

Dental Anxiety Scales Used in Pediatric Dentistry: A Systematic Review and Meta-analysis

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ABSTRACT

Aim: To assess various dental anxiety scales used in children and to know the effectiveness of different projective dental anxiety scales used in pediatric dentistry.

Background: Dental anxiety poses a significant problem in child patient management and is considered to be the main barrier for successful completion of the dental treatment.

Review results: This systematic review and meta-analysis has been registered at the International prospective register of systematic reviews—PROSPERO—CRD42021247586. The systematic review was conducted in accordance with the Preferred Reporting Items in Systematic Review and Meta-Analysis (PRISMA) guidelines. Electronic databases [PubMed (MEDLINE), COCHRANE Library, EMBASE, EBSCO host, and Google Scholar database] were searched for corresponding references up to 2021. Observational cross-sectional studies comparing two different dental anxiety scales were selected for this systematic review. Search strategy generated 500 articles out of which 13 studies included in qualitative synthesis and only 7 studies were taken for quantitative synthesis. Among these seven studies, five studies compared FIS and VPT scales, two studies compared RMS, FIS, and VPT scales. Results of meta-analysis showed that an overall mean difference of dental anxiety between VPT and FIS scales was 0.11 (95% CI: 0.26–0.48), RMS and FIS scales was 0.05 (95% CI: 0.40–0.50), RMS and VPT was 0.27 (95% CI: 0.80–0.27) in the investigated population.

Conclusion: No statistically significant difference was noted in all comparisons suggesting that all these scales are at par in assessing anxiety levels in pediatric population.

Clinical significance: The projective scales Raghavendra, madhuriu, sujata pictorial scale (RMS), Facial image scale (FIS), and Venham's picture test (VPT) can be a pragmatic tool in assessing children's dental anxiety.

Keywords: Children, Dental anxiety, Dental anxiety scales, Reliability.

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INTRODUCTION

Anxiety is a human emotion involving behavioral, affective, and cognitive responses to the perception of danger.¹ The knowledge and understanding of anxiety not only lays the foundation of our ability to provide the best possible care for children but more importantly allow us to establish a healthy and long-term relationship with them.² Dental anxiety is a universal phenomenon that affects people of all ages across different countries. The condition negatively impacts oral health-related quality of life in children, adults, and may also impose a substantial burden to society.^{1,2} The etiology of dental anxiety is multifactorial, hence there is no monotherapy for management which is a significant barrier to seeking and receiving dental care.³ Furthermore, dentists perceive anxious patients as more difficult to deal with and treating people with dental anxiety require more time. In addition, anxious patients usually delay dental treatment and routinely miss dental appointments, which can lead to more complex treatment needs.⁴ Children with high levels of dental anxiety have increased numbers of decayed, missing and filled tooth surfaces compared with low levels of dental anxiety. Certain dental procedures do trigger dental anxiety like needles, drills, or eugenol smell.^{3,4} Prevalence of dental anxiety in children and adolescents ranges from 5.7 to 20.2%. The associated factors of dental anxiety such as age, sex, cultural context, socioeconomic status, presence of dental caries, history of toothache, and previous dental treatments.⁵ Children with high dental anxiety have neglected oral healthcare which will

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lead to dental problems like dental caries, periodontal diseases, and poor oral hygiene. Furthermore, underlying dental anxiety will make the children uncooperative, dental treatment a difficult one and challenging for pediatric dentist. Proper evaluation of the patient and identifying their source, level of anxiety can enable the pediatric dentist in deciding proper strategies to manage. Additionally, dental anxiety prevalence estimates may be influenced by methods used to assess it. For a pediatric dentist it is of utmost important to assess anxiety levels of a child before performing any dental treatment.⁶ There is a large pool of multiitem self-report scales and single-item questionnaires with result interpretation that can be used to measure dental anxiety in children and adolescents.^{5,6} Various methods (Nonprojective

