

Development of Cartoon-based Dental Anxiety Scale for Children: Validation and Reliability

Ayesha Fathima¹, Ramesh Ravikumar², Lalitha Rani Chellappa³

ABSTRACT

Background: Dental fear and anxiety (DFA) is a common, deterring problem affecting children, which has a significant negative impact on children's oral health, leading to avoidance of dental care, poor dental hygiene, and an increased risk of dental caries and other oral health problems. The Oddbods DFA assessment is an innovative, child-friendly instrument that has been developed to assess DFA in children.

Aim: To evaluate the reliability and validity of the scale, and to examine the internal consistency, test-retest reliability, and criterion and construct validity of the scale.

Materials and methods: This study has assessed the reliability, criterion validity, and construct validity of the novel Oddbods anxiety assessment scale among 4–6-year-old children. Different samples were recruited to assess different criteria. A normative study was done to assess the distribution of age of the children according to anxiety levels. For assessing the test's retest reliability statistically, Statistical Package for the Social Sciences (SPSS) software version 23.0, Cronbach's α , interclass correlation coefficient, and *t*-test were used. For evaluating the criterion validity, the Spearman correlation coefficient was used. The Kaiser–Meyer–Olkin (KMO) test was used in an exploratory factor analysis to determine whether the sample size was sufficient for the factor analysis.

Results: The scale had a high positive correlation with the modified child dental anxiety scale (MCDAS), which is considered a gold standard, and a higher Cronbach's α value, which proved its internal consistency. It also showed a significant difference between anxious and nonanxious children, but there were no differences in the scores with respect to age.

Conclusion: The present scale proved to be a very effective tool for assessing DFA among young children.

Clinical significance: It is important to identify children at risk of dental anxiety. This scale helps to follow-up on children for their innate DFA, evaluate the efficacy of dental anxiety interventions, enhance communication, and improve access to dental care by encouraging children to seek dental care without fear or hesitation, promoting preventive care and better oral health outcomes.

Keywords: Anxiety assessment scale dental fear and anxiety, Behavior management, Dental anxiety.

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INTRODUCTION

Dental anxiety is a primitive response developed in an individual to protect oneself from harm or self-destruction. This psychological problem particularly affects children, representing a vulnerable group who are unfamiliar with dental procedures. The childhood experience of the hospital, coupled with the dental clinical environment, often triggers intense dental fear and apprehension in young patients.¹ It is described as a systemic response to imminent danger when going to the dentist for therapeutic or preventive care, as well as unnecessary concern about dental procedures, and usually influences one's behavior, cognition, and psychology.²

Managing children's dental anxiety is influenced by a wide range of circumstances. The emotional response of a child to dental care is greatly influenced by their developmental stage, temperament, previous dental experiences, and parental behavior.³ The sensory components of the clinical context make dental operations novel and sometimes frightening for children. Dental equipment can be intimidating in terms of sight, sound, and feel, which can increase anxiety. Alleviating dental anxiety in children helps the dentist to perform and implement better treatment strategies. Young children usually do not have the cognitive ability to fully understand the benefits and importance of dental care, which exacerbates their anxiety. Cartoons can distract anxious children and encourage them to attend the dentist for care.⁴ The literature regarding the use of child-based cartoons for the assessment of dental fear and anxiety (DFA) scales is scarce.

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Children who exhibited a moderate or high level of dental anxiety were more likely to have untreated dental caries compared to children whose mothers had a low degree of dental anxiety. Possible outcomes include avoidance behaviors, a higher probability of dental neglect, and deteriorated oral health. Long-term, this could cause oral anxiety to persist into adulthood, resulting in a vicious cycle of avoidance and neglect.⁵ The need to create efficient assessment tools to accurately quantify dental

anxiety in young populations is highlighted by the seriousness of this issue.⁶ Assessing the dental anxiety of the child helps to provide better behavior guidance. Thus, good dental health education, regular dental visits, excellent rapport between the patient and dentist, and, most importantly, effective communication with the parents of pediatric patients.

