



## Effectiveness of Breathing Exercises in Reducing Dental Anxiety in Children Aged 6-12 Years: A Systematic Review

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### Abstract

**Background:** Dental anxiety in children is a significant barrier to effective dental care, often leading to avoidance of treatment and poorer oral health outcomes. Breathing exercises have been proposed as a simple, non-pharmacological intervention to alleviate dental anxiety. This systematic review aims to evaluate the effectiveness of breathing exercises in reducing dental anxiety among children aged 6-12 years.

**Methods:** A comprehensive search was conducted across electronic databases including PubMed, PsycINFO, Cochrane Library, and Embase, covering studies from 2019 to 2023. Studies included randomized controlled trials (RCTs), quasi-experimental studies, and observational studies focusing on children aged 6-12 years who participated in breathing exercises to reduce dental anxiety. Both subjective (e.g., FIS, FLACC, WBFPS, VAS) and objective measures (e.g., pulse rate, respiratory rate) were considered. The Cochrane Collaboration's Risk of Bias tool and Newcastle-Ottawa Scale were used for quality assessment. Data were synthesized narratively, and meta-analysis was performed where feasible.

**Results:** Seven studies met the inclusion criteria, with most conducted in India and one in Italy. Sample sizes ranged from 20 to 70 participants. Breathing exercises analyzed included bubble breathing, diaphragmatic breathing, and deep breathing using a smart-watch. The majority of studies found significant reductions in dental anxiety and pain perception, lower pulse rates, and improved behavior during dental procedures. Bubble breathing, in particular, showed consistent effectiveness across multiple studies.

**Conclusion:** Breathing exercises, especially bubble breathing, are effective in reducing dental anxiety among children aged 6-12 years. These techniques offer a simple, engaging, and non-pharmacological approach to managing dental anxiety, which can be easily incorporated into pediatric dental practice. Further research is needed to explore long-term benefits and integration with other anxiety-reduction strategies.

**Keywords:** Breathing Exercises; Dental Anxiety; Children; Systematic Review; Non-Pharmacological Interventions; Pediatric Dentistry

## Introduction

Dental anxiety is a prevalent issue among children, significantly impacting their overall dental health and well-being. Various factors contribute to this anxiety, including fear of pain, previous negative dental experiences, and the inherently intimidating environment of a dental clinic [1,2]. This anxiety often leads to the avoidance of dental care, which can result in deteriorating oral health and necessitate more invasive treatments in the future [3]. Therefore, addressing dental anxiety in children is a critical aspect of pediatric dental care. Various interventions have been explored to mitigate this anxiety and improve the dental experience for young patients [4].

Breathing exercises have emerged as a promising intervention for managing anxiety in various contexts. Rooted in the principles of mindfulness and relaxation techniques, breathing exercises are designed to promote a state of calmness and reduce physiological arousal [5]. These exercises typically involve slow, deep breathing patterns that can help lower heart rate, reduce muscle tension, and induce a sense of tranquility [6]. In pediatric dentistry, several types of breathing exercises have been utilized to mitigate dental anxiety, each with distinct techniques and potential benefits. These exercises are simple and engaging, making them suitable for young children [7].

Pinwheel breathing, for instance, is a playful and visually engaging exercise that involves using a pinwheel as a tool to guide the child's breathing. The child is instructed to blow on the pinwheel, making it spin with each exhale [8]. This exercise not only helps the child focus on their breathing but also provides tangible visual feedback, encouraging deep, slow breaths that promote relaxation and reduce anxiety [9,10]. Diaphragmatic breathing, also known as abdominal or belly breathing, is another effective technique. It focuses on engaging the diaphragm to facilitate deep breathing, encouraging full oxygen exchange and helping to lower heart rate and stabilize blood pressure [11].

