



Gagging Assessment Scale: A Reliable Tool for Assessing Association Between Gagging and Dental Fear in Children Prior Dental Treatment-A Cross-Sectional Pilot Study

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ABSTRACT

Gagging is a normal protective defence mechanism of our body that prevents entry of foreign bodies into the airway, which can create undue havoc during dental treatment especially in children. The present study aims to assess the prevalence of gagging and any of its existing association with dental fear and anxiety in children prior to dental treatment. A cross-sectional pilot study design was conducted in South Indian children (age group: 3-10 years) having no history of underlying psychological and systemic ailment. Different assessment scales of gagging (Gagging Assessment Scale [GAS], Shorter Objective Form of Gagging Problem Assessment [GPA-SF]/OGPA), dental fear (Children's Fear Survey Schedule Dental Subscale [CFSS-DS]) and anxiety (Modified Dental Anxiety Scale- Faces [MDASF]) were administered to evaluate their response prior to the treatment. Younger children specifically females demonstrated severity of gagging reflex, which was directly correlated to their higher perception of dental fear and anxiety. However, no conclusive evidence of an association between gagging, dental fear and anxiety was ascertained. Prior knowledge of the gagging problem in children can help clinicians to effectively modify the treatment modalities for successful outcomes, while GAS could be a reliable tool for assessing its severity in children prior to dental treatment.



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INTRODUCTION

The complexity of reflexes and the quality of movements according to these reflexes gradually changes with age (Sheppard and Mysak, 1984). The per-

sistence of any normal oral reflex beyond the time of its expected integration, may be an indication of psychological ailments (i.e; cerebral palsy, oral-motor delay, or head injury) which can jeopardize the daily normal activities especially feeding practices of an individual (Ottenbacher *et al.*, 1983). The oral primitive reflexes of a normal infant comprises of rooting, suckling-swallow, biting and gagging reflexes which are pivotal for an infant's survival and is part of the normal development (Tuchman, 1988). The gagging reflex is considered to be protective somatic response by which the body tries to expel objects from the oral cavity (trachea, pharynx or larynx) by the mechanism of muscular (oro-pharyngeal musculature) contraction (Fiske and Dickinson, 2001; Santos and Nogueira, 2005). There are five important trigger zones in the oral cavity (palate, palatoglossal-palatopharyngeal folds

or fauces, uvula, posterior pharyngeal walls, base of the tongue) which are prone to sensitivity and can initiate gagging reaction (Conny and Tedesco, 1983; Meeker and Magalee, 1986). Non-tactile sensations such as visual, auditory, olfactory, or psychological stimuli can also trigger the sensation of gagging (Murphy, 1979; Wilks and Marks, 1983).

Gagging has a multifactorial model of causation, having either a somatogenic or psychogenic origin (Krol, 1963). The physical stimuli responsible in somatogenic origin of gagging can be either local or systemic. Certain individuals are more prone to sensitivity at different intra-oral sites, even introduction of mouth mirrors or other instruments into the oral cavity by dental personnel can initiate the gagging reflex while use of a fork or toothbrush by an individual itself do not cause gagging sensation (Milgrom *et al.*, 1995). On the other hand psychogenic origin of gagging is marked by a gagging response in absence of actual stimuli or if the individual gags in response to the thoughts of dental instruments or treatment (Fiske and Dickinson, 2001). Exaggerated gag reflexes can compromise every aspect of dentistry from routine diagnostic procedures to radiography or any other form of dental treatment (Hainsworth *et al.*, 2008). However, a wide range of management techniques has been proposed to alleviate this problem such as relaxation, distraction, desensitization, psychological and behavioral techniques, local anesthesia, conscious sedation, general anesthesia techniques, complementary medicinal therapies such as hypnosis (Bassi *et al.*, 2004; Fiske and Dickinson, 2001), acupuncture, acupressure (Vachiramon and Wang, 2002), combined acupuncture and acupressure and hypnopuncture (Eitner *et al.*, 2005).

Gagging can occur in patients of all ages (Kramer and Braham, 1977), however, prevalence studies are mostly limited to the adult population. One of the studies reported that the occurrence of gagging reflex may be less common in older adults (Davies *et al.*, 1995), while on a contrary another study reported that dental patients who gagged were significantly older than non-gaggers (Almoznino *et al.*, 2015). 8.2% of dutch adults stated that they generally gagged during dental treatment (van Houtem *et al.*, 2015) and who were primarily seeking emergency dental care stated that 49% of them gagged sometimes or frequently at the site of a dentist, whereas an additional 7.5% of adults stated that they almost always gagged (Randall *et al.*, 2014). Knowledge of an individual's likelihood to gag is highly essential and of particular importance to the pediatric dentists as prior information of gagging problem in children can help clinicians to

deliver treatment effectively with appropriate use of behavioural management techniques (Malkoc *et al.*, 2013; Sari and Sari, 2010).