Children's dental anxiety has been measured using a variety of evaluation scales, each of which has its own advantages and disadvantages. The dental anxiety scale (DAS) and the modified child dental anxiety scale (MCDAS) are the gold standards and two of the most popular scales.⁷ The DAS, which was adjusted to suit children and is based on Corah's dental anxiety scale, evaluates dental anxiety in adults. The MCDAS, which was created specifically for pediatric populations, provides a thorough assessment of anxiety levels by taking into account both child's and the parent's viewpoints.⁸

Questionnaires or scales are the most common and easiest way to assess anxiety in children. These scales are useful for gaining an understanding of how younger patients are feeling, although they do have certain drawbacks. For example, the DAS mainly relies on self-reporting, which might be difficult for young children with limited verbal communication abilities. It might also miss particular worries and fears that apply only to pediatric patients.⁹ The MCDAS may introduce potential biases and disparities between the child's and parent's assessments, despite including both viewpoints. Additionally, neither measure systematically addresses physiological signs of worry, which are crucial for understanding and reducing children's dental fear.¹⁰

Thus, the history of visual scales with pictures began. The Venham picture scale, designed by the renowned psychologist Robert Venham, is a psychometric tool employed in clinical psychology to assess the experiences of individuals, especially children and adolescents. It utilizes a series of visual representations depicting a spectrum of emotions, ranging from joy and satisfaction to sadness and distress.¹¹

Participants are tasked with selecting the image that best reflects their current emotional state, providing valuable insights into their emotional well-being and enabling practitioners to tailor interventions accordingly.¹² This nonverbal approach proves particularly advantageous for individuals who may struggle to articulate their feelings verbally, making it an invaluable asset in therapeutic settings. Ultimately, the Venham picture scale lacks a connection to emotional elements and is sensitive to age and subject to response bias.¹³

The influence of cartoons has an emotional connection to children, so the development of the scale has a high cognitive attachment to children's psychology. The Oddbods cartoon

scale is a brand-new, all-encompassing measurement tool designed exclusively for assessing children's dental anxiety, given the drawbacks of current evaluation scales. To ensure reliable assessments across a variety of groups, it should also support a wide range of communication abilities. One of the best ways for children to connect is to include expressive cartoon characters.¹⁴

Children's dental anxiety scales with cartoon themes provide a novel and useful method for identifying and treating dental anxiety. These scales enable children to communicate their anxiety levels in a way that transcends language limitations by offering visual representations. A child's capacity to articulate their anxieties is facilitated by familiarity with cartoons, as they create a comforting environment.¹⁵ The cartoon's captivating appeal also acts as a strong deterrent, drawing focus away from potential stressors. The gradual desensitization process, which identifies particular triggers, is facilitated by the progression from less to more anxiety-inducing imagery. Children's anxiety can be further alleviated when they are given the choice or ability to rate it through the use of cartoons, as this provides them with a sense of control.¹⁶ Therefore, this study was conducted to develop a novel Ayesha's Oddbods Dental Anxiety Scale (AODAS) and to assess its reliability and validity for clinical practice.

MATERIALS AND METHODS

Development of the Dental Anxiety Scale

Ayesha's Oddbods scale was designed as a 5-point Likert scale consisting of eight questions, with the options including five Oddbods cartoon characters with different emotions. The questions were taken from a prevalidated study.¹⁷ The Oddbods characters were different in color, showing a variety of emotions so that the children could distinguish between the items on the Likert scale and connect more with the scale. They were arranged in a straight line in the order of blue, yellow, purple, red, and green, ranging from no fear or anxiety to severe dental anxiety (Figs 1 to 3).

- How do you feel about...**
1. Going to the dentist generally
 2. Having your teeth looked at?
 3. Having your teeth scraped and polished?
 4. Having an injection in the gum?
 5. Having a filling?
 6. Having a tooth taken out?
 7. Being put to sleep to have treatment?
 8. Having a mixture of gas and air which will help you feel comfortable for treatment but cannot put you into sleep?