Deep breathing exercises, which involve taking slow, deep breaths in through the nose and exhaling through the mouth, are widely recognized for their calming effects. In pediatric dentistry, children can be guided to inhale slowly for a count of four, hold their breath for a count of four, and then exhale slowly for a count of four [12]. Bubble breathing, where children blow bubbles to regulate their breathing, serves as both a breathing exercise and a visual distraction, transforming the dental visit into a more enjoyable experience [9].

The integration of breathing exercises into dental practice for children aged 6-12 years is of particular interest due to the developmental characteristics of this age group. Children within this age range are generally capable of understanding and following instructions for simple breathing techniques [12,13]. Additionally, this period is critical for establishing positive dental habits and attitudes, making it an opportune time to introduce interventions that can alleviate anxiety and foster a more positive dental experience [14].

This systematic review aims to consolidate existing evidence on the effectiveness of breathing exercises in reducing dental anxiety among children aged 6-12 years. By synthesizing findings from various studies, this review provides a clearer understanding of the efficacy of breathing exercises as a standalone intervention or as part of a multimodal approach in pediatric dental settings. Furthermore, this review seeks to identify potential gaps in the literature and suggest directions for future research to enhance the understanding and application of breathing exercises in managing dental anxiety.

## Methods

The present systematic review investigated the effectiveness of breathing exercises in reducing dental anxiety among children aged 6-12 years. The primary objective of this systematic review was to assess the effectiveness of breathing exercises in reducing dental anxiety in children aged 6-12 years.

### Search strategy

A comprehensive search strategy was developed to identify relevant studies published in English language without any restriction for the date of publication. Electronic databases including PubMed, PsycINFO, Cochrane Library, and Embase were systematically searched. The search strategy combined keywords and controlled vocabulary terms related to "breathing exercises," "dental anxiety," and "children." Additionally, reference lists of included studies and relevant review articles were hand-searched for additional studies.

### Selection of the articles

Studies were included if they met the following criteria

- **Participants:** Children aged 6-12 years.
- **Intervention:** Diaphragmatic, pinwheel, bubble, or any other breathing exercises aimed at reducing dental anxiety.
- **Comparator:** Studies with or without comparators were included.

- **Outcomes:** Studies reporting outcomes related to dental anxiety reduction.
- **Study Design:** Randomized controlled trials (RCTs), quasi-experimental studies, and observational studies were included.

Studies were excluded if they focused on adults or adolescents outside the specified age range, did not analyze the effect of breathing exercises, or lacked outcomes related to dental anxiety reduction. Animal-based studies, case reports, editorials, and conference abstracts were also excluded.

Two independent reviewers screened titles and abstracts of identified studies against the inclusion criteria. Full-text articles of potentially eligible studies were then assessed for inclusion. Any discrepancies were resolved through discussion or consultation with a third reviewer.

**Data extraction**

A standardized data extraction form was developed to extract relevant information from included studies. Data extracted included study characteristics (e.g., author, year, study design), partici-