method and Projective method) have been used in literature for the assessment of dental anxiety. Nonprojective methods such as self-reporting questionnaires such as Corah's dental anxiety survey and modified Corah's dental anxiety survey.⁷ Projective methods utilize picture tests such as Venham's pictorial test (VPT), facial index scale (FIS), RMS Scale, RMS-PS, Animated Emoji Scale, Chotta Bheem—Chutki scale assess trait anxiety. Though there have been numerous scales enlisted in the literature to assess dental anxiety, all having their own advantages and disadvantages with age appropriateness, creating pediatric dentist in a stage of dilemma to select appropriate scales to assess children's dental anxiety before performing a dental treatment. Therefore, there is a need to have a collective literature describing dental anxiety scales in one frame.

Thus, this systematic review and meta-analysis is planned to throw a light on various dental anxiety scales available in the literature and to know their effectiveness. "Objectives of the present study are to assess various available dental anxiety scales used in children and their effectiveness of different projective dental anxiety scales used in children."

MATERIALS AND METHODS

Protocol Registration and Review Reporting

This systematic review and meta-analysis has been registered at the international prospective register of systematic review—Prospero CRD42021247586. This review follows the guidelines of Preferred Reporting Items in Systematic Review and Meta-Analysis (PRISMA) (Flowchart 1).

Focused Research Question

What are the most common Dental Anxiety Scales used in Pediatric Dentistry and what is the efficiency of Facial Image Scale, Venham's Picture Test, and RMS in Pediatric Dentistry?

Eligibility Criteria

We use the PICO format, where in population (P), children of age group 3–15 years, no intervention applied, comparison between types of anxiety (Facial Image Scale, Venham's Picture Test and RMS) and outcome (O) anxiety levels.

Types of studies used for this meta-analysis were observational cross-sectional studies.

Inclusion Criteria

- Observational cross-sectional studies comparing different dental anxiety scales.
- Studies on children of age group 3–15 years which are published in English language only.

Reason for Exclusion

Studies which did not evaluate primary or secondary outcome and published in languages other than English and not related to the topic of interest were excluded from this systematic review. Also literature reviews, letter to editors, abstracts presented at conference, and book chapters were excluded.

Search Strategy

The literature search was done using computerized data base [PubMed (MEDLINE), COCHRANE Library, EMBASE, EBSCO host, and Google Scholar database] for corresponding references up to 2021. The following terms were used in our search strategy: "dental anxiety" OR "dental anxiety scales" OR "dental anxiety in children" OR "dental anxiety scales used in children" OR "anxiety scales used in pediatric dentistry" OR "Dental fear and dental anxiety scales". The reference list of identified studies was manually searched to find any articles missed during the initial search.

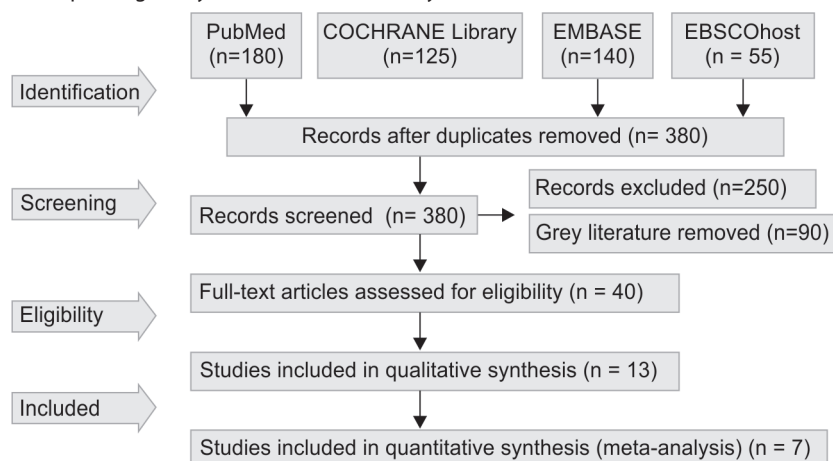
Data Collection Process

Two independent reviewers performed the selection of the articles in two phases. In phase one, both the reviewers performed searches of titles and abstracts based on eligibility criteria independently. In case of discrepancies a consensus decision was taken by third evaluator, and then articles were included in the systematic review. In phase two, the same reviewers performed full text evaluation of the preselected articles for determining eligibility and extraction of relevant information.