The existing literature also states that the presence of dental fear and anxiety in children as well as in adults prior to any dental treatment also initiates the gagging response with a prevalence rate varying between 5-20% in the adult population and between 3-55% in children (Boman *et al.*, 2013; Esa *et al.*, 2015; Hakeberg *et al.*, 1992). Adults who gag are more likely to experience dental fear (Akarслан and Erten, 2010; Randall *et al.*, 2014; van Houtem *et al.*, 2015; Winocur *et al.*, 2011) and more severe gagging is associated with higher levels of dental fear (Randall *et al.*, 2014) which strongly suggests that dental fear might also be a relevant cause related to gagging response in children. Literature also suggests that fearful individuals seek dental care only on the occurrence of unbearable orofacial pain and mostly avoids preventive dental treatment (Armfield *et al.*, 2007). Since Fear pertaining to dental pain with negative thoughts, emotions and beliefs about dental treatment and its professionals, has shown clear association with dental care-related fear and anxiety which generally contributes to the underutilization of dental care (Doerr *et al.*, 1998; McNeil and Berryman, 1989). Hence, the concept of gagging and its association with dental fear and anxiety is highly pivotal in understanding the underlying importance of gagging and its management in dentistry.

Thus, the aim of the present study is to explore the prevalence of gagging in children and to assess any existing association or relationship between gagging, dental fear and anxiety prior to dental treatment in children.

MATERIALS AND METHODS

Study Design and Ethical Considerations

A cross-sectional pilot study design was formulated for carrying out the present study in the department of Paediatric and Preventive Dentistry in India from September 2017 till February 2018. The present study was approved by the Institutional Scientific Review Board (SRB/MDS/PEDO/17-18/0027) followed by the Ethical Committee (SDC/MDS/17-18/097) in accordance to the ethical standards laid down in the 1964 declaration of Helsinki and its later amendments. Prior written informed consent was obtained from the parents/accompanying caregivers of the recruited children after explaining to them the purpose and objectives of the study. Each step of the present study was planned, carried out and reported according to the STROBE guidelines

for observational studies (Vandenbroucke *et al.*, 2007).

Sample Size Determination and Recruitment of Study Participants

A sample of 81 healthy South Indian children in an age group of 3-10 years old visiting the outpatient department preferably for their first dental visits and in need of dental treatment were enrolled in the present study. A convenient sampling method was used for recruiting the study participants. Healthy children requiring dental treatment in their first or subsequent dental visits but have not earlier being treated except for consultation were included into the present study while children with special health care needs, any form of psychological ailments, underlying systemic diseases, or under the influence of continuous medication, which might affect the gagging response or evokes any exaggerated response prior to dental treatment were excluded from the study.

Study Tools

Four questionnaires were employed in the present study for assessing any existing association between gagging, dental fear and anxiety prior to dental treatment in children i.e,

- (1) English version of GAS (Katsouda *et al.*, 2017).
- (2) English version of CFSS-DS (Katsouda *et al.*, 2017).
- (3) English version of MDAS-F (Katsouda *et al.*, 2017).
- (4) Shorter version/ Shortened form of the dentist's portion of GPA-SF/OGPA (Katsouda *et al.*, 2017) which was proposed by Van Linden van den Heuvel *et al.* (2015) and was used by Akarlan and Erten (2010). The GPA-SF scale has been also suitably modified for use in paediatric patients.

Besides the study tools, a validated and slightly modified Gagging Behaviour Questionnaire (GBQ) was also used to elucidate further information on the presence of gagging reflex in the participants. The GBQ consists of seven questions which are highly essential for ascertaining the presence of gagging response in children. The responses obtained from the GBQ supplemented along with the findings of the other assessment scales helps ineffective management of the gagging problem and along with subsequent modification in the treatment planning for effective management in children.

Training and Calibration of Investigators and Recruited Participants

Prior to the main study, two investigators (authors) were calibrated and trained to examine the recruited

participants by using the study tools. Training and calibration exercises were conducted for both the authors on twenty children who were not part of the main study. All the assessment scales and their pattern of marking the responses were explained elaborately to all the participants and their parents/ accompanying caregivers in the regional dialect (i.e; Tamil). Any difficulty faced by the children in understanding the study tools were incorporated to modify the scales accordingly (i.e; reframing the scale items in simple and easier words) for its suitability and use in paediatric patients. Certain rephrasing of the words in regional dialect was done for better comprehension and understanding by the parents/accompanying caregivers and their children.