Fig. 1: Questions of Ayesha's Oddbods scale



Fig. 2: Ayesha's Oddbods scale—5 point Likert scale

Ethical Considerations

The study was commenced after obtaining ethical clearance from the Institutional Research Ethics Committee (SRB/SDC/PEDO-2104/23/112). Each parent and child who participated in the study received written material outlining the purpose of the study and confirming that participation was entirely voluntary. Written approval was obtained for the inclusion of both child and parent.

Reliability

There are two ways to measure reliability—test-retest and interrater reliability. The test-retest reliability of Ayesha’s Oddbods scale was investigated in a nonprobability sample of 189 schoolchildren, ages 4–6, who visited the Department of Pedodontics Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences (SIMATS) (Deemed to be University), Chennai, Tamil Nadu, India. Participants completed the Ayesha’s Oddbods scale twice, 24 weeks (6 months) apart, to evaluate the test-retest reliability (Fig. 4). All of the participants’ standardized questionnaires were filled out in class, and they all included their age and gender.

Statistical Analysis

The data were entered into Statistical Package for the Social Sciences (SPSS) version 23.0 and subjected to the intraclass

- Scale 1. Not fearful and anxious: Listens to the dentist, is cooperative, attentive to verbal rapport, and participates enthusiastically in treatment
- Scale 2. Mild fear and anxiety: Mildly anxious, shy, becomes a good patient once fear is overcome
- Scale 3. Moderate anxiety and fear: Fearful and anxious child, who cries deliberately and avoids conversation with a clinician and difficult to make them cooperate. External fear is invoked into the child usually by parents
- Scale 4. Extreme fear and anxiety: Spoilt child, avoids dental treatment complains the fear and anxiety as an excuse, the mother is usually overprotective
- Scale 5. Severe fear and anxiety: The child shouts and cries loudly, exhibits temper tantrums, moves their head and extremities swiftly, extremely uncooperative for dental treatment.

Fig. 3: Explanation of the Likert scale

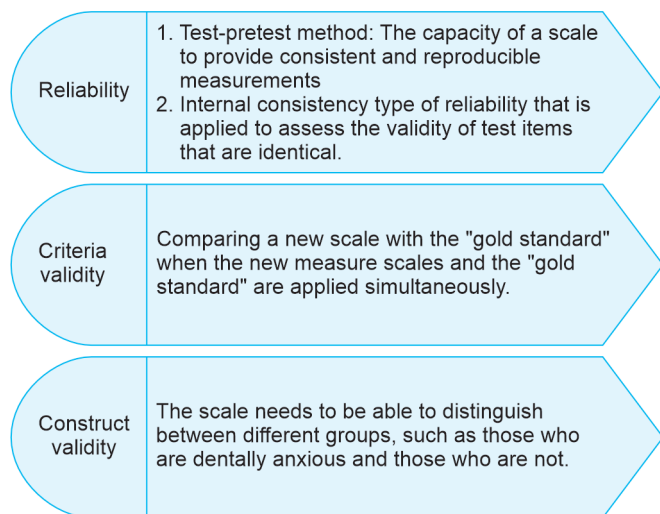


Fig. 4: Reliability and validity

correlation coefficient and *t*-test to test the test-retest reliability. The data were also analyzed using Cronbach’s α for internal consistency.

Criterion Validity

A nonprobability sample of 156 students, ages 4–6, was asked to complete the MCDAS and Ayesha’s Oddbods scale in one sitting to examine the criterion validity of the scale. Each participant’s age and gender were noted on the questionnaires, which were filled out in a controlled environment in class.

Statistical Analysis

The data were entered into SPSS version 23.0 and subjected to the Spearman correlation coefficient to assess criterion validity.