Data Extraction

Two reviewers extracted the following data from the selected articles: author(s), year of publication, study design, aim of the study, population size and age, dental anxiety scales used, outcome (Table 1).

Flowchart 1: PRISMA flowchart explaining the synthesis of the data for systematic review



Quality Assessment

The methodological quality of the included studies was assessed by using the Appraisal tool for Cross-sectional Studies (AXIS tool) for observational cross-sectional studies. The AXIS tool consisted of 20 components. A detailed explanatory document was also developed with the tool, giving expanded explanation of each question and providing simple interpretations and examples of the epidemiological concepts being examined in each question to aid nonexpert users.

Statistical Analysis

A meta-analysis was performed with the aid of review manager (Revman 5.4 software). The effect size estimated and reported as the mean difference (MD) and 95% confidence interval (CI) was calculated. A p value <0.05 was considered indicative of a statistically significant result. We used a randomized effect model to address heterogeneity. The I^2 index was used to assess statistical heterogeneity.

RESULTS

We followed the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-analyses statement. We also followed the recommendations of the Meta-analysis of Observational Studies in Epidemiology for the report of this systematic review.

Study Selection

Executing the search strategy generated 500 articles. After removing 120 duplicate articles, abstracts of 380 articles were viewed. On the basis of the exclusion criteria, we excluded 250 articles from the database and 90 from the gray literature after reviewing titles and abstracts, resulting in 40 articles for full-text evaluation. Out of these 40 full texts 13 studies met eligibility criteria which were taken for systematic review. Of these, only seven articles were retained for meta-analysis. Publication bias was not found in any of the analysis.

Study Characteristics

Table 1 describes the main characteristics of the studies which are included in the review. All included studies were observational cross-sectional studies, having full texts articles published in the English language till January 2021. The sample size ranges widely from 60 to 200 participants. Children's age ranged from 3 to 15 years. Summary of available dental anxiety scale is provided in Table 3.

Quality of Studies

Tables 2A and B show quality assessment of scientific evidence in chosen articles as per Axis tool.

Studies which scored more than 10 items criteria were considered of good scientific evidence. This criterion of fulfilling 50% or greater items of the Axis tool criteria said to be good scientific evidence study

Table 1: Summary of descriptive characteristics of 13 included studies

Sl. No	Author, year	Study design	Settings	Population size	Age	Intervention	Mean DA scores
1	Buchanan and Niven, 2002	Observational cross-sectional study	Hospital-based study	100 (T) 50 (M) 50 (F)	3–15 years	(FIS) facial image scale (VPT) venham picture test	FIS—2.2 VPT—1.4
2	Buchanan et al., 2005	Observational cross-sectional study	Study setting in school	241 (T) SFP 52 (F) 48 (M) MDAS and DFSS 120 (F) 120 (M)	4–10 years	(SFP) scale of protective factors (MDAS) modified dental anxiety scale (DFSS) dental fear schedule subscale	SFP—18
3	Dogan et al., 2006	Observational cross-sectional study	Hospital-based study	258 (T) 133 (M) 125 (F)	8–12 years	(CDAS) corah's dental anxiety scale (FIS) facial image scale (ComDAS) combined dental anxiety scale	C-DAS—10.8 Com-DAS—11.6
4	Howard and Freeman, 2007	Observational cross-sectional study	Hospital-based study	287 (T) 191 (F) 96 (M)	8–10 years	(MCDASf) modified child dental anxiety scale with faces	
5	Krishnappa et al., 2013	Observational cross-sectional study	Hospital-based study	52 (T) 28 (M) 28 (F)	6–12 years	(FIS) facial image scale (VPT) venham picture test	FIS—2.9 VPT—2.8

(Contd...)