Parents/accompanying caregivers were also a part of the training session since children below the age of 6 years lack proper cognition ability to understand and interpret the different items of the study tools, however such training exercises was not required for parents/accompanying care-givers of children in the age group of 7-10 years old, mostly due to their improved cognition to understand the scales better. During such interaction the parents/accompanying care-givers and children pairs were also interviewed to obtain any prior knowledge of gagging problems using the GBQ.

The Tell-show-do technique was employed prior to intra-oral examination for demonstrating the use of different dental instruments, used to assess the prevalence of gagging reflex in children by their subjective symptoms of nausea, discomfort or vomiting. The technique was also highly helpful in children of younger age groups (3-6 years) to improve their cognitive ability for understanding the occurrence of any gagging reflex on introduction of dental instruments into the oral cavity. All the intra-oral examination of 20 children was done successively on the same day by both the investigators in an erect posture on the dental chair for appropriate assessment of gagging reflex using the study tools. Inter and intra-examiner agreement of the two investigators was obtained for each of the GPA sites to increase the reliability and consistency of the findings between the two investigators. The inter-examiner agreement was for site 1* (98%), site 2* (92%), site 3* (96%), site 4* (72%), site 5* (70%) and site 6* (64%) while the kappa value for intra-examiner reliability was 0.95 (*Anatomical sites are mentioned in Table 2 [OGPA]).

Clinical Examination

Prior to the clinical examination, baseline information and demographic details were obtained from the study participants, mostly emphasizing on their

Table 1: Depicting baseline data of study participants

Baseline Data	Frequency Analysis (N)	Percentage Analysis (N%)	p-value
Age (Years)			
3-5	22	27.2%	0.688
6-8	40	49.4%	
9-10	19	23.5%	
Total	81	100.0%	
Gender			
Males	37	45.7%	0.389
Females	44	54.3%	
Total	81	100.0%	
Dental History			
First visit	61	75.3%	0.031*
Second visit	19	23.5%	
Multiple visits	01	01.2%	
Total	81	100.0%	

number of dental visits. Clinical examination for assessing the gagging reflex at different sites of the GPA-SF study tool was done by making the participant to sit erect on the dental chair (KAVO, Germany) and using a stainless steel dental mouth mirror under the normal chair light. Intra-oral examination took a minimum of five minutes duration for each participant. Different assessment scales were also administered to the children for marking their response pertaining to gagging reflex, dental fear and anxiety. Approximately 15-20 minutes was taken for the training of the participants and the parents/accompanying caregivers along with marking their responses for each scale on the printed sheets. For younger children (< 6 years), the responses for each scale was marked by the parents/accompanying caregiver after eliciting the correct information from their children. However, children in the age group of 7-10 years filled their responses for each of the scale on their own in the printed sheets. A full mouth examination of each participant was completed and an appropriate treatment plan was made while treatment was rendered to each of the participants on subsequent appointments.

Statistical Analysis

The collected data were analysed using IBM.SPSS statistics software 23.0 version. For descriptive statistics such as age, gender, dental history visits, assessment scores of different scales were evaluated using the frequency and percentage analysis while Pearson's Chi-square analysis was used for deter-

mining the significant difference in relation to the demographic data and assessment scores of different scales. Kruskal Wallis test was used to find the mean assessment scores of different scales in relation to different age groups of participants while the Mann Whitney test was used to find the mean assessment scores of different scales in relation to gender. Spearman's correlation was used to find any association between the over-all age group of participants with the different assessment scales. A p-value of < 0.05 was set as the statistically significant value for the present study.

RESULTS AND DISCUSSION

A total of 81 children (37 males and 44 females) in the age group of 3-10 years were enrolled in the present study. Pearson's Chi-square analysis was used for comparison of the distribution of participants in different age groups ($p= 0.688$) and gender ($p= 0.389$) which shown an equal distribution of participants preventing selection bias. However, there was a significant difference in the distribution of participants in relation to their dental visit history ($p= 0.031$) (Table 1).