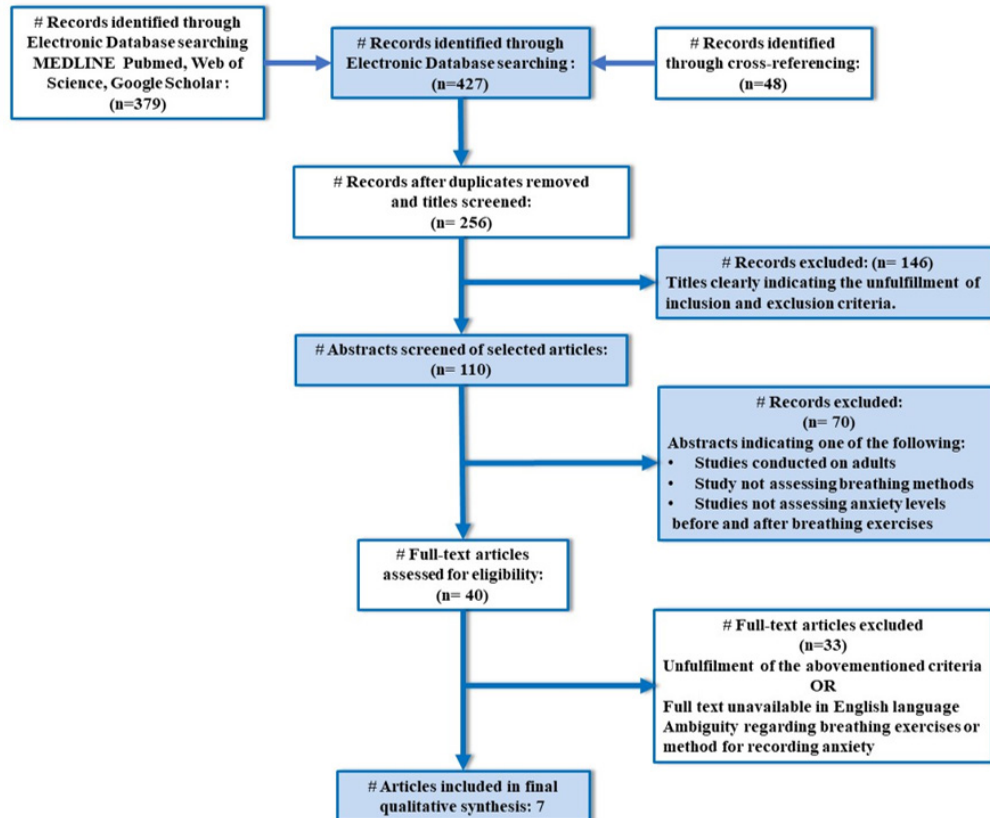
part demographics, details of the intervention and comparator (if applicable), outcome measures, and results related to dental anxiety reduction.

**Quality assessment**

The methodological quality of the included studies was assessed using appropriate tools depending on the study design. For RCTs, the Cochrane Collaboration’s Risk of Bias tool was used, while the Newcastle-Ottawa Scale was employed for observational studies. Quality assessment was conducted independently by two reviewers, with any discrepancies resolved through discussion or consultation with a third reviewer.

**Data synthesis**

Data synthesis involved a narrative synthesis of study findings, summarizing the effectiveness of diaphragmatic and pinwheel breathing exercises in reducing dental anxiety among children aged 6-12 years. If feasible, a meta-analysis was conducted to quantitatively synthesize the results. Meta-analysis was performed using appropriate statistical models, exploring statistical heterogeneity through subgroup analyses if necessary.



**Figure 1:** PRISMA Flow diagram indicating the selection process of the studies included in the present systematic review.

**Results**

A total of seven randomized clinical trials were identified from the years 2019 to 2023.[15-22] The PRISMA Flow diagram indicating the selection process of the studies included in the present systematic review is delineated in Figure 1. The data extracted from these studies is summarized in Table 1. Of the seven studies, six were conducted in India and one was carried out in Italy. With the exception of two studies having a sample size of 20 and 35 individuals respectively, all the other studies had sample sizes ranging between 60 to 70. The two studies with smaller sample sizes had a cross-over study design thereby making the effective sample size double the aforementioned numbers. All the studies included children within the range of 6 to 12 years with n=5 studies recruiting children above 7 years. The proportion of boys and girls was identical in all studies with the exception of a study conducted by Sridhar et al. (2019) which had a greater number of boys. A possible reason could be a higher prevalence of caries in children in the region of their study (Manipal). n = 4 studies employed bubble breathing exercises, n = 2 studies employed diaphragmatic breathing, and n = 1 studies utilized deep breathing exercises with a smartwatch. N = 5 studies performed only local anaesthesia and then recorded the children’s anxiety, while n = 2 studies performed pulp therapy/ The study by Levi et al. indicated that regular dental