6	Esa et al., 2015	Observational cross-sectional study	Study setting in school	87 (T) 40 (M) 47 (F)	5–12 years	(MCDASf) modified child dental anxiety scale with faces (CFSS-DS) schedule dental subscale	MCDASf—21.7 CFSS-DS—37.5
7	Shetty et al., 2015	Observational cross-sectional study	Hospital-based study	102 (T) 59 (M) 43 (F)	4–12 years	RMS raghavendra, madhuri, sujata pictorial scale (VPT) venham picture test (FIS) facial image scale	
8	Howard et al., 2017	Observational cross-sectional study	Study setting in school	287 (T) 191 (F) 96 (M)	8–10 years	(MCDASf) modified child dental anxiety scale with faces (CFSS-DS) schedule dental subscale	
Sl. No	Author, year	Study design	Settings	Population size	Age	Intervention	Mean DA scores
9	Sadana et al., 2017	Observational cross-sectional study	Hospital-based study	100 (T) 61 (M) 39 (F)	4–12 years	CBC VPT FIS	CBC (M)—2.4 (F)—2.5 VPT (M)—3.8 (F)—3.9 FIS (M)—2.5 (F)—2.7
10	Shetty et al., 2018	Observational cross-sectional study	Study setting in school	94 (T) 49 (M) 45 (F)	12–15 years	MDAS RMS-TS	
11	Fathima et al., 2018	Observational cross-sectional study	Hospital-based study	50 (T) 25 (M) 25 (F)	5–12 years	FIS VPT	FIS—2.7 VPT—2.6
12	Setty et al., 2019	Observational cross-sectional study	Hospital-based study	102 (T) 52 (M) 50 (F)	4–14 years	Animated emoji scale (AES) VPT FIS	AES—1.7 FIS—1.9 VPT—1.5
13	Oliveira et al., 2020	Observational cross-sectional study	Hospital-based study	30 (T) 15 (M) 15 (F)	4–9 years	Modified (VPT) RMS-PS FIS	

(T), total; (M), male; (F), female

Table 2A: Risk of bias—assessment of quality of study by axis tool

	Buchanan and Niven, 2002	Buchanan et al., 2005	Dogan et al., 2006	Howard and Freeman, 2007	Krishnappa et al., 2013	Esa et al., 2015	Shetty et al., 2015	Howard et al., 2017	Sadana et al., 2017	Shetty et al., 2018	Fathima et al., 2018	Setty et al., 2019	Oliveira et al., 2020
Introduction													
1. Were the aims/objectives of the study clear?	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Methods													

(Contd...)

Table 2A: (Contd...)

2. Was the study design appropriate for the stated aim(s)?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3. Was the sample size justified?	Yes	No	No	Yes	No	No	No	No	Yes	No	No	No	No
4. Was the target/reference population clearly defined? (is it clear who the research was about?)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5. Was the sample frame taken from an appropriate population base so that it closely represented the target/reference population under investigation?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	<i>Buchanan and Niven, 2002</i>	<i>Buchanan et al., 2005</i>	<i>Dogan et al., 2006</i>	<i>Howard and Freeman, 2007</i>	<i>Krishnappa et al., 2013</i>	<i>Esa et al., 2015</i>	<i>Shetty et al., 2015</i>	<i>Howard et al., 2017</i>	<i>Sadana et al., 2017</i>	<i>Shetty et al., 2018</i>	<i>Fathima et al., 2018</i>	<i>Setty et al., 2019</i>	<i>Oliveira et al., 2020</i>
6. Was the selection process likely to select subjects/participants that were representative of the target/reference population under investigation?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7. Were measures undertaken to address and categorize non-responders?	No	No	No	No	No	Yes	No	Yes	Yes	No	Yes	No	No

and less than 50% of Axis tool criteria said to be moderate studies and those studies which were under both the categories, i.e., good evidence and moderate studies demonstrated a very low risk of bias. In our systematic review and meta-analysis, of 13 studies 5 studies had a good methodological approaches (Sadana et al.,⁷ Fathima and Jeevanandan,⁸ Howard et al., 2017, Esa et al., 2015, Setty et al.¹⁰) and 7 studies were found to be moderate studies (Buchanan and Niven,¹¹ Dogan et al.,¹² Howard and Freeman,⁹ Krishnappa et al.,¹³ Shetty et al.,¹⁴ Shetty et al., 2018, Oliveira et al.¹⁵).