Assessment of gagging problem, dental fear and anxiety using different scales among participants was also evaluated using the descriptive statistics (frequency and percentage analysis). Using the OGPA scale, it was found that participants experienced gagging sensation mostly at the sites of last molars (52/64.2%) followed by at the transition of the soft palate (44/54.3%), maxillary process at the level of

Table 2: Depicting assessment of gagging problem, dental fear and anxiety among participants using different scales

Assessment Scales	Frequency Analysis (N)	Percentage Analysis (N%)
GAS		
Brushing your back teeth		
No nausea	29	35.8%
Slightly nauseated	41	50.6%
May vomit	10	12.3%
Feel nauseated and feel like vomiting	01	1.2%
Actual spasms in the throat and sometimes actually vomit	00	00%
Total	81	100%
Waiting in the dentist's waiting room and thought of the anticipated dental treatment		
No nausea	61	75.3%
Slightly nauseated	15	18.5%
May vomit	05	6.2%
Feel nauseated and feel like vomiting	00	00%
Actual spasms in the throat and sometimes actually vomit	00	00%
Total	81	100%
Sitting in a dental chair and dentist examining your teeth with a mirror and other instruments		
No nausea	55	67.9%
Slightly nauseated	19	23.5%
May vomit	05	6.2%
Feel nauseated and feel like vomiting	01	1.2%
Actual spasms in the throat and sometimes actually vomit	01	1.2%
Total	81	100%
Dentist working on back teeth?		
No nausea	28	34.6%
Slightly nauseated	38	46.9%
May vomit	10	12.3%
Feel nauseated and feel like vomiting	04	4.9%
Actual spasms in the throat and sometimes actually vomit	01	1.2%
Total	81	100%
GBQ		
Problems of gagging during dental visits		
No	79	97.5%
Yes	02	2.5%
Total	81	100%
The severity of gagging problems		
Very mild	01	1.2%
Mild	00	00%
Neither mild nor severe	01	1.2%
Severe	00	00%
Very severe	00	00%
Not applicable	79	97.5%
Total	81	100%

Continued on next page

Table 2 continued

Assessment Scales	Frequency Analysis (N)	Percentage Analysis (N%)
Problems of gagging interrupting dental treatment		
Never	02	2.5%
Rarely	00	00%
Sometimes	00	00%
Frequently	00	00%
Almost always or always	00	00%
Not applicable	79	97.5%
Total	81	100%
Experience of gagging at times other than dental visits		
Yes	52	64.2%
No	29	35.8%
Total	81	100%
Factors triggering gagging problem during dental visits		
On visiting hospital	21	25.9%
On seeing a white coat doctor	14	17.2%
On sitting in a dental chair	36	44.4%
On the introduction of dental mouth mirror	07	8.6%
Not aware	00	00%
All of the above conditions	03	3.7%
Not applicable	00	00%
Total	81	100%
The severity of gagging problems at times other than dental visits		
Very mild	02	2.5%
Mild	27	33.3%
Neither mild nor severe	15	18.5%
Severe	07	8.6%
Very severe	00	00%
Not applicable	30	37.0%
Total	81	100%
Factors triggering gagging problems at other times		
While brushing	15	18.5%
On using a tongue cleaner	20	24.6%
On using a spoon while eating	08	9.8%
On putting fingers into the mouth	38	46.9%
Not aware	00	00%
All of the above conditions	00	00%
Not applicable	00	00%
Total	81	100%

Continued on next page

Table 2 continued

Assessment Scales	Frequency Analysis (N)	Percentage Analysis (N%)
OGPA (Short Version/ Dentist's Part) Holding mouth mirror In front of the opened mouth (Site 1)		
Yes	07	8.6%
No	74	91.4%
Total	81	100%
At the level of last molars (Site 2)		
Yes	52	64.2%
No	29	35.8%
Total	81	100%
Touching behind the upper incisors (Site 3)		
Yes	09	11.1%
No	72	88.9%
Total	81	100%
The touching transition of the soft palate (Site 4)		
Yes	44	54.3%
No	37	45.7%
Total	81	100%
The inner side of the cheek at the level of the last molars (Site 5)		
Yes	33	40.7%
No	48	59.3%
Total	81	100%
Touching the maxillary process at the level of the last molars (Site 6)		
Yes	39	48.1%
No	42	51.9%
Total	81	100%
CFSS-DS How afraid is your child of		
Dentists		
Not afraid at all	53	65.4%
A little afraid	21	25.9%
A fair amount afraid	06	7.4%
Very afraid	00	00%
Very much afraid	01	1.2%
Total	81	100%
Doctors		
Not afraid at all	59	72.8%
A little afraid	15	18.5%
A fair amount afraid	06	7.4%
Very afraid	00	00%

