

Systematic Review

Psychological behavior management techniques to alleviate dental fear and anxiety in 4–14-year-old children in pediatric dentistry: A systematic review and meta-analysis

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ABSTRACT

Child's uncooperative behavior can impede the efficient delivery of dental care. Therefore, in spite of exceeding availability of behavior management techniques there is a need to search for a psychological behavior management technique that effectively reduces fear and anxiety during dental treatment and instill a change in child's attitude toward the treatment and is also acceptable by the parents. The aim of our systematic review is to determine the efficacy of various psychological behavior management techniques in managing a child's behavior in pediatric dentistry by assessing the fear and anxiety levels, ease of use by the clinician, application in various operative procedures, and parental acceptance. A systematic search was conducted by two reviewers in databases PubMed, Google Scholar, Scopus, Web of Science, and Cochrane for the studies published from January 1, 2011, to December 31, 2020. Studies included were clinical studies which evaluated the efficacy of various psychological behavior management techniques by evaluating the fear and anxiety levels and the changes in behavior during dental treatment in children aged between 4 and 14 years. The studies selected were then assessed for quality with the help of predetermined criteria which categorized the studies into high, medium, and low. Through search strategy, 7147 articles were yielded. After screening through titles and abstracts, 60 nonduplicated articles were selected which were further screened for full text. At the end, 15 articles were included in systematic review and 3 articles for meta-analysis. It was concluded that all the psychological behavior management techniques aided in reduction of fear and anxiety. In noninvasive procedures, conventional psychological behavior management techniques can be effective but in invasive procedures other newer psychological behavior management techniques showed better results. The aspect of parental acceptance regarding various techniques was not discussed in any of the included studies.

Key Words: Cooperative behaviors, dental anxieties, dental fear, pedodontics

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INTRODUCTION

“Although operative dentistry may be perfect, the appointment is a failure if a child departs in tears,” this statement by McElory beautifully emphasizes the

importance of behavior management over technical excellence in pediatric dentistry.^[1]

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Dentistry has an environment which can stimulate the natural fear responses even in adults. This is even more extensive in children because of lack of maturity, intellectual capacity, and communication deficits. Various studies reported the prevalence of dental fear and anxiety in children to be as high as 30%–40%.^[1,2]

Children often try all means to avoid dental treatment resulting in failed or missed appointments. They are difficult to treat leading to prolonged appointment durations. Their uncooperative nature also creates occupational stress on dentist. All these results in neglected dental care.

Delay in seeking treatment leaves conservative treatment options unviable. They may require more complex treatment with the aid of pharmacological interventions.^[3] Psychological behavior management techniques are meant to reduce need for excessive and potentially unsafe use of medications. Moreover, behavior management technique should focus on decreasing fear and anxiety toward a dental procedure and on increasing children's coping abilities. The use of pharmacological techniques does not fulfill these purposes. This highlights the need for using psychological behavior management techniques over pharmacological ones.

A literature search was carried out but no systematic reviews were found which highlighted this aspect, hence this study is planned to discuss in detail, the plethora of psychological behavior management techniques and emphasizing the one which is the most effective in reducing dental fear and anxiety.

Population exposure comparison outcome format

- Population (P): Children between 4 and 14 years of age
- Exposure (E): To assess fear and anxiety using different psychological behavior management techniques
- Comparison (C): Comparison of different psychological behavior management techniques
- Outcome (O): To establish communication, alleviate fear, diminish anxiety, deliver quality dental care, and promote child's positive attitude toward dental health.

Objectives

1. To evaluate various psychological behavior management techniques by assessing the fear and anxiety levels and change in behavior
2. To evaluate various psychological behavior management techniques in terms of its ease of use by the clinician, different operative procedures, and acceptance by parents.

METHODS

Protocol and registration

The systematic review followed preferred reporting items for systematic reviews and meta-analyses guidelines and was registered at PROSPERO (CRD42020211883) and can be accessed at <http://www.crd.york.ac.uk/prospero/index.php>.

Eligibility criteria

Inclusion criteria

1. Study setting should be clinical
2. Study design should be randomized control trial, quasi-randomized, control clinical trial and retrospective or a cohort study
3. Study population should be between 4 and 14 years of age
4. Study evaluating the fear and anxiety levels and the changes in behavior using standard parameters
5. Study published between January 1, 2011, and December 31, 2020
6. Studies written in English language or any other language than can be translated into English.

Exclusion criteria

1. Articles reported as letter to editor, case reports, and review
2. Studies conducted on special children or children with medical condition that could potentially influence their behavior.

Search strategies and data extraction

Literature search strategy was developed using keywords related to psychological behavior management techniques in Pediatric Dentistry. The search strategy used for searching articles was psychological behavior management/nonpharmacological behavior management AND dental fear and anxiety AND Pediatric dentistry. Data were searched through PubMed, Google Scholar, Scopus, Web of Science, and Cochrane from January 1, 2011, to December 31, 2020. Cross-references were checked, gray literature and hand searching of articles were done when full texts of the relevant studies were unavailable through electronic database.

Two review authors (NK, SMH) screened the titles, abstracts, full text, and included them if they met

inclusion criteria. All the excluded studies were recorded with their reason for exclusion [Figure 1].

RESULTS

The total articles yielded after the search were 7149. After screening through duplicates, titles, abstracts, and full text 15 studies were included in the systematic review which were then qualitatively analyzed. Data extraction was performed using a standardized outline. Study characteristics were tabulated for the selected studies [Table 1]. Summary of the effectiveness of psychological behavior management techniques is compiled in Table 2.