Meta-analysis Results

This meta-analysis comprises studies comparing FIS, VPT, and RMS scales. Hence seven studies which could be meaningfully pooled

and their comparisons were of similar units of dental anxiety scales were included for meta-analysis.

Facial Image Scale vs Venham's Picture Test

We performed the meta-analysis regarding the outcome measures. The analysis included five studies. A total of 295 children and 293 children were evaluated for the scales of Facial Image Scale and Venham's Picture Test. An overall mean difference of 0.11 (95% CI: 0.26–0.48) was noted between the two scales in the investigated population (Fig. 1A). No significant difference (p value = 0.56) was noted suggesting both the scales are at par in assessing anxiety levels in pediatric population. Heterogeneity of 80% suggested variability which could be attributed to difference in age-groups and methodological differences.

RMS Scale vs Venham's Picture Test

Second analysis included three studies. A total of 209 children and 209 children were evaluated for the scales of RMS and Venham's Picture Test. An overall mean difference of -0.27 (95% CI: $0.80-0.27$) was noted between the two scales in the investigated population (Fig. 1B). Both were at the same par demonstrating equal reliability of both ($p=0.33$). Heterogeneity of 86% showed variance was within high level.

RMS Scale vs Facial Image Scale

Third analysis included three studies. A total of 209 children and 208 children were evaluated for the scales of RMS and Facial Image Scale.

Table 2B: Perception of quality of study (risk of bias)

Category	Authors
Good study	Sadana et al., 2017
	Fathima et al., 2018
	Howard et al., 2017
	Esa et al., 2015
	Setty et al., 2019
Moderate study	Buchanan and Niven, 2002
	Dogan et al., 2006
	Howard and Freeman, 2007
	Krishnappa et al., 2013
	Shetty et al., 2015
	Shetty et al., 2018
Low study	Oliveira et al., 2020
	Buchanan et al., 2005