Continued on next page

Table 2 continued

Assessment Scales	Frequency Analysis (N)	Percentage Analysis (N%)
Very much afraid	01	1.2%
Total	81	100%
Injection shots		
Not afraid at all	01	1.2%
A little afraid	05	6.2%
A fair amount afraid	16	19.8%
Very afraid	22	27.2%
Very much afraid	37	45.7%
Total	81	100%
Somebody examining mouth		
Not afraid at all	60	74.1%
A little afraid	14	17.3%
A fair amount afraid	05	6.2%
Very afraid	01	1.2%
Very much afraid	01	1.2%
Total	81	100%
To open the mouth		
Not afraid at all	66	81.5%
A little afraid	10	12.3%
A fair amount afraid	04	4.9%
Very afraid	00	00%
Very much afraid	01	1.2%
Total	81	100%
Touch of a stranger		
Not afraid at all	59	72.8%
A little afraid	17	21.0%
A fair amount afraid	05	6.2%
Very afraid	00	00%
Very much afraid	00	00%
Total	81	100%
Someone looking at the child		
Not afraid at all	68	84.0%
A little afraid	11	13.6%
A fair amount afraid	02	2.5%
Very afraid	00	00%
Very much afraid	00	00%
Total	81	100%
Dentist's drill		
Not afraid at all	37	45.7
A little afraid	33	40.7%
A fair amount afraid	08	9.9%

Continued on next page

Table 2 continued

Assessment Scales	Frequency Analysis (N)	Percentage Analysis (N%)
Very afraid	01	1.2%
Very much afraid	02	2.5%
Total	81	100%
The sight of the dentist's drill		
Not afraid at all	65	80.2%
A little afraid	09	11.1%
A fair amount afraid	07	00
Very afraid	00	00%
Very much afraid	00	00%
Total	81	100%
The noise of the dentist's drill		
Not afraid at all	53	65.4%
A little afraid	19	23.5%
A fair amount afraid	09	11.1%
Very afraid	00	00%
Very much afraid	00	00%
Total	81	100%
Someone putting instruments in the mouth		
Not afraid at all	59	72.8%
A little afraid	16	19.8%
A fair amount afraid	05	6.2%
Very afraid	00	00%
Very much afraid	01	1.2%
Total	81	100%
Choking		
Not afraid at all	00	00%
A little afraid	01	1.2%
A fair amount afraid	10	12.3%
Very afraid	32	39.5%
Very much afraid	38	46.9%
Total	81	100%
Going to hospital		
Not afraid at all	60	74.1%
A little afraid	16	19.8%
A fair amount afraid	05	6.2%
Very afraid	00	00%
Very much afraid	00	00%
Total	81	100%

Continued on next page

Table 2 continued

Assessment Scales	Frequency Analysis (N)	Percentage Analysis (N%)
People in white uniforms		
Not afraid at all	63	77.8%
A fair amount afraid	02	2.5%
A little afraid	16	19.8%
Very afraid	00	00%
Very much afraid	00	00%
Total	81	100%
Nurse cleaning the teeth		
Not afraid at all	58	71.6%
A little afraid	17	21.0%
A fair amount afraid	05	6.2%
Very afraid	01	1.2%
Very much afraid	00	00%
Total	81	100%
MDAS- FACES How would your child feel		
Going to the dentist generally		
Relaxed/not worried	39	48.1%
Very slightly worried	28	34.6%
Fairly worried	10	12.3%
Worried a lot	01	1.2%
Very worried	03	3.7%
Total	81	100%
Someone looking at the teeth		
Relaxed/not worried	60	74.1%
Very slightly worried	12	14.8%
Fairly worried	06	7.4%
Worried a lot	01	1.2%
Very worried	02	2.5%
Total	81	100%
Teeth scraped and polished		
Relaxed/not worried	54	66.7%
Very slightly worried	17	21.0%
Fairly worried	07	8.6%
Worried a lot	03	3.7%
Very worried	00	00%
Total	81	100%

Continued on next page

Table 2 continued

Assessment Scales	Frequency Analysis (N)	Percentage Analysis (N%)
Injection in the gums		
Relaxed/not worried	00	00%
Very slightly worried	03	3.7%
Fairly worried	10	12.3%
Worried a lot	16	19.8%
Very worried	52	64.2%
Total	81	100%
Having a filling		
Relaxed/not worried	37	45.7%
Very slightly worried	29	35.8%
Fairly worried	11	13.6%
Worried a lot	04	4.9%
Very worried	00	00%
Total	81	100%
A tooth was taken out		
Relaxed/not worried	00	00%
Very slightly worried	02	2.5%
Fairly worried	06	7.4%
Worried a lot	09	11.1%
Very worried	64	79.0%
Total	81	100%
Put to sleep to have treatment		
Relaxed/not worried	49	60.5%
Very slightly worried	21	25.9%
Fairly worried	04	4.9%
Worried a lot	05	6.2%
Very worried	02	2.5%
Total	81	100%
A mixture of gas and air for comfort of having treatment without sleeping		
Relaxed/not worried	20	24.7%
Very slightly worried	37	45.7%
Fairly worried	14	17.3%
Worried a lot	06	7.4%
Very worried	04	4.9%
Total	81	100%