Construct Validity

A cohort group of 178 consecutive new child patients, as well as those attending for a follow-up course of treatment at Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences (SIMATS) (Deemed to be University), Chennai, Tamil Nadu, India, were invited to participate, along with the accompanying adult. The aim was to evaluate the effectiveness of Ayesha’s Oddbods scale. Children aged between 4 and 6 years who had been referred for dental care or ongoing treatment, and did not have any reported learning difficulties, were included. The parents provided demographic information through a dental health questionnaire. Data on the participants’ gender, age, and referral source were collected. Prior to any treatment or examination, the participants completed Ayesha’s Oddbods scale. Those referred for dental anxiety were categorized as having high dental anxiety for the purpose of assessing the scale’s construct validity, while all other referrals were considered to have low dental anxiety (Fig. 5).

Statistical Analysis

The data were entered into SPSS version 23.0 and subjected to *t*-tests to examine the relationship between dental anxiety and referral type.

Normative Study

Normative data were obtained from all children who had once completed Ayesha’s Oddbods scale in a test-retest or criterion validity research. In order to investigate the themes of the questionnaire, psychometric analysis was also conducted.



Fig. 5: Child assessed using AODAS

Statistical Analysis

The data were checked for differences in mean scores according to age using the Kruskal–Wallis test. The study employed factor analysis to investigate whether the Ayesha's Oddbods scale was primarily rooted in a number of dimensions. Exploratory factor analysis, utilizing maximum likelihood estimation and Promax rotation with principal component analysis, was conducted. Additionally, the Kaiser–Meyer–Olkin test (KMO) was applied to assess the adequacy of the sample for the factor analysis.

RESULTS

Reliability

There were 94 girls and 95 boys among the 189 samples. The statistical study included participants who had completed the Ayesha's Oddbods scale twice and were between the ages of 4 and 6 years (mean age: 5.51 ± 1.15). Three additional participants were eliminated due to missing values, and nine were excluded because they were only included in one administration of the scale. This resulted in a 95% response rate.

At the first administration (19.54), Ayesha's Oddbods scale score was statistically significantly higher than at the second administration (18.03) ($t = 6.52, p = 0.010$). The intraclass correlation coefficients for the individual items of Ayesha's Oddbods scale ranged from 0.65 to 0.89 between the first and second evaluations, showing good to outstanding correlation. The intraclass correlation coefficient for the mean overall score on Ayesha's Oddbods scale between the first and second evaluations was 0.83. Cronbach's α , which was around 0.89, was used to evaluate internal consistency (Table 1).

Criterion Validity

Out of 156 participants, there were 78 boys and 78 girls. The mean age of the participants was 5.23 ± 1.86 . The mean overall score for Ayesha's Oddbods scale was 20.45 ± 5.52 , with a range of scores from 14 to 26. The mean overall score for the MCDAS was 28.65 ± 4.23 , with a range of scores from 23 to 34. The mean overall scores for the MCDAS and Ayesha's Oddbods scale were highly statistically significantly correlated ($r = 0.80, p < 0.001$). The individual item scores of Ayesha's Oddbods scale were statistically positively correlated with MCDAS scores, with correlation coefficients ranging from 0.78 to 1 (Table 2).

Table 1: Reliability of Ayesha's Oddbods scale with test pretest method

Reliability	Mean		t-value	p-value	Cronbach's α value
	score	SD			
First administration	19.54	5.65	6.52	0.01	0.89
Second administration	17.03	7.73			

Table 2: Criterion validity by correlation

Correlation between Ayesha's Oddbods scale and MCDAS scale	Spearman correlation coefficient (r)	p-value
Qn 1	0.78	0.002
Qn 2	0.79	0.003
Qn 3	0.86	0.031
Qn 4	1.00	0.000
Qn 5	1.00	0.000
Qn 6	1.00	0.000
Qn 7	0.91	0.001
Qn 8	0.92	0.001

Construct Validity

Out of 178 participants, six were excluded due to incomplete information. Of the remaining 172 participants, 85 were boys and 87 were girls, with a mean age of 5.48 ± 1.95 . Of these, 61.2% were referred due to anxiety, and 38.8% were referred for reasons other than anxiety.