Risk of bias

The studies were categorized into high-, medium-, and low-risk bias according to Cochrane handbook for systematic review using RevMan 5.3.^[4] Most studies

were at low risk of bias in the seven domains that we assessed. The assessment of each article was done on the basis of Random sequence generation, allocation concealment, blinding of participants and outcome assessments, incompleteness of outcome data, and selective reporting. A summary of the risk of bias for individual study as well as the judgments of the risk of bias for each domain is mentioned [Figures 2 and 3].

Meta-analysis

For quantitative measures, 15 articles were reviewed and three of them were selected for meta-analysis. These three articles were statistically evaluated using statistics and data software STATA (Statistical Software: College Station, TX: StataCorp LLC). Forest graph was plotted while comparing the Audio-visual distraction as the experimental group and conventional tell show do like the control group. Heart rate was taken for assessing the change in

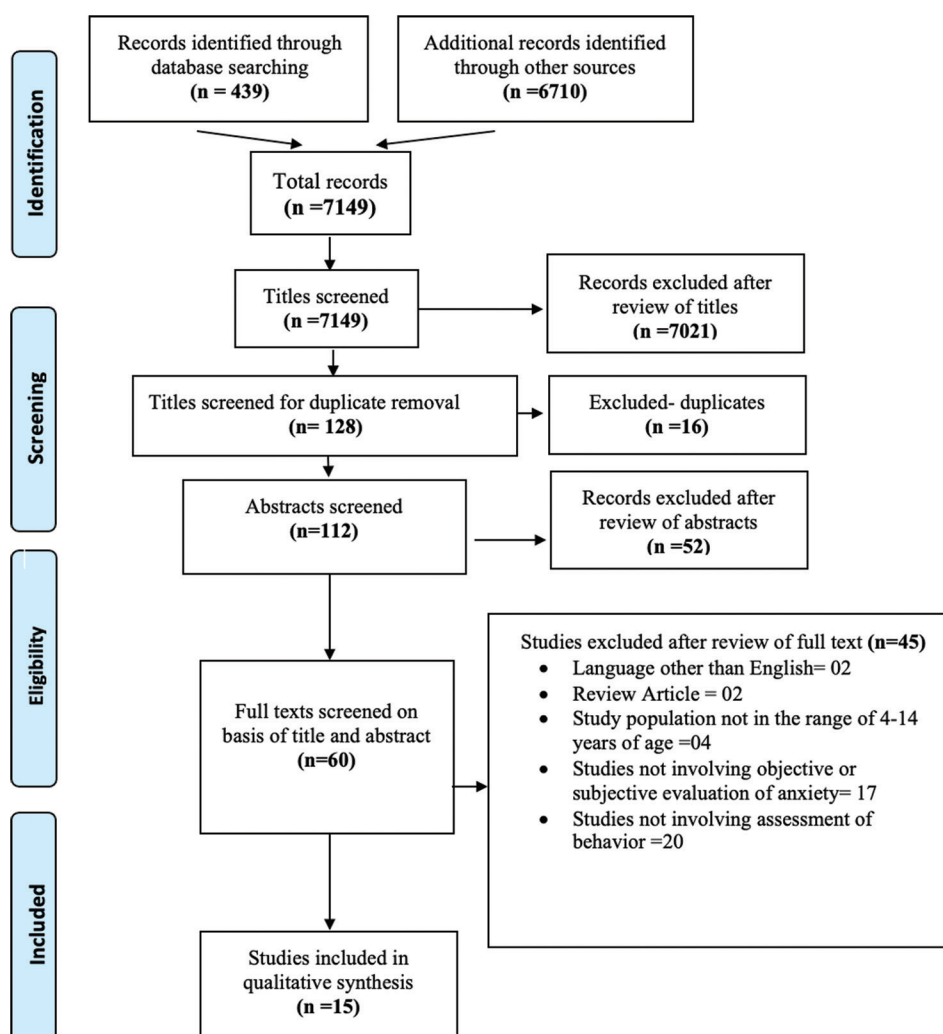


Figure 1: Flow diagram depicting the process of selection and exclusion of articles at each step.