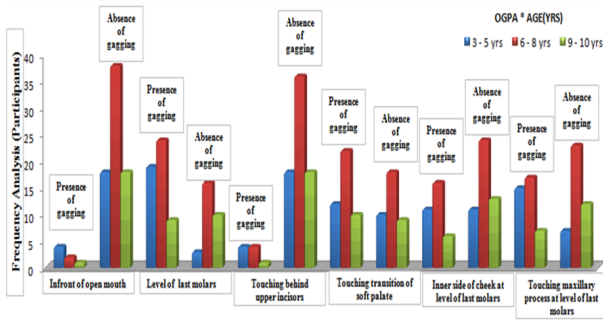


Figure 1: Depicting the association of objective gagging problem with the age of participants

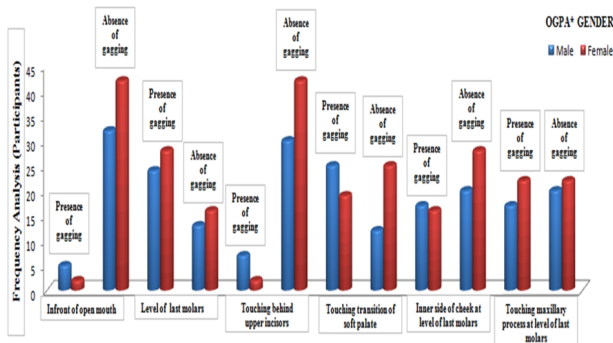


Figure 2: Depicting the association of objective gagging problem with the gender of participants

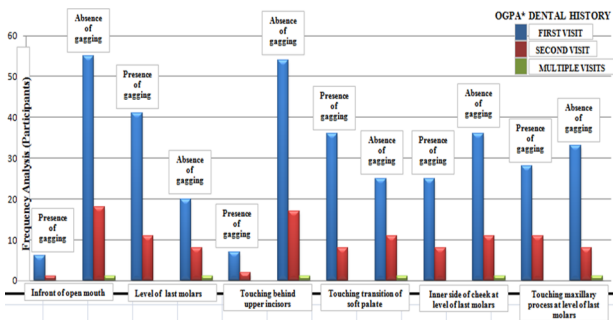


Figure 3: Depicting the association of objective gagging problem with the dental history of participants

last molars (39/48.1%), the inner side of cheek at the level of last molars (33/40.7%), behind the upper incisors (09/11.1%) and in front of the opened mouth (07/8.6%) (Table 2).

The mean assessment scores of different scales in the different age groups of participants are tabulated in Table 3. The highest mean score of GAS (7.36 ± 2.682) was found in the age group of 3-5 years and was statistically significant across all the age groups (p= 0.024). The highest mean score for OGPAS (10.21 ± 1.718) was found in the age group of 9-10 years while the assessment of dental fear and anxiety using CFSS-DS (28.14 ± 9.172) and MDAS-Faces (20.95 ± 5.843), was found to be higher in

3-5years of age group. Both the scales were found to be statistically significant in relation to different age groups respectively (p= 0.013) and (p= 0.016) (Table 3).

However, all the scales were found to show a statistically significant difference in relation to the overall age group (Table 4, Figure 1).

The mean assessment scores of different scales in relation to gender is tabulated in Table 5. Highest mean score of GAS (6.92 ± 2.910), CFSS-DS (27.03 ± 9.173) and MDAS-Faces (20.03 ± 6.457) was found in males while mean score of OGPAS was found to be higher in females (9.98 ± 1.649) but the difference was found to be statistically insignificant (p= 0.256) (Table 5, Figure 2).

Prevalence of dental anxiety and fear is higher in children and is the most common cause of interference in dental treatment due to impeding behavioral problems. Gagging is also an associated problem in children which tremendously affects the quality of dental treatment and poses a negative impact on the quality of life. The presence of gagging reflex serves as a serious limitation to the routine diagnostic and clinical dental procedures which can eventually result in the treatment to stop. Gagging reflex can be suitably modified chair side, while implementation of behavioral techniques either pharmacological or non-pharmacological by dentists can result in effective management of the problem (Bassi et al., 2004). Use of diagnostic aids such as bitewing or intra-oral periapical radiographs (IOPAR), impression making or insertion of appliances in children are generally associated with greater occurrence of gagging reflexes, which needs to be effectively managed since the above procedures forms an integral part of the treatment phase and cannot be avoided by the dentists. Proper assessment of gagging problems in children is highly pivotal for its efficient management. One of the effective strategies to manage gagging sensation along by the chairside in children could be to encourage them to breathe through the nose before the gagging response is triggered. Nose breathing can be encouraged by making them practice the habit while putting their own fingers or dental instrument into the mouth. Another strategic technique to manage gagging in children could be to wiggle their toes during the dental procedures that can help in distracting their attention and provides an outlet of physiological arousal for decreasing the gagging sensation.