Based on Ayesha's Oddbods scale, the participants who were referred due to dental anxiety had a statistically significantly higher mean overall score ($t = 2.25, p < 0.05$) than the participants who were referred for nonanxiety reasons (Table 3).

Normative Study

A total of 345 schoolchildren, aged 4–6 years, completed Ayesha's Oddbods scale in a single session. The statistical analysis included 330 children within this age range, with a mean age of 5.1 ± 1.85 . The average overall score was 18.43 ± 5.23 . The findings indicated no significant difference in mean scores with respect to age (Table 4).

The mean scores for individual questions were documented. Notably, questions 4 and 6, pertaining to injection and extraction, showed a high level of anxiety. An exploratory factor analysis was conducted, revealing that 65% of the data's variability was accounted for by two factors—factor 1 (with an eigenvalue of 3.41) and factor 2 (with an eigenvalue of 2.01), following promax rotation. The KMO value of 0.686 affirmed the sample's adequacy. When the feared dental elements were correlated with the statistically significant factors 1 and 2, they fell into two distinct groups. Factor 2,

Table 3: Construct validity showing the capacity of the scale to distinguish between the anxious and nonanxious groups

	Anxiety	Mean	SD	t-value	p-value
Qn 1	Anxiety absent	1.75	0.500	2.75	0.040
	Anxiety present	2.83	0.983		
Qn 2	Anxiety absent	2.00	0.816	2.59	0.042
	Anxiety present	2.83	0.408		
Qn 3	Anxiety absent	1.25	0.500	4.12	0.002
	Anxiety present	2.00	0.000		
Qn 4	Anxiety absent	4.50	0.577	1.56	0.049
	Anxiety present	4.90	0.837		
Qn 5	Anxiety absent	3.00	0.816	2.01	0.045
	Anxiety present	3.17	0.408		
Qn 6	Anxiety absent	4.25	0.957	2.10	0.048
	Anxiety present	4.33	0.816		
Qn 7	Anxiety absent	2.75	0.500	4.63	0.000
	Anxiety present	3.83	0.753		
Qn 8	Anxiety absent	1.12	0.012	5.65	0.000
	Anxiety present	3.25	0.062		
Overall mean score	Anxiety absent	2.53	0.319	2.25	0.04
	Anxiety present	3.57	0.592		

Table 4: Distribution of mean score according to age

Age	N	Mean \pm SD	p-value
4 years	113	18.93 ± 4.63	0.235
5 years	109	19.56 ± 6.56	
6 years	108	18.03 ± 4.52	
Mean overall score	330	18.43 ± 5.23	

Table 5: Exploratory factorial analysis

Exploratory factor analysis with KMO test			
Ayesha's Oddbods scale questionnaire	Mean	SD	Factor loading
Qn 1	1.9	0.74	0.55
Qn 2	3.4	0.84	0.90
Qn 3	4.3	0.82	0.63
Qn 4	4.5	0.79	0.76
Qn 5	3.2	0.70	0.93
Qn 6	4.6	0.85	0.76
Qn 7	2.5	0.85	0.65
Qn 8	3.1	0.73	0.92
KMO value		0.686	

labeled the "examination factor," encompassed items like "going to the dentist generally," "having your teeth looked at," and "having your teeth scraped and polished." Conversely, factor 1, termed the "treatment factor," encompassed all other treatment-related items. The Cronbach's α for factor 1 was 0.84, while for factor 2 it was 0.94 (Table 5).

DISCUSSION

This research assessed AODAS in terms of its psychometric characteristics, validity, and reliability. The scale exhibited strong consistency in repeated testing over an extended timeframe. Although there was a notable decline in scores between the initial and subsequent administrations of the questionnaire, this was likely attributed to a decrease in participants' experimental state anxiety, possibly due to increased familiarity with the scale. The choice of a 24-week test-retest interval aimed to ascertain reliability within this suggested recall period, indicating the potential usefulness of the scale in clinical studies involving children. Additionally, the higher Cronbach's α underscored the scale's high internal consistency. The scale was able to distinguish between anxious and nonanxious children. It did not differ according to age, showing that children aged 4–6 years can easily understand and connect with it. The scale was also highly correlated with the MCDAS, which is considered the gold standard for assessing dental anxiety in children. The difference is that the present scale has more distinguishable items.

