (2.59)	299.04	2.03	1.80–2.25	<0.001
Male	277	8.46 (3.23)	4143	6.64 (2.19)	84.62	1.82	1.43–2.21	<0.001
Female	678	9.67 (3.48)	6474	7.71 (2.74)	193.59	1.96	1.68–2.23	<0.001
Anxious depression (0–30)								
Overall	956	5.19 (5.84)	10 618	4.31 (5.16)	19.54	0.87	0.49–1.26	<0.001
Male	281	4.15 (5.27)	4144	3.29 (4.53)	6.87	0.86	0.22–1.50	0.009
Female	675	5.62 (6.01)	6474	4.97 (5.42)	7.16	0.65	0.17–1.13	0.008
Neuroticism (12–60)								
Overall	803	30.39 (7.71)	8650	28.85 (7.39)	28.83	1.54	0.98–2.10	<0.001
Male	226	28.03 (7.65)	3149	26.51 (6.84)	8.33	1.51	0.49–2.55	0.004
Female	577	31.31 (7.53)	5501	30.19 (7.36)	11.31	1.12	0.47–1.78	0.001

**Table 1.** (continued)

Self-reported oral health	<i>N</i>	Proportion (%)	<i>N</i>	Proportion (%)	Wald $\chi^2$	OR	95% CI	<i>P</i> -value
State of teeth	912		10 352					
No cavities	805	88.3	9467	91.5				
A few/many untreated cavities	107	11.7	885	8.5	10.37	1.42	1.15–1.76	0.0013
Bleeding of the gingiva	909		10 371					
Never	582	64.0	7497	72.3				
Occasionally or often	327	36.0	2874	27.7	26.83	1.47	1.27–1.69	<0.001
Complete dentures	966		11 180					
No	911	94.3	10 780	96.3				
Yes	55	5.7	400	3.7	9.34	1.57	1.17–2.09	0.0022
Avoidance of dental care	965		10 772					
No	777	80.5	8821	81.9				
Yes	188	19.5	1951	18.1	1.12	1.09	0.93–1.29	0.29

**Table 2.** Proportions of individuals with an extreme fear of anxiety-provoking stimuli in individuals who reported to gag and those who reported not to gag during dental treatment

Stimulus	Gagging		No gagging		Wald $\chi^{2*}$	OR	95% CI
	<i>N</i>	Proportion (%)	<i>N</i>	Proportion (%)			
Having a root canal treatment	212	23.1	1037	10.1	130.94	2.68	2.26–3.17
Things at the back of your mouth	155	16.5	206	2.0	409.91	9.88	7.92–12.34
Insufficient anaesthetics	154	16.4	901	8.6	59.98	2.08	1.73–2.51
Having surgery	144	15.1	543	5.2	131.00	3.29	2.68–4.03
Extractions of tooth or molar	137	14.5	626	5.9	94.53	2.69	2.20–3.29
Gagging	129	13.6	241	2.3	268.67	6.57	5.25–8.23
The sense of vomiting	128	13.6	286	2.8	229.29	5.53	4.43–6.90
Being pushed about/rough/harsh	120	12.9	387	3.7	147.86	3.84	3.09–4.78
Cutting or tearing in soft tissue	109	11.6	573	5.5	52.93	2.26	1.81–2.81
Fainting	97	10.6	509	5.0	48.02	2.25	1.79–2.83
A dentist in a hurry	78	8.4	321	3.1	62.20	2.87	2.21–3.74
Dentist drilling your tooth or molar	79	8.3	274	2.6	85.86	3.42	2.64–4.44
Receiving an injection	73	7.6	312	2.9	58.18	2.74	2.12–3.56
Objects in your mouth	65	7.0	68	0.6	192.15	11.47	8.12–16.19
A remark made by de dentist	63	6.7	192	1.8	81.06	3.85	2.87–5.15
Pain	63	6.6	345	3.3	27.12	2.10	1.59–2.78
Feeling helpless	57	6.1	198	1.9	61.01	3.37	2.48–4.56
Lack of explanation of the dentist	48	5.2	173	1.7	49.15	3.24	2.33–4.50
Getting injured	47	5.2	198	1.9	38.12	2.78	2.01–3.84
The fact that you don't know what is going to happen	47	5.0	122	1.2	73.40	4.52	3.20–6.38
The sound of the drill	47	5.0	187	1.8	42.10	2.94	2.12–4.06
Not knowing what's happening in the mouth	41	4.3	123	1.2	54.19	3.86	2.70–5.54
Filling of a cavity in a tooth or molar	38	4.0	108	1.00	52.24	4.04	2.77–5.90
Braces fixed on your teeth	29	3.3	83	0.8	41.71	4.08	2.66–6.24
Lying in the dental chair (position)	21	2.2	32	0.3	50.52	7.47	4.29–13.00
Sight of certain dental instruments	20	2.1	37	0.3	40.71	6.14	3.52–10.73
The sight of blood	18	1.9	82	0.8	11.96	2.48	1.48–4.14
Feeling numb	8	0.8	15	0.1	16.63	6.00	2.54–14.19