Apart from the routine behavioral techniques available to manage gagging, there are also some alternative behavioral therapies such as salt-on-the tongue technique, acupuncture and hypnosis that

Table 3: Depicting mean assessment scores of assessment scales in different age groups with the over-all p-value

Age	3-5 Years	6-8 Years	9-10years	Total	p-value
Assessment Scales	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	
	Assessment Scores	Assessment Scores	Assessment Scores	Assessment Scores	
GAS	7.36 \pm 2.682	6.28 \pm 2.013	5.79 \pm 2.637	6.46 \pm 2.403	0.024*
OGPA- Short Version (Dentist's Part)	9.05 \pm 1.864	9.88 \pm 1.771	10.21 \pm 1.718	9.73 \pm 1.817	0.101
CFSS-DS	28.14 \pm 9.172	26.48 \pm 6.177	23.47 \pm 7.684	26.22 \pm 7.537	0.013*
MDAS	20.95 \pm 5.843	19.73 \pm 5.149	17.16 \pm 5.871	19.46 \pm 5.617	0.016*

Table 4: Depicting Spearman's Correlation between age and different assessment scores with the p-value

Assessment Scales	OGPA- Short Version (Dentist's Part)	CFSS-DS	MDAS	GAS
Age (3-10) Years	0.012*	0.003*	0.002*	0.001*

Table 5: Depicting mean assessment scores of assessment scales in relation to gender with over-all p-value

Gender	Male	Female	Total	p-value
Assessment Scores	Mean \pm SD	Mean \pm SD	Mean \pm SD	
	Assessment Scores	Assessment Scores	Assessment Scores	
GAS	6.92 \pm 2.910	6.07 \pm 1.822	6.65 \pm 2.435	0.340
OGPA- Short Version (Dentist's Part)	9.43 \pm 1.980	9.98 \pm 1.649	9.45 \pm 1.332	0.256
CFSS-DS	27.03 \pm 9.173	25.55 \pm 5.849	26.01 \pm 7.742	0.913
MDAS	20.03 \pm 6.457	18.98 \pm 4.825	19.75 \pm 5.654	0.729

can be used in the treatment of frequent gagging reflexes (Chidiac *et al.*, 2001; Eitner *et al.*, 2005). Pharmacological techniques using sedative agents like nitrous oxide and midazolam can also be employed in depressing the sensitivity to gagging reflex (Kaufman *et al.*, 1988). One of the important management techniques is the process of distraction which includes the use of audiovisual equipment in reducing dental fear, anxiety and pain chair-side and is particularly useful in managing children with gagging responses (Frere *et al.*, 2001). However this technique cannot work effectively in addressing the gagging problems in every patient and distraction alone cannot eliminate the problem altogether (Armfield *et al.*, 2007; Frere *et al.*, 2001). Extensive research work have revealed that patients with gagging problem are found to demonstrate a high degree of dental fear, however presence of dental fear alone cannot be associated with the severity

of gagging problems. More comprehensive behavioral techniques can be adopted to eliminate the gagging problem in patients who desire a long-lasting reduction of dental care-related fear and associated problems with frequent gagging reflexes. A clinical psychologist, behavioral specialist, or dentist with specialized training can be able to treat frequent gagging problems using appropriate behavioral techniques.

In the present study, the recruited participants were screened for any gagging problems using the GAS and it was found that children in the age group of 3-5 years had a greater prevalence of gagging response which was also related to the presence of their higher dental fear and anxiety, measured using the CFSS-DS and the MDAS-Faces. Hence an association was outlined between gagging, dental fear and anxiety among participants in the present study. The findings of the present study are in accordance

with the results mentioned by [Katsouda et al. \(2017\)](#) in children of 8 and 14 years old, which also shown a similar association between gagging and dental fear in children ([Katsouda et al., 2017](#)). Higher scores on GAS, however did not correlate with the findings substantiated using the OGPA sites for assessing the objective symptoms of gagging and neither did children with higher scores of OGPA shown higher scores of CFSS-DS and MDAS-Faces. However higher scores of GAS are important to analyze, which can be predictive of definitive gagging response at the sites of OGPA. Therefore GAS can be a promising tool for predicting gagging response in paediatric patients. Moreover, its shortness and rapid administration makes it most suitable for use in screening of patients with gagging response.