Table 1: Qualitative analysis of the studies selected for the systematic review

Author and year of publication	Sample size (n)	Age (years)	Study design	T/t given	Behavior management technique used	Objective assessment of anxiety	Subjective assessment of anxiety	Assessment of behavior	Effectiveness of technique
Shah et al. 2018	50	4-7	Randomized controlled trial	Restorative treatment	Group A: Tell Play Do Group B: Audio-visual distraction	Heart rate (bpm) Mean difference between (A) and (B) Before=-0.179 After=0.1153 P=0.133	Facial Image Scale Mean difference between (A) and (B) Before=0.0513 After=-0.1699 P=0.39	Venham Picture Scale Mean difference between (A) and (B) Before=0.0897 After=0.2852 P=0.525	Tell play do was equally effective as audio-visual distraction
Vishwakarma et al. 2017	98	5-7	Randomized controlled trial	Oral prophylaxis+ restorative treatment	Group A: Live modeling Group B: Tell play do	Heart rate (bpm) a. Before=102.49±7.90 After=95.20±7.60 b. Before=100.14±8.88 After=90.06±7.09 P=0.001**	Facial Image Scale a. Before=16.22 After=20.00 b. Before=16.78 After=13.00 P=0.007**	Venham 6-point index a. Before=17.28 After=20.00 b. Before=15.72 After=13.00 P=0.010*	Tell play do was more effective than live modeling
Kharouba et al. 2020	69	5-12	Randomized controlled trial	Restorative treatment	Group A: Tell show do Group B: Audio-visual distraction (television)	Heart rate (bpm) a. Before=104 After=102 b. Before=97 After=95 P=0.008**	Facial Image Scale a. Before=3.06 After=2.74 b. Before=1.52 After=1.32 P=0.036*	FBRS a. Before=2.5 After=2.74 b. Before=2.9 After=3.8 P=0.001**	Television distraction was more effective than tell show do
Sridhar et al. 2019	66	7-11	Randomized controlled trial	Local anesthesia	Group A: Control Group B: Relaxation training	Heart rate (bpm) a. Before=96.00±10.27 After=94.7±8.73 b. Before=93.30±8.52 After=92.5±8.03 P=0.319	Facial Image Scale a. Before=1.76±0.61 After=1.84±0.61 b. Before=1.60±0.5 After=1.57±0.56 P=0.073	Wong Baker Faces Pain Rating Scale a. 2.45±0.56 b. 1.51±0.67 P=0.001** FBRS (A) and (B) Negative=18% Positive=72.7% Definitely positive=9.1% P=0.001**	Relaxation Training reduced the pain perceived but no significant difference found in anxiety
Radhakrishna et al. 2019	66	4-8	Randomized controlled trial	Restorative treatment	Group A: Tell play do Group B: smartphone dentist game Group C: tell show do	Heart rate (bpm) a. Before=108.5 After=91.75 P=0.002** b. Before=108.35 After=92.65 P=0.007** c. Before=109.60 After=100.10 P=0.5	Facial Image Scale a. Before=2.40 After=1.00 P=0.005** b. Before=2.55 After=1.10 P=0.01* c. Before=2.35 After=1.15 P=0.5	FBRS a. Definitely positive=85% b. Definitely positive=85% c. Definitely positive=55% P=0.04*	Tell play do and Smartphone dentist game are more effective than tell show do

Contd...

Table 1: Contd...

Author and year of publication	Sample size (n)	Age (years)	Study design	T/t given	Behavior management technique used	Objective assessment of anxiety	Subjective assessment of anxiety	Assessment of behavior	Effectiveness of technique
Ghadimi et al. 2018	28	4-5	Randomized clinical trial	Pulpotomy	Group A: Visual distraction in I and tell show do in II visit Group B: Tell show do in I and visual distraction in II visit	Heart rate (bpm) I visit a. 83.85±2.41 b. 81.43±3.18 II visit a. 81.14±2.32 b. 81.29±2.79 P=0.001**	Venham picture test I visit a. 1.86±1.29 b. 1.71±1.33 II visit a. 1.00±1.04 b. 1.07±1.21 P=0.001**	Frankl Behavior rating scale I visit a. 3.14±0.66 b. 3.07±0.62 II visit a. 3.43±0.51 b. 3.64±0.50 P=0.24	Visual Distraction by playing cartoons was more effective
Al-Khotani et al. 2016	56	7-9	Randomized Controlled Trial	Restorative Treatment	Group A : Control Group B : Audio-visual distraction	Heart rate (bpm) a. Before=94.3 After=93.4 B. Before=95.5 After=95.3 P=0.04*	MVARs a. Before=0.64 After=0.75 b. Before=0.71 After=0.25 P=0.04* Facial Image Scale a. 1.68±0.86 B. 1.93±1.15 P=0.570	MVARs a. 0.75±0.52 b. 0.14±0.36 P=0.03*	Audio-visual distraction was more effective
Mitrakaul et al. 2015	42	5-8	Randomized Controlled Trial	Restorative treatment/pulpectomy/ extraction	Group A: Tell show do in I visit and audio-visual distraction in II visit Group B: Audio-visual distraction in I visit and tell show do in II Visit	Heart rate (bpm) I visit a. Before=94.5±15.9 After=96.96±1 b. Before=88.06±12.74 After=95.24±12 II visit a. Before=88.14±10.07 After=93.51±9.8 b. Before=89.86±12.11 After=91.96±10 P=0.043*	Faces Pain Scale- Revised I visit a. 1.62±2.94 b. 1.9±2.93 II visit a. 0.86±1.49 b. 1.9±3.32 P=0.032*	FLACC Scale I visit a. Before=0.57±0.98 After=0.57±0.9 b. Before=0.1±0.3 After=0.95±1.63 II visit a. Before=0.1±0.3 After=0.33±0.7 b. Before=0.4±0.8 After=0.7±1.1 P=0.047*	Audio-visual distraction was more effective than tell show do
Kaur et al. 2015	60	4-6	Randomized clinical trial	II visit: restorative treatment without LA III visit endodontic/ extraction procedure with LA	Group A: Control Group B: Audio distraction Group C: Audio-visual distraction	Heart rate (bpm) I visit a. Before=122.70 After=128.90 b. Before=115.10 After=110.00 c. Before=115.90 After=101.50	DSCFSS Scale II visit a. Before=23.50 After=22.00 b. Before=21.60 After=19.30 c. Before=19.5 After=15.8 P=0.001	Clinical Anxiety Rating Scale and cooperative behavior rating scale II Visit a. 2.50 b. 1.00 c. 0.20 III visit a. 3.40 b. 1.80 c. 1.00 P=0.018*	Audio-visual distraction was more effective

Contd...