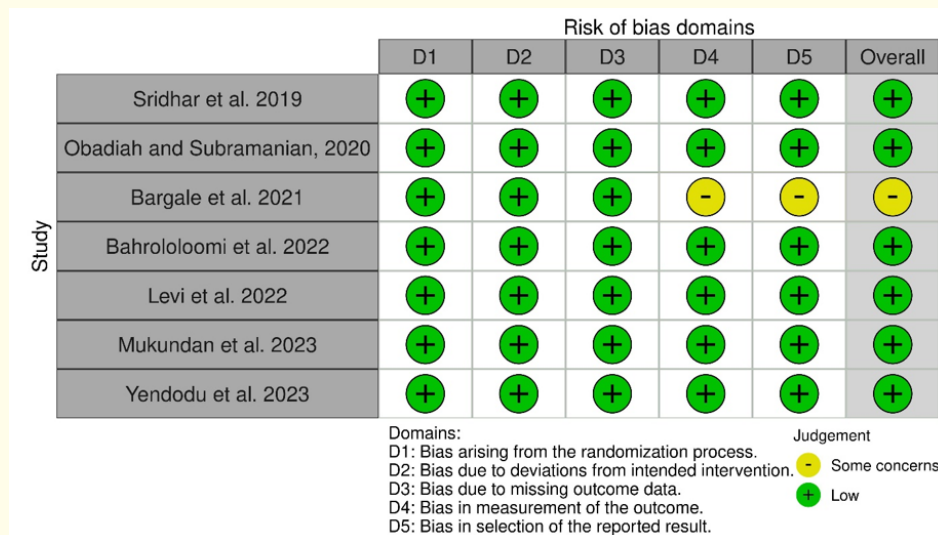
treatment was performed although the procedures were not specified. With the exception of two studies, all the other studies (n = 5) recorded the pulse rate for objectively gauging the anxiety levels. FIS was used in n = 3 studies, FLACC in n = 4 studies, WBFPS in n = 4 studies, and VAS in one study which also recorded respiratory rate.

The systematic review included studies that examined the effects of breathing exercises on dental anxiety in children. Five studies concluded that bubble blowing significantly reduced anxiety and pain perception after injection, along with lower pulse rates and positive behaviour during procedures in children aged 7-10 years. Additionally, one study found that both bubble blowing and deep breathing techniques were equally effective in reducing anxiety, while another study highlighted the effectiveness of deep breathing using a Smartwatch in reducing anxiety, pain, and pulse rate during dental procedures.

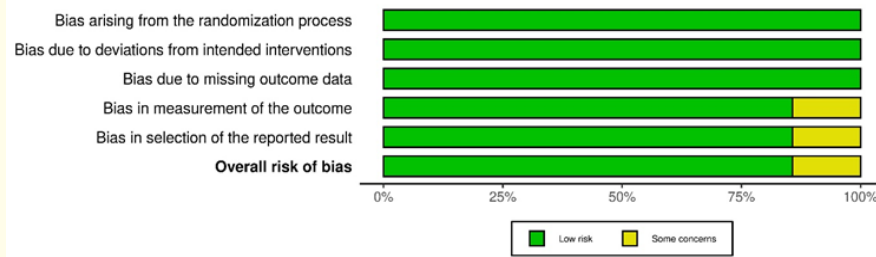
**Risk of bias assessment**

The risk of bias in the individual studies is depicted in figure 2.

The overall risk of bias across all the studies included in the present systematic review is summarized in figure 3.



**Figure 2:** Traffic light plot indicating the risk of bias in the studies included in the present systematic review.



**Figure 3:** Summary plot indicating the overall risk of bias of the studies included in the present systematic review.

Therefore, the overall quality of evidence across all the studies was High, except for one study by Bargale, *et al.* (2021) which had a Moderate quality of evidence due to bias in outcome recording and reporting.

## Discussion

The present systematic review aimed to evaluate the effectiveness of breathing exercises in reducing dental anxiety among children aged 6-12 years. The results from the seven included studies, spanning from 2019 to 2023, provide compelling evidence that various breathing exercises can significantly mitigate dental anxiety in this age group. Among the different breathing exercises analyzed, bubble breathing emerged as particularly effective. Five studies highlighted its positive impact on reducing anxiety and pain perception, as evidenced by lower pulse rates and improved behavior during dental procedures. The simplicity and engaging nature of bubble breathing make it an accessible technique for young children, who may find the activity enjoyable and thus more likely to comply. This finding aligns with existing literature suggesting that engaging children in playful activities can distract them from anxiety-inducing stimuli.

Diaphragmatic breathing and deep breathing using a smartwatch were also found to be beneficial. One study indicated that both bubble-blowing and deep breathing techniques were equally effective in reducing anxiety. The use of smartwatches introduces an element of novelty and can appeal to tech-savvy children, potentially enhancing compliance and effectiveness. The physiological basis for these techniques lies in their ability to activate the parasympathetic nervous system, promoting relaxation and reducing stress responses [23].

The studies included in this review employed a variety of tools to measure dental anxiety, including subjective scales like

the Facial Image Scale (FIS), Face, Legs, Activity, Cry, Consolability (FLACC) scale, Wong-Baker FACES Pain Rating Scale (WBFPS), and the Visual Analog Scale (VAS). Objective measures, such as pulse rate and respiratory rate, were also utilized. The convergence of findings from both subjective and objective measures strengthens the evidence supporting the effectiveness of breathing exercises [24].

The variability in sample sizes and study designs across the included studies warrants consideration. While most studies had sample sizes ranging from 60 to 70, two studies with smaller sample sizes used a crossover design, effectively increasing the robustness of their findings. The predominance of studies conducted in India may limit the generalizability of the results to other cultural contexts. Future research should aim to include a more diverse demographic to enhance the external validity of the findings.

The overall quality of evidence across the included studies was high, with the exception of one study that had moderate quality due to bias in outcome recording and reporting. This suggests that the findings of this systematic review are reliable and can be used to inform clinical practice. The assessment of risk of bias, as depicted in Figures 2 and 3, underscores the importance of rigorous study design and transparent reporting in future research.

The findings of this systematic review have significant implications for clinical practice. Incorporating breathing exercises, particularly bubble breathing, into routine dental visits for children could be a simple and cost-effective strategy to reduce dental anxiety. Dental practitioners can easily teach these techniques to children and their parents, fostering a more positive and less stressful dental experience. Additionally, the use of breathing exercises can complement other behavior management strategies, providing a holistic approach to managing dental anxiety in children.

Several limitations should be noted. The relatively small number of studies and the focus on a limited geographical area may restrict the generalizability of the findings. Additionally, the heterogeneity in study designs, interventions, and outcome measures could introduce variability in the results. Further high-quality, large-scale studies are needed to confirm these findings and explore the long-term effects of breathing exercises on dental anxiety.

Future research should aim to address the limitations identified in this review. Expanding the geographical scope of studies to include diverse populations will enhance the generalizability of the findings. Investigating the long-term benefits of breathing exercises and their impact on subsequent dental visits will provide valuable insights into their sustained effectiveness. Moreover, exploring the integration of breathing exercises with other non-pharmacological interventions could offer a comprehensive approach to managing dental anxiety in children.

Overall findings of the present systematic review provide evidence supporting the effectiveness of breathing exercises in reducing dental anxiety among children aged 6-12 years. Bubble breathing, in particular, stands out as an effective, engaging, and easy-to-implement technique. Incorporating breathing exercises into pediatric dental care can significantly enhance the dental experience for young patients, promoting better oral health outcomes and fostering a positive attitude towards dental visits.

## Conclusion

The present systematic review found that breathing exercises, particularly bubble breathing, are effective in reducing dental anxiety among children aged 6-12 years, as evidenced by both subjective and objective measures across multiple studies. The engaging and accessible nature of these techniques makes them a valuable addition to pediatric dental practice, providing a simple, non-pharmacological strategy to alleviate anxiety and improve the overall dental experience for young patients. These findings underscore the potential of breathing exercises to enhance child compliance and comfort during dental procedures, highlighting the need for their broader implementation and further research to explore long-term benefits and integration with other anxiety-reduction interventions.

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