\*All *P*s < 0.001.

report a high level of dental trait anxiety (i.e. DAS  $\geq$  13) compared with the non-gagging participants (4.6%; OR = 4.12; 95% CI 3.39–5.01;

*P* < 0.001). Table 2 presents data on the proportion of individuals with an extreme fear of stimuli comprising the dental setting. For all 28 stimuli, a significant

greater proportion of gagging individuals reported these stimuli as extremely anxiety provoking compared to non-gagging individuals (ORs ranging from 2.08 to 11.47). The highest ORs were found for extreme fears of typical gagging-related stimuli, such as objects in the back of the mouth.

#### *Self-reported oral health*

Participants who reported to gag during dental treatment were significantly more likely to report untreated cavities, gingival bleeding during tooth brushing and the wearing of complete dentures compared with those without such a tendency (Table 1).

#### *Avoidance of dental care*

No difference in avoidance of dental care could be detected between individuals who indicated to gag and those who indicated not to gag during treatment. Also, no significant interaction between dental trait anxiety and gagging was found in relation to avoidance of dental care (OR = 1.16; 95% CI 0.76–1.33; Wald  $\chi^2$  (1) = 0.47;  $P$  = 0.50).

#### *Logistic regression analyses*

All variables of Tables 1 and 2 were entered as predictors into a multiple logistic regression model. Table 3 shows the results of the final multiple regression model, in which only significant predictors were retained. The model was statistically significant [Wald  $\chi^2$  (39) = 255.85;  $P$  < 0.001; Nagelkerke  $R^2$  = 0.076], with ten predictors significantly contributing to the prediction.

## **Discussion**

As far as we know, this study provides a first population-based estimate of dental treatment-related self-reported gagging. Overall, more than eight percentage of the participants reported to gag, with higher prevalence reports among women compared to men, and among individuals with a lower level of education. The estimated prevalence of gagging seems to incline with increasing age, with the highest prevalence reports among individuals between 45 and 54 years.

Gagging individuals reported higher levels of dental trait anxiety than non-gagging individuals. This is

**Table 3.** Odds ratios for significant predictor variables in logistic regression model predicting self-reported gagging during dental treatment

	Odds ratio	95% CI	$P$ -value
Female	1.56	1.22–1.98	<0.001
High level of dental trait anxiety	1.97	1.23–3.15	0.004
Bleeding of the gingiva	1.36	1.09–1.71	0.007
Extreme fear of			
Things at the back of your mouth	3.77	2.17–6.53	<0.001
The sight of blood	3.17	1.04–9.61	0.042
Objects in your mouth	2.49	1.11–5.58	0.027
Having a root canal treatment	1.47	1.00–2.15	0.050
Cutting or tearing in soft tissue	0.59	0.36–0.99	0.045
Fainting	0.48	0.26–0.91	0.025
Not knowing what's happening in the mouth	0.24	0.066–0.90	0.034