On using the OGPA in the present study, it was noted that younger children demonstrated comparatively less gagging response than the older children, which is in contrary to the mean scores reflected by the GAS. The probable reasons for such a finding could be the wide age range of recruited participants enrolled into the study which might account for the difference in the prevalence rate of gagging response in children of different age groups. Hence appropriate sampling is highly essential for elucidating the correct gagging response in participants. Other contributing factors could be the tender age of children between 3-6 years who are known to lack proper cognition ability to understand a condition such as gagging and to interpret its response according to the GAS, which is not observed in older children with better cognitive ability. Hence in the present study, a noted difference was found in the mean scores of GAS and OGPA, both in terms of younger as well as older children. A recent version of OGPA was structured which included placement of a dental mouth mirror near to the tongue ([Van Linden van den Heuvel et al., 2015](#)), in addition to its six other sites for obtaining the correct gagging response in children. However further research work should be carried out to confirm the suitability of this site to be used in children for elucidating whether this particular site is associated with higher recurrence of gagging sensation and needs to be included along with the six other sites of OGPA. Another important finding which was observed in the present study was the association of the number of dental visits with the gagging response in children. It was observed that children in their first dental visit had a gagging reflex due to their anticipated fear and anxiety towards dental treatment but it was also found that even a small proportion of children in their second dental visits also experienced gagging reflex on administration of the OGPA study tool. The probable

reason for such a finding could be that the children even though aware and desensitized towards dental treatment in their first visit, still experiences a subjective perception of fear and apprehension towards dental procedures which can eventually be alleviated through systematic desensitization and exposure towards dental treatment in subsequent multiple dental visits, thereby reducing the propensity of gagging sensation (Figure 3).

Assessment of dental fear and anxiety using CFSS-DS and MDAS-Faces in the present study revealed higher mean scores of dental fear and anxiety in children of younger age group (3-5 years) and showed a direct relationship with the assessment scores of GAS. While an inverse relationship was found between gagging and dental fear/anxiety according to the mean assessment scores of OGPA and CFSS-DS/ MDAS-Faces. Such difference in finding can be explained on the observation that with advancing age, older children can assess their experience of gagging and can rate their score on the GAS and until any pertinent apprehension is developed towards dental treatment older children generally don't exhibit any expression of dental fear and anxiety but while administering OGPA, gagging response might get initiated on actual introduction of a dental mouth mirror or instrument and might also arouse a significant degree of dental fear and anxiety but may not show an exaggerated expression of fear and anxiety-like the ones usually expressed by younger children. However, considering the overall age of the study participants, all the assessment scales showed significant differences with the response obtained from the participants. Another important factor to be considered for occurrence of gagging and dental fear/anxiety in the present study was the gender of the participants. According to the GAS, males were found to have greater gagging responses than females while females demonstrated higher gagging responses than males on the administration of OGPA. However, the present study findings are not in accordance with the results stated by [Katsouda et al. \(2017\)](#) where girls showed higher anxiety traits along with gagging problems. A similar finding was also outlined by [Randall et al. \(2014\)](#) who stated that adult females are more prone to gag than males. On the contrary [Akarslan and Erten \(2010\)](#); [Winocur et al. \(2011\)](#) found no significant association of dental anxiety and gagging in relation to gender in adults. However the evidence regarding the association of dental fear/anxiety, gagging, age and gender is not substantial enough to arrive at any conclusive decision ([Arapostathis et al., 2008](#)). In one of the studies, it was stated that gender had no correlation with the level of dental anxiety/fear

and gagging response (Elbay *et al.*, 2016). However in the present study females exhibited a low score of dental fear and anxiety with higher gagging response than males, therefore more of clinico-analytical studies must be conducted to evaluate this intricate association of gagging, dental fear/anxiety, age and gender to support and substantiate the findings of the present study.

CONCLUSIONS

A significant direct relationship was observed between self-reported dental fear/anxiety and gagging response while an inverse relationship was found between objective symptoms of gagging and dental fear/anxiety. GAS can be considered to be a reliable tool for ascertaining the presence of gagging response or its association with dental fear/anxiety by the aid of other study tools in children and necessarily do not objectify the gagging reflex thereby eliminating the bias of under or overrating the occurrence of gagging sensation. However, no definite conclusion can be drawn from the results due to the variability in the sampling pattern which is one of the known limitations of the present study.

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Conflict of Interest

The authors declare that they have no conflict of interest for this study.

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