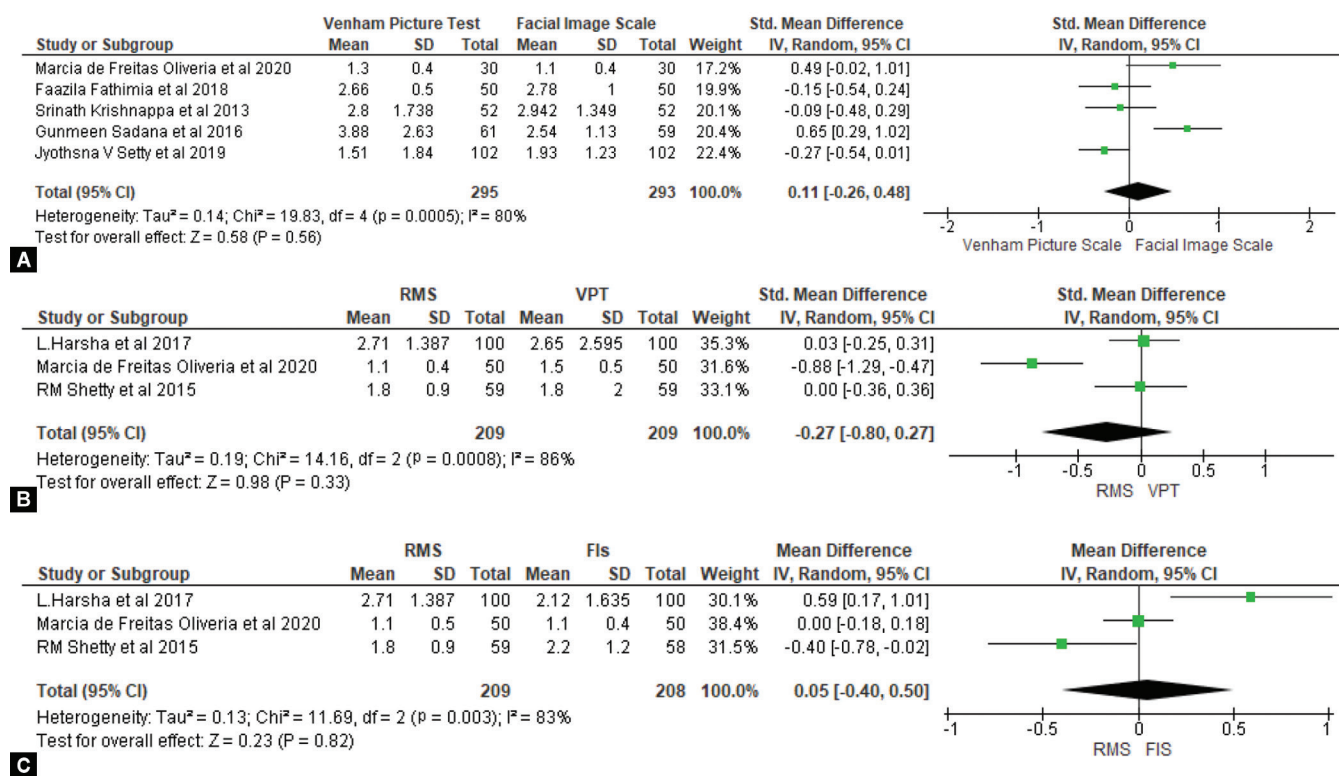
An overall mean difference of 0.05 (95% CI: $0.40-0.50$) was noted between the two scales in the investigated population (Fig. 1C). Both were at the same par demonstrating equal reliability of both ($p=0.82$). Heterogeneity of 83% showed variance was within high level.

DISCUSSION

Dental anxiety in children has been a major concern for dentist for a long time. Many authors have evaluated dental anxiety levels in children using various dental anxiety scales.^{8,10,12,13,16-19} In an effort to more accurately assess anxiety levels in children, pediatric dentists typically utilize scales, which are particularly designed for use with children.¹⁴ The first developed pictorial scale was Venham's Picture Test given by Venham and Gaulin-Kremer¹⁹ in which children are presented with eight pairs of pictures, each depicting cartoon boys in contrasting moods.³ Though this scale is the oldest and most widely used, it posed certain drawbacks like the figures on the cards are all boys; this may present problems when the young patient is a girl. Also, the scale is more time-consuming, making it difficult to use in very young patients.¹² Further in this field, research on developing newer scales led to the development of many pictorial scales. Facial Image Scale given by Buchanan and Niven¹¹ is quick and easy to administer scale, takes less time to record dental anxiety of a child, and the score is simply a reflection of the face chosen. It comprises a row of five faces ranging from very happy to very unhappy.²⁰ In FIS, young children often face difficulties in interpreting the drawings of facial expressions.⁴ RMS-Pictorial scale given by Shetty et al.¹⁴ consists of a row of five faces which ranges from very happy to very unhappy. A photocopy of the scale was shown to the child and he/she was asked to choose one among the five faces according to how they feel at that moment in the dental clinic.¹⁰ Narkey et al. in 2012