The present study employed a Likert-type scale, a well-established self-reported measure, to assess participants' anxiety from their own perspectives. This measurement approach offers several advantages, including being simple and clear, and having greater reliability in questions compared to other types of scales.^{18,19} Research indicates that aggregating responses across multiple items, as done with the Likert scale, results in more consistent and unbiased estimations compared to responses to individual items. This is likely attributed to the tendency for random measurement errors to balance out when combining responses from multiple items, thereby enhancing the reliability of construct measurement.^{20–22}

In the present study, mean anxiety scores varied across items. This is consistent with Humphris et al.'s findings using the MDAS with adults.²³ In the same study, he asserted the inclusion of questions about injections, which were also present in our study and had the highest mean score.

In the present study, there is no difference in the mean score of the scale among the age groups and gender differences. However

in studies with validation of child anxiety scales, age and anxiety had mostly been negatively correlated.^{24,25} This means that as the child gets older, anxiety levels are lower. Regarding gender, literature shows that there are studies with significant changes based on gender,^{26,27} and studies with consistent results regardless of gender.^{28,29} This study yields the same results irrespective of gender, which is essential for administering the scale to any child of a particular age.

In the present study, the scale was able to distinguish between anxious and nonanxious children, which was very important. This correlates with findings from studies conducted elsewhere on child and adult anxiety scales.^{10,15,17,30}

It is important from a clinical standpoint to understand the causative factor to address dental fear and anxiety.³¹ Children who scored highly on the injection item may require further dental care to help them manage their fear of injections. Communicating with the patients who are very nervous about injections may help them understand the basis of their fear and dental management.^{32–34}

This study is limited in several ways. First, the sample may have been biased because nonprobability sampling was used to choose participants from only one dentistry college. Further investigation using a random sample from throughout the state is advised to reduce this bias. Second, there may have been a bias toward social desirability since the children completed the questionnaire in the clinic's waiting room while awaiting dental care. Third, the study evaluated only age and gender, two key demographic characteristics. To protect privacy, income and educational levels were not assessed. Lastly, the study did not evaluate any of the child's dental conditions, such as dental caries or previous dental experiences. Further research should focus on a larger sample with a wider age range using a multistage sampling design.

CONCLUSION

In conclusion, this study represents a significant advancement in pediatric dentistry by introducing a novel and innovative tool for measuring dental anxiety among children. Leveraging the universally popular Oddbods cartoon as a means of assessment, this scale offers a unique approach and addresses the critical need for a reliable and child-friendly instrument in this domain.

The assessment of the novel scale's reliability through both test-retest methodology and internal consistency measures yielded highly positive results. The scale's performance across these dimensions attests to its consistent ability to gauge dental anxiety levels among children over time, as well as its internal stability in measuring the construct of interest.

Furthermore, the rigorous evaluation of the scale's validity, encompassing both criterion and construct validity, solidifies its credibility as a reliable instrument. The successful validation against established criteria and the demonstrated ability to differentiate between distinct constructs related to dental anxiety underscore the scale's accuracy and efficacy in assessing this complex phenomenon.

Overall, the findings of this study substantiate the exceptional reliability, validity, and consistency of the novel Oddbods cartoon-based dental anxiety scale. This innovative tool not only contributes significantly to the field of pediatric dentistry but also holds immense potential for widespread application in clinical settings, research endeavors, and educational contexts. By offering a child-centric and engaging means of evaluating dental anxiety, this scale has the potential to revolutionize the understanding and

management of this critical aspect of pediatric oral health. As such, the novel scale represents a pivotal advancement in enhancing the dental experiences of children and promoting their overall oral health and well-being.

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