consistent with several other studies (1, 2, 22, 23). In addition, patients' self-report of gagging was more strongly associated with severity of a number of specific gagging-related fears (e.g. objects in the mouth or things at the back of the mouth) than with typical dental fears (e.g. fear of the dental drill, or other common stimuli comprising the dental setting). This is in line with the *classical conditioning theory* (24), which predicts that when an initially neutral (*conditioned*) stimulus (CS; e.g. an object in the back of the mouth) has once been paired with a negative experience (i.e. gagging; *unconditioned stimulus, US*), which elicited a (*unconditioned*) fear response (UR), the latter can become a learned (i.e. *conditioned*) response (CR) to cues which more or less *predict* the occurrence of unconditioned response (US; gagging) for which the individual prepares by a fear response (CR).

It is assumed that feelings of embarrassment associated with gagging (4) might discourage patients from seeking dental care, resulting in a deteriorating oral health (5). Indeed, gagging individuals reported a worse oral health condition, and significantly more of them indicated wearing full dentures, than their non-gagging counterparts. Surprisingly, however, in the present study, no difference in dental attendance pattern was found between both groups. Although in agreement with findings of Akarslan and Biçer (6), this finding is inconsistent with what the *operant conditioning theory* would predict [i.e. behaviour patterns increase in frequency because these ensure sympathy

and attention (positive reinforcement) or lead to avoidance (negative reinforcement)]. Possibly, although gagging does not lead to irregular attendance, the oral health condition of gagging individuals is negatively affected by the fact that they are less able to provide themselves with proper oral care, and that dental care professionals are less able to offer adequate dental care.

A combination of variables, including sex, dental trait anxiety, fear of particularly gagging-related stimuli and gingival bleeding, maximised the prediction of dental-related gagging. However, the combination of all potential predictive variables explained only a modest part of the variance of dental-related gagging. This finding suggests that a variety of other, local, systematic, anatomical, iatrogenic, idiosyncratic (e.g. exposure to certain life events that increase sensitivity of the gag reflex), and biological (e.g. genetic) factors are likely to play a role as well.

A number of limitations need to be noted. Firstly, the cross-sectional nature of the study limits inferences with causality. To this end, it remains unclear whether the elevated levels of dental trait anxiety are the cause, or the result, of peoples' tendency to gag during dental treatment. Secondly, oral health was assessed with self-reported oral health measures. Although self-reports have been found to correlate with objectively established clinical features (25), these data are certainly less accurate than when an intra-oral examination would have been used. Thirdly, gagging was assessed using a single dichotomous question, since at the time of sending the first wave of questionnaires (January 2011), no valid or reliable Dutch version of such an instrument was available that was appropriate for research as a self-assessment instrument of gagging during dental treatment. However, gagging is not necessarily a dichotomous phenomenon and the use of one yes/no self-reported question might not have been a sufficient way to evaluate this complex issue. Furthermore, there was a lack of data regarding age of onset, aetiology and severity of the gag reflex both inside and outside the dental setting. Therefore, albeit the findings of the current study should be interpreted with caution, these are valuable in providing clues for future research regarding dental treatment-related gagging, and associations with a wide set of variables. As the data of the current study were derived from a large number of twin families of the Netherlands Twin Register (NTR) (7) not

only population-based conclusions can be drawn, in the future familial prevalence or heritability of dental treatment-related gagging may become available.

In conclusion, the results of the present study suggest that people who report gagging are moderately dentally anxious, fear-specific situations that can trigger a gagging response and, in spite of visiting the dentist equally frequently, have a worse self-reported oral health than those who do not gag. Given the fact that only a part of the variance was explained by socio-demographic and psychological variables, it remains important to conduct studies that include a much broader set of variables than has been done until now. In other words, to gain a better understanding of the causes, maintenance and treatment of this complex, both intriguing and debilitating, phenomenon, studying the interaction of psychological, social and biological factors is pivotal.

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## Conflict of interest

No conflict of interest declared.

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