Table 1: Contd...

Author and year of publication	Sample size (n)	Age (years)	Study design	T/t given	Behavior management technique used	Objective assessment of anxiety	Subjective assessment of anxiety	Assessment of behavior	Effectiveness of technique
Nuvvula et al. 2015	90	7-10	Randomized clinical trial	Local anesthesia	Group A: Control Group B: Audio distraction Group C: Audio-visual distraction	Ill visit a. Before=113 After=130.20 b. Before=109.4 After=111.40 c. Before=103.3 After=91.80 P=0.047* Heart Rate (bpm) a. Before=95.4±5.6 After=119±13.1 b. Before=89.3±3 After=104.6±2.9 c. Before=102.4±8 After=109.4±5 P=0.001**	Ill visit a. Before=27.50 After=25.70 b. Before=25.10 After=22.30 c. Before=22.20 After=18.90 P=0.001** MCDAS a. Before=20.6±2.4 After=20.9±7.2 b. Before=21.5±2.5 After=14.1±4.4 c. Before=22.2±4 After=8.3±2.5 P=0.001**	Frankl's Behavior rating scale a. Before rating 2=30% Rating 3=70% after rating 3=36.6% rating 4=10% b. Before rating 2=40% Rating 3=60% after rating 3=53.3% rating 4=30% c. Before rating 2=63% rating 3=36.6% after rating 3=20% rating 4=73% P=0.001**	Audio-visual distraction using 3D glasses was more effective than Audio Distraction
Dixit et al. 2020	120	4-6	Randomized controlled trial	Oral prophylaxis+fluoride treatment	Group A: Bach flower therapy Group B: Music therapy Group C: Control	Heart Rate (bpm) a. Before=109.2±11.6 After=103.9±12 b. Before=105.5±13.6 After=102.9±13 c. Before=108±12.6 After=108.3±11 P=0.243	Facial Image Scale a. After very happy=70% happy=17.5% b. After very happy=47% happy=40% c. After very happy=60% happy=25% P=0.001**	North Carolina Behavior Rating Scale a. 0.5±0.5 b. 1.88±0.9 c. 5.98±2.4 P=0.014*	Both Bach flower therapy and music therapy were equally effective
Rajeswari et al. 2019	45	6-10	Randomized Clinical Trial	Not specified	Group A: Cognitive Behavioral Play Therapy Group B: Audio-visual Distraction Group C: Tell Show Do	Heart Rate (bpm) a. Before=93.33±4 After=73.00±4 b. Before=94.8±5 After=80.93±5 c. Before=94.13±4.2 After=83.93±3.8 P=0.001**	Facial Image Scale a. Very happy=80% happy=20% b. Very happy=26% happy=46.7% c. Very happy=0% happy=53.3% P=0.001**	FIS a. Very happy=80% happy=20% b. Very happy=26% happy=46.7% c. Very happy=0% happy=53.3% P=0.001**	Active distraction using CBT was more effective than Passive form using Audio-visual distraction

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Table 1: Contd...

Author and year of publication	Sample size (n)	Age (years)	Study design	T/t given	Behavior management technique used	Objective assessment of anxiety	Subjective assessment of anxiety	Assessment of behavior	Effectiveness of technique
Azher et al. 2020	48	6-8	Pilot study	Restorative treatment	Group A: Relaxation training Group B: Tell show do	Heart rate (bpm) a. Before=106.95±11.16 After=103.50±13.52 b. Before=102.25±7.95 After=93.58±8.18 P=0.014*	Venham's Interval Rating Scale a. After=4.2% total cooperation 87% mild protest b. After=16.7% total cooperation 75% mild protest P=0.003*	Venham Scale a. Relaxed=4.2% b. Relaxed=25% P=0.004*	Tell show do is more effective than bubble breath play therapy
Paryab 2014	46	4-6	Randomized Clinical Trial	Pulpotomy	Group A: Tell Show Do Group B: Filmed Modeling	Heart rate (bpm) a. Before=98.89±10.1 After=111.17±11.93 b. Before=102.8±12.91 After=113.90±14.70 P=0.6	Venham Scale a. 0.96±0.72 b. 1.09±0.99 P=0.61	Frankl's Behavior rating scale a. 3.02±0.57 b. 3.03±0.62 P=0.95	Filmed Modeling is equally effective as tell SHOW Do
Pani et al. 2016	150	6-8	Controlled Clinical Trial	Restorative Treatment	Group A: Presence of father Group B: Presence of mother Group C: Parent outside operatory	Heart rate (bpm) a. Before=85.06±13 After=87.57±12 b. Before=87.74±8.9 After=94.88±12 c. Before=95.91±8.9 After=100.1±10 P=0.001**	Venham anxiety rating scale a. 2.64 b. 2.26 c. 1.34 P=0.05*	Venham Behavior Rating Scale a. 1.74 b. 1.49 C. 1.44 P=0.05*	Presence of parents in operatory reduces anxiety

*Statistically significant, **Highly statistically significant. P value=Probability value, MCDA: Modified child dental anxiety scale, DSCFS: Dental subscale of children's fear survey schedule, FLACC: Face, legs, activity, cry, consolability scale, MVARS: Modified venham's clinical rating of anxiety and cooperative behaviour scale, FBR: Frankl behaviour rating scale