Table 3: Summary of dental anxiety scales

Scale	Year of first publication	Age range	Items	Reliability	Limitations
VPT	1979	3-18	8 pictures/children do not read questions or responses	Assessed	The figures on the cards are all male, this may present problems when the young patient is a girl
MCDAS	1998	8-15	8 questions with 5 responses for each question	Assessed	Issues with how patients perceive the faces relate to their anxiety status, with evidence to suggest that face numbers 1, 2, and 3 may be seen as a relaxed response, while faces 4 and 5 an anxious response
FIS	2002	3-18	Row of 5 faces ranging from 1 to 5	Assessed	Single item measure which may make it difficult to identify the construct of anxiety being measured
DAS	2002	5	Two sets of 12 clinical pictures with 4 face responses for each picture	Assessed	Cannot be used for children above 5 years of age
SFP	2005	4-11	5 computerized questions with 7 face responses for each question	Assessed	The accuracy of the results could be affected by the use of seven faces
MCDASf	2007	8-12	8 questions with 5 face responses for each question	Assessed	
RMS	2015	4-12	Row of 5 faces for boys and girls ranging from 1 to 5		
Chotta Bheem-Chutki Scale	2016	4-12	2 cards For boys, Chotta Bheem cartoon and for girls, Chutki cartoon		
Animated Emoji Scale (AES)	2019	4-14	5 graphic of animated emoji faces The scale had scores from 1 (very happy emoji) to 5 (very unhappy emoji)		



Figs 1A to C: (A) Forest plot showing comparison of Venham's Picture Test and Facial Image Scale; (B) Forest plot depicting anxiety scores of RMS and VPT scales; (C) Forest plot depicting anxiety scores of RMS and FIS scales

and Porritt et al.² did a systematic review on measures used to assess dental anxiety of children and they stated that there is no scale that can be considered as a gold standard, and there is a need for further development of an anxiety scale with a cognitive component for children.²¹ The above-mentioned systematic reviews have been done a decade ago; many newer scales would have been developed since then and also till date no meta-analysis has been performed on this particular topic. Thus, we planned this systematic review and meta-analysis looking into the need arisen from the previous systematic reviews and also adding different newer dental anxiety scales. So, in the present study, we analyzed commonly used dental anxiety scales available in the literature till January 2021.^{8,10,13,17-19} From the literature search 13 studies were included in qualitative synthesis and 7 studies were included in quantitative studies. These studies had enough data to be included in the meta-analysis which were comparing FIS VPT and RMS with good methodological approach. Axis tool instrument given by Downs and Black was used to assess the quality of studies. Comparative studies of pictorial scales like Venham's Picture Scale, Facial Image Scale, and RMS Scale were selected for meta-analysis. And our results showed that the mean difference of dental anxiety between VPT and FIS was 0.11 (95% CI: 0.26–0.48) with p value 0.56, RMS with FIS was 0.05 (95% CI: 0.40–0.50) with p value 0.82, and RMS with VPT was 0.27 (95% CI: 0.80–0.27) with p value 0.33 which is statistically not significant. So, our results are suggesting that most commonly employed scales in pediatric dentistry are VPT, FIS, and RMS; also it can be stated from our meta-analysis that all three scales are equally effective in assessing dental anxiety of children.

CONCLUSION

Dental anxiety of children is challenging for pediatric dentist as well as for clinician. An accurate assessment of dental anxiety is necessary, not only to determine its prevalence but also to overcome the problems associated with individual diagnosis and planning an appropriate treatment. Thus, from this systematic review and meta-analysis, we conclude that most commonly employed projective scales in pediatric dentistry are Venham's Picture Test, Facial Image Scale, and RMS scales. All these three scales are equally effective in assessing children's dental anxiety. This paper is throwing a light for pediatric dentist to choose appropriate dental anxiety scales to assess children's anxiety prior to dental treatment thus making dental treatment hassle-free and also these findings can be utilized by academician, clinician as well as psychologist to select the right dental anxiety assessment tool for their intended purpose.

RECOMMENDATIONS

- Projective dental anxiety scales can be a pragmatic tool in assessing children's dental anxiety.
- The most commonly used dental anxiety scales are Facial Image Scale, Venham's Picture Test, and RMS.
- Facial Image Scale, Venham's Picture Test, and RMS are equally effective, easy to administer in children, and are less time-consuming.
- Facial Image Scale, Venham's Picture Test, and RMS can be employed by Clinician and Researcher in assessing dental anxiety of children.

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