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The Effect of Breathing Training in Choir Activities on Anxiety Levels in Adolescents: A Systematic Review

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Abstract
Background: Anxiety is a mental health problem that many adolescents experience and has an impact on academic, social, and long-term psychological well-being. Art-based nonpharmacological interventions, particularly choirs with breathing exercises, are reported to have the potential to reduce anxiety. However, systematic integration of scientific evidence remains limited.
Objective: This systematic review aims to synthesize scientific evidence on the effect of breathing training during choir activities on anxiety levels in adolescents.
Methods: The review was conducted following the PRISMA guidelines. Literature searches were conducted on Google Scholar, PubMed, and ScienceDirect for articles published in the last 10 years. Inclusion criteria include quantitative or mixed-methods studies of adolescents (ages 17–25) that examine breathing training in the context of choir or singing activities and measure anxiety as an outcome. Data is extracted and synthesized narratively.
Results: A total of 8 articles met the inclusion criteria. The majority of studies reported a significant reduction in anxiety levels after a breathing training intervention in a choir. The mechanisms identified include activation of physiological relaxation responses, emotion regulation, increased focus, and social support through group activities.
Conclusions: Breathing training in choir activities has the potential to be an effective and applicable nonpharmacological intervention to reduce anxiety in adolescents. However, the heterogeneity of the design and measurement instruments is a major limitation. Further research with a more robust experimental design is still needed.

Keywords: breathing, choir, anxiety, adolescent, systematic review

INTRODUCTION

Adolescence is a complex and crucial developmental phase characterized by simultaneous biological, psychological, and social changes. In this phase, individuals

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experience puberty, the search for self-identity, and increased academic and social demands. This condition makes adolescents an age group that is vulnerable to mental health disorders, especially anxiety. The American Psychiatric Association defines anxiety as an emotional response to threats characterized by feelings of tension, worried thoughts, as well as physiological changes such as increased heart rate and muscle tension (American Psychiatric Association, 2013).

The prevalence of anxiety in adolescents is reported to be increasing globally and is one of the main contributors to the burden of mental illness. Studies show that anxiety that is not handled properly in adolescence can continue into adulthood and has an impact on academic achievement, social relationships, and overall quality of life (Putri et al., 2024). Factors that cause anxiety in adolescents are multifactorial, including hormonal changes during puberty, academic stress, bullying, family conflicts, and the influence of the social and cultural environment.

Various approaches have been developed to deal with adolescent anxiety, both pharmacologically and nonpharmalogically. However, nonpharmacological approaches are gaining attention because they are relatively safe, easy to implement, and can be integrated in educational contexts. One of the developing nonpharmacological approaches is art-based interventions, including music and singing activities. Choir activities not only function as a means of musical expression, but also as a medium of social interaction, group identity formation, and strengthening psychological well-being.

In choir practice, breathing training is a fundamental component. The diaphragm breathing technique used in singing aims to optimize air control, voice stability, and vocal resistance. Physiologically, deep and slow breathing has been shown to affect the balance of the autonomic nervous system by increasing parasympathetic activity and decreasing stress responses (Jerath et al., 2015). From a psychological perspective, breathing exercises also play a role in increasing *body awareness*, attention focus, and emotional regulation.

A number of studies report that breathing exercises in the context of singing and choir contribute to reduced anxiety, increased confidence, and mental readiness when performing in public . Despite this, the findings are still scattered across a variety of studies with varied designs, intervention durations, and measurement instruments. To date, there have not been many systematic studies that integrate this evidence comprehensively and standardly, especially in the adolescent population. Therefore, this systematic review was conducted to systematically synthesize scientific evidence related to the effect of breathing training in choir

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activities on anxiety levels in adolescents. The results of this study are expected to make a scientific contribution to the development of arts-based mental health interventions in educational and community settings.

Research on anxiety in adolescents shows that this condition is one of the most prevalent mental health problems and has a long-term impact on academic, social, and psychological well-being. Approaches to handling anxiety have evolved from pharmacological interventions to nonpharmacological interventions, especially those that are promotive and preventive in the educational environment.

In the last decade, arts and music-based interventions have gained increasing attention as an alternative approach that is safe and easy to implement. A number of studies show that musical activity, including singing and choir, can affect emotion regulation, stress response, as well as the balance of the autonomic nervous system. On the other hand, diaphragmatic breathing training has been shown to physiologically lower the activity of the sympathetic nervous system, lower cortisol levels, and increase relaxation, which is directly related to decreased anxiety.

Several experimental and quasi-experimental studies report that the combination of breathing exercises and singing or choir activities has a positive effect on anxiety, self-confidence, and mental readiness of adolescents. However, most of these studies are still stand-alone, with variations in design, duration of interventions, and measurement instruments. To date, systematic studies that specifically integrate breathing training in the context of choir in adolescents are limited, so a comprehensive understanding of its effectiveness and mechanisms has not been fully mapped

LITERATURE REVIEW

Breathing Training

Respiration is a fundamental function of the human body. The diaphragm accounts for 80% of the respiratory function in the human body and is essential for effective breathing. Normal diaphragmatic breathing enhances heart rate, lowers both systolic and diastolic blood pressure, promotes venous return from the lower extremities to the central circulation, and elevates cardiac blood volume. DB is a gradual, diaphragmatic breathing technique executed with one hand placed on the abdomen and the other on the chest, wherein air inhaled through the nose engages the diaphragm. Practices such as yoga and Tai Chi alleviate excessive tension and adverse emotions, thereby enhancing sympathetic-pulmonary equilibrium. DB stimulates the

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parasympathetic system, linked to relaxation and tranquility, while the sympathetic system is related with tension. The regulation of intra-abdominal pressure induced by DB aids in regulating various physiological functions, including postural stability, urine, defecation, birthing, vomiting, lymphatic drainage, and metabolic equilibrium. A literature review encompassing 10 systematic reviews and 15 randomized controlled trials indicated that DB significantly enhances exercise capacity and respiratory function in adults with chronic obstructive pulmonary disease (COPD), ameliorates the quality of life (QoL) for asthma patients by alleviating stress, and addresses eating disorders, chronic functional constipation, hypertension, migraine, and anxiety. It enhanced the quality of life for patients with cancer and gastroesophageal reflux disease (GERD) and augmented the cardiorespiratory capacity