Table 2: Table showing effectiveness of various psychological behavior management techniques in the reduction of anxiety and change in behavior of children

Author	Technique	Outcomes			Conclusion
		Reduction in physiological parameters of anxiety	Reduction in anxiety rating scales	Change in behavior	
Shah <i>et al.</i>	Audio-visual distraction	↓↓	↓↓	++	Audio-visual distraction and tell play do equally effective
	Tell play do	↓↓	↓↓	++	
Vishwakarma <i>et al.</i>	Tell play do	↓↓	↓↓	++	Tell play do more effective than audio-visual distraction
	Live modeling	↓	-	-	
Kharouba <i>et al.</i>	Audio-visual distraction	↓↓	↓↓	++	Audio-visual distraction more effective than tell show do
	Tell show do	↓	↓	+	
Sridhar <i>et al.</i>	Relaxation therapy	-	↓	+	Relaxation therapy show no significant effect on dental anxiety and behavior
	Control	-	-	+	
Radhakrishna <i>et al.</i>	Tell play do	↓↓	↓↓	++	Tell play do and smartphone game are more effective than tell show do
	Smartphone game	↓↓	↓↓	++	
	Tell show do	↓	↓	-	
Ghadimi <i>et al.</i>	Audio-visual distraction	↓↓	↓↓	-	Audio-visual distraction is more effective
	Tell show do	↓	↓	-	
Khotani <i>et al.</i>	Audio-visual distraction	↓↓	↓↓	+	Audio-visual distraction more effective
	Control	-	-	-	
Mitrakaul <i>et al.</i>	Audio-visual distraction	↓↓	↓↓	+	Audio-visual distraction more effective
	Control	↓	↓	-	
Kaur <i>et al.</i>	Audio-visual distraction	↓↓	↓↓	++	Audio-visual distraction more effective
	Audio distraction	↓	↓	+	
Nuvvula <i>et al.</i>	Audio-visual distraction	↓↓	↓↓	++	Audio-visual distraction more effective
	Audio distraction	↓	↓	+	
Dixit <i>et al.</i>	Audio distraction	↓↓	↓	+	Bach flower therapy and audio distraction are equally effective
	Bach flower therapy	↓↓	↓	++	
	Control	-	↓	-	
Rajeswari <i>et al.</i>	Active Distraction	↓↓↓	↓↓↓	+++	Active distraction more effective
	Audio-visual distraction	↓↓	↓↓	++	
	Tell Show Do	↓	↓	+	
Azher <i>et al.</i>	Relaxation Therapy	↓	↓	+	Tell Show Do is more effective
	Tell Show Do	↓↓	↓↓	++	
Paryab <i>et al.</i>	Filmed Modeling	↓↓	↓↓	++	Filmed modeling and tell show do are equally effective
	Tell Show Do	↓↓	↓↓	++	
Pani <i>et al.</i>	Presence of father	↓↓	↓↓	++	Presence of father is effective in reduction of anxiety
	Presence of mother	↓	↓↓	+	
	Parents absent	-	↓	+	

↓: Effective in anxiety reduction, ↓↓: More effective in anxiety reduction, +: Effective in changing the behavior positively, ++: More effective in changing the behavior positively, -: No effect

anxiety due to its unswerving association with the anxiety levels.

Meta-analysis was carried out using studies conducted by Al-Khotani *et al.* (Study 1), Mitrakul *et al.* (Study 2), and Nuvvula *et al.* (Study 3) and all three were given equal weightage as indicated by the size of the boxes.^[5-7] Horizontal lines across the squares depict the length of confidence intervals (CIs). Smaller lines indicate that the study results were more precise. The horizontal lines of each study lie in the “favors experimental” territory. The values of 95% CI for each study are negative, indicating that the entire

CI is below “0.” These findings suggest that the difference between experimental group and the control group is statistically significant. The overall results are also depicted by the diamond which sits on the value of overall effect estimate and the width depicts the overall CI. The diamond is merely crossing the line of no effect and is lying on the left side of the line which suggests that the difference between both groups is statistically significant [Figure 4].

The funnel plot was also plotted and it was observed that most of the literature search was seen inside the funnel indicating the proper standardization followed

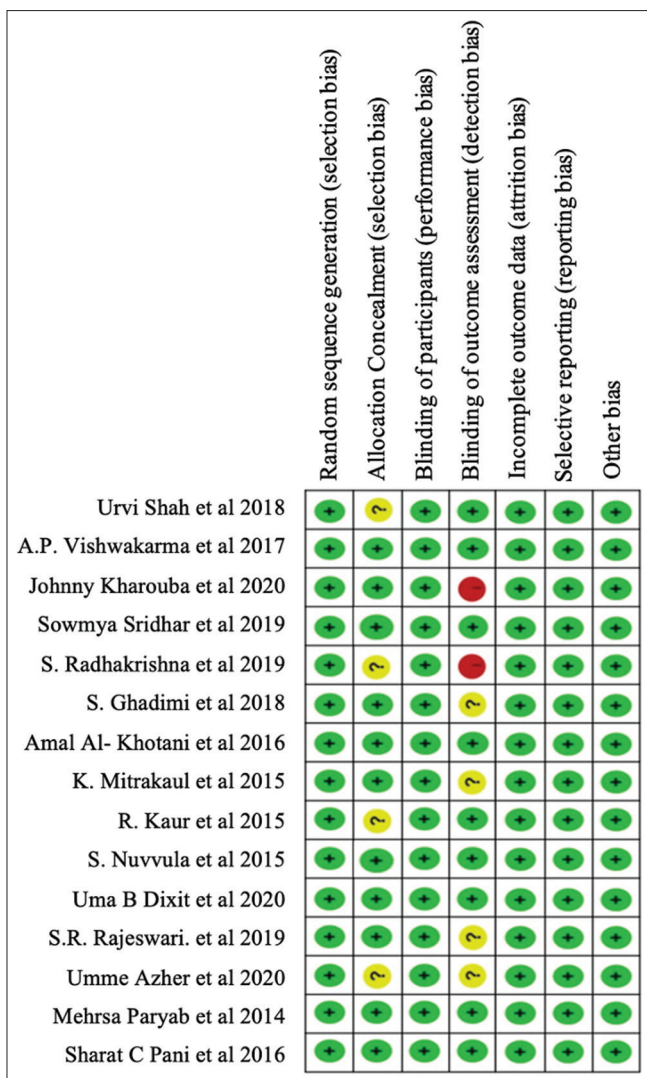


Figure 2: Summary of Risk of bias: Review authors' judgements about each risk of bias item for each included study.

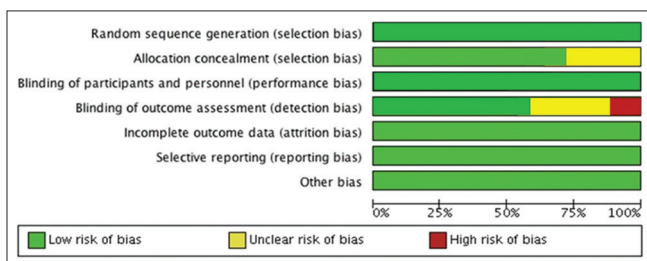


Figure 3: Summary of Risk of bias: Review authors' judgements about each risk of bias item presented as percentages across all included studies.

during study selection. However, it is difficult to draw conclusions from a funnel plot when the number of studies is small (<10). This also calls for the need of conducting more studies in the future with proper standardization [Figure 5].

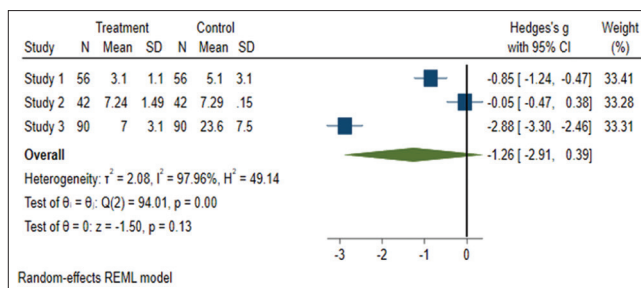


Figure 4: Forest plot showing pooled data obtained from meta-analysis of tell show do and Audio-visual distraction.

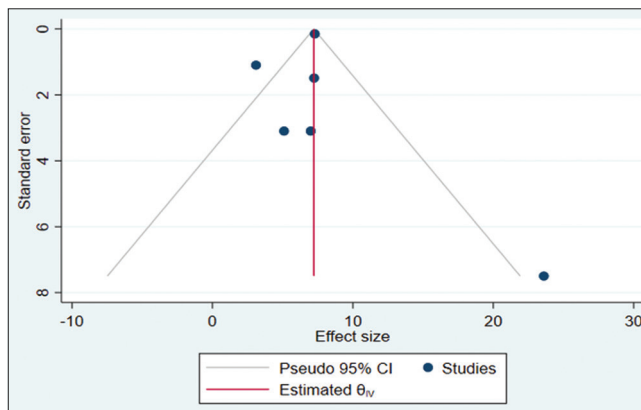


Figure 5: Funnel plot showing pooled data obtained from meta-analysis of tell show do and Audio-visual distraction.

DISCUSSION

The criteria used for the evaluation of effectiveness covers all aspects by which anxiety levels can be determined. Heart rate, blood pressure, oxygen saturation, and salivary cortisol levels were the physiological parameters and psychological determination was done using anxiety rating scales. The assessment of change in behavior was done using various behavior rating scales.

Tell show do

Paryab and Arab evaluated the effect of Tell Show Do and Filmed modeling in children between 4 and 6 years. Tell show do was as efficient as filmed modeling in reduction of anxiety and making the patients cooperative during treatment.^[8] The results were in accordance with a study conducted by Virupaxi Both studies involved the usage of airtor whose sight, sound, and sensation is rated as one of the most fear-eliciting stimuli in children. Despite this, a conventional behavior management technique like tell show do was effective in plummeting the anxiety levels.^[9]

Azher *et al.* compared tell show do with relaxation therapy and 25% children in former group appeared more relaxed when compared to 4.2% in the latter group.^[10] Al-Halabi *et al.* evaluated the effect of virtual reality glasses and tell show do during LA administration. They had similar results in anxiety reduction. It was difficult for practitioner to perform the procedure as the use of VR box was blocking the vision. Thus, tell show do is comparatively operator friendly and cost-effective.^[11]

However, in other studies where it is compared with more advanced techniques, it has been proven to be less effective.

Tell play do

Shah and Bhatia compared audio-visual distraction with tell play do and both techniques were found to be equally effective. The author stated that the use of dental imitating toys makes children understand the dentist's frame of reference instilling a sense of confidence.^[12]

Radhakrishna *et al.* compared tell play do, smartphone dentist game, and tell show do in 4–8-year-old children.^[13] Tell play do and active distraction technique were equally effective. Vishwakarma *et al.* compared it with live modeling and concluded that tell play do was more effective in reducing anxiety.^[14]

Modeling

A study by Tiwari *et al.* observed that children who received live modeling with parents as model had lower heart rates than those who received it with siblings as model.^[15] Among parents, children whose behavior shaping was done taking mother as a model showed a greater reduction in anxiety. Similar findings were obtained in studies conducted by Alrshah *et al.* and Sharma and Tyagi^[16,17] Walimbe *et al.* attributed this to the fact that modeling familiarizes children to procedures they will be subjected to, thus eliminating the threat of the unknown.^[18]

Modeling can be performed in two forms, live or filmed. When compared, it was observed that anxiety scores in filmed modeling group were least, reason being the consistency in the message. The author also stated that in routine dental practice a cooperative live model may not always be available.^[18] Virupaxi, Paryab and Arab, and Sahebalam *et al.* also advocated the use of filmed modeling due to lesser consumption of dentist's time.^[8,9,19]

Distraction

Audio distraction

Studies conducted by Navit *et al.*, Singh *et al.*, and Tshiswaka and Pinheiro concluded that audio distraction decreases anxiety to a significant extent. However, in these studies comparison was done with a control group in which no other technique was used.^[20-22]

Studies done by Khandelwal *et al.*, Naithani and Viswanath, Nuvvula *et al.*, and Kaur *et al.* also stated that the efficacy of audio distraction is better when compared to the control group.^[7,23-25] Kaur *et al.* stated that this might be due to the fact that music helps cutting down unpleasant noise of handpieces or other anxiety-inducing stimuli.^[25] Furthermore, playing familiar songs gave them feeling of being in a familiar environment. However, when comparison was done with audio-visual distraction in these studies, it was seen that audio-visual distraction was more effective.

Audio-visual distraction

Various studies conducted on audio-visual distraction using virtual reality by Asl Aminabadi *et al.*, Shetty *et al.*, Niharika *et al.*, Nunna *et al.*, Rao *et al.*, Koticha *et al.*, Pande *et al.*, and Khanapurkar *et al.* prove the efficacy of this technique in reducing anxiety. Virtual Reality combines audio, visual, and kinesthetic sensory modalities which makes it the most immersive of all other distraction techniques, and thus the child's attention is greatly "drained" from the surrounding fear-provoking environment. It also reduces the amount of pain-related brain activity.^[26-33]

In a study by Nuvvula *et al.*, 83.3% children showed positive behavior in audio-visual distraction group as compared to 60% in audio distraction group during LA administration. However, certain limitations were reported with the usage of eyeglasses such as unavailability in small size, high cost, need for sterilization, and hindrance during communication.^[7]

Similar limitations were reported by Khandelwal *et al.* In addition, the author did not recommend it in children with disruptive behavior who insist on controlling the situation.^[23] In another study by Mitrakul *et al.*, children also reported reduced pain while wearing audio-visual glasses during treatment. However, it was also seen that children who presented with high anxiety did not respond well as they felt a lack of control due to blockage of their visual field.^[6]

In Adel Zakhary *et al.*'s study, virtual reality sickness was observed in two children who suffered from nausea, sweating, and blurred vision.^[34] Shetty *et al.* also reported the incidence of headaches in few children.^[27]

Al-Halabi *et al.* reported that audio-visual distraction using a tablet device was more effective than virtual reality eyeglasses.^[11] Sahu *et al.* compared virtual reality distraction with television distraction. Television was more effective in managing the anxiety as reported on self-reporting anxiety rating scales.^[35] The studies conducted by Al-Khotani *et al.* and Kharouba *et al.* had similar results.^[5,36] Al-Khotani *et al.* stated that television requires low maintenance and many pediatric dental offices are equipped with it. In contrast, virtual reality devices are costly, can break easily, and have to be disinfected between patients. Moreover, they limit the ability of the child to hear the clinician's instructions. The use of television distraction, on the other hand, enables quick disengagement of the child when needed.^[5]

Active distraction

A study was done by Allani and Setty to determine the effectiveness of distraction using video game and it was found to be effective.^[37] Varun *et al.* evaluated its effectiveness in the form of stimulation games and 40% children showed positive behaviour during the treatment as compared to merely 3.3% in the control group.^[38]

Rajeswari *et al.* compared the effectiveness of cognitive behavioral play therapy and audio-visual distraction wherein 100% children showed positive response for the former as compared to 73.4% in the latter.^[39] Tirupathi *et al.* conducted a study on eye movement distraction in which children who exhibited negative behavior or were needle-phobic were included. They were less anxious than children in the control group. The author advocated the use of this technique as it does not require any additional equipment and can be easily performed.^[40]

Dental apps

In a study by Shah *et al.*, behavior modification was done by allowing children to use dental apps which demonstrated the use of common dental equipment in form of animated pictures with sound. The reduction in anxiety parameters was double as compared to conventional techniques.^[41] Similar results were obtained by Coutinho *et al.*, Elicherla *et al.*, and

Patil *et al.*^[42-44] However, Patil *et al.* reported that these applications are available mostly in English and hence a big chunk of population was unable to use them.^[44]

Parental presence

Results of the study conducted by Shindova *et al.* showed that parental presence or absence has no impact on the anxiety levels of children aged 6–12 years.^[45] Cox *et al.*, Vasiliki *et al.*, and Ahuja *et al.* obtained similar results in their studies.^[46-48] Cox *et al.* also reported that 4–5 years old children showed more disruptive behavior when parent was present in the operatory.^[46]

However, a study done by Pani *et al.* in 6–8-year-old children showed contrasting results. It was observed that children accompanied by their father had the lowest anxiety scores and greatest rate of completion of treatment.^[49]

Hypnosis

A study was done by Carrasco *et al.* to evaluate the efficacy of hypnosis during the administering of anesthesia. Results showed that hypnosis, combined with conventional behavior management techniques, is a more effective tool to help children relax than conventional behavior management techniques alone.^[50]

Parental acceptance of behavior management techniques

An integral aspect of child dental care is to provide parents with information of the treatment. This also helps in reducing parental anxiety. Hence, one of the objectives of our systematic review was the parental acceptance of these techniques. However, it was surprising to see that none of the articles obtained through our literature search discussed this aspect. This calls for a need of inclusion of parents in treating their children.

Evaluation of psychological behavior management techniques during different dental procedures

Oral prophylaxis + fluoride varnish

In a study by Dixit *et al.*, a significant reduction in anxiety was seen after intervention with audio distraction.^[51] Rajeswari *et al.* also reported a decrease in anxiety scores with active distraction and audio-visual distraction.^[39]

In studies conducted by Sharma *et al.* and Alrshah *et al.* in 5–11-year-old children, it was seen that live modeling using mother as a model was effective.^[16,17] Sahebalam *et al.* and Walimbe *et al.* reported the

effectiveness of filmed modeling in 4–9-year-old children.^[18,19] However, these studies did not use any behavior rating scales to evaluate the effect on cooperation of children.

The importance of subjecting children to a simple, painless procedure in the first visit has also been highlighted in these studies as this makes them accustomed to the dental setting. In Sahebalam *et al.*'s study, children exhibited less anxiety in their second dental visit where they underwent restoration along with LA administration. Here, both the treatment modalities are fear-provoking but despite this, children were less anxious during the procedures.^[19]

Restorative procedures

Shah *et al.* demarcated that the efficacy of tell play do in 4–7-year-old children. Reduction in anxiety was seen using both self-reported anxiety rating scales and operator-rated anxiety rating scale.^[12] Similar results were obtained by Vishwakarma *et al.* and Radhakrishna *et al.*^[13,14]

Another efficient technique highlighted in several studies is audio-visual distraction technique. In a study by Khandelwal *et al.*, 5–8-year-old children showed decrease in heart rate and blood pressure along with lower self-rated anxiety scores.^[23] Kharouba *et al.* also advocated the use of audio-visual distraction technique.^[36]

The efficacy of virtual reality has also been highlighted in studies conducted by Rao *et al.*, Aminabadi *et al.* and Pande *et al.*^[26,30,32] Aminabadi *et al.* also reported decrease in pain perception in 4–6-year-old children.^[26] Pande *et al.* reported similar results in 5–8-year-old children.^[32]

Local anesthesia administration/extraction procedure

Various authors have reported the efficiency of distraction techniques in managing children undergoing LA administration or extraction. Khandelwal *et al.*, Allani and Setty, Naithani *et al.*, and Sahu *et al.* reported the efficacy of audio-visual distraction in 4–12 year children.^[23,24,35,37] Allani and Setty reported that the efficacy of active distraction in the form of video games was even better than audio-visual distraction.^[37]

In a study by Nunna *et al.* and Koticha *et al.*, virtual reality distraction caused a decrease in anxiety in 7–11-year-old children.^[29,31] However, both the studies did not assess the change in behavior. Tirupathi *et al.* reported the efficacy of eye movement distraction

in 8–13-year-old children. However, more studies are needed to establish its effect on anxiety rates in children.^[40]

Pulp therapy

Niharika *et al.* and Khanapurkar *et al.* reported the efficacy of virtual reality in 4–8-year-old children. These studies reported a significant decrease in pain perception and anxiety scores.^[28,33] Shetty *et al.* and Zakhary *et al.* also observed that virtual reality distraction led to decrease in pain perception, salivary cortisol levels and state anxiety in 5–8-year-old children.^[27,34] However, Rangel *et al.* concluded that there was no significant difference between the control group and the virtual reality group in 5–8-year-old children.^[52]

Limitations

Although several studies were conducted between the span of 2011 and 2020, majority of studies did not assess all the factors which can evaluate dental fear and anxiety. Another major drawback was that very few studies were conducted on newer behavior management techniques such as relaxation therapy and hypnosis. Thus, more meticulous research is needed to be carried out in this direction.

CONCLUSION

- Based on the critical evaluation of dental literature, all the psychological behavior management techniques aided in reduction of fear and anxiety
- It was observed that in noninvasive procedures which do not include the use of airtor or needles, conventional behavior management techniques alone can be effective in reduction of dental fear and anxiety. However, in terms of ease of use by the clinician, live modeling technique was less preferred. In restorative procedures and invasive procedures like extraction or pulp therapy, more advanced techniques like various forms of distraction have proven to be efficient in reduction of dental fear and anxiety. Among them, clinicians found it difficult to operate with virtual reality eyeglasses
- Aspect of parental acceptance regarding various techniques was not discussed in any of the included studies.

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Conflicts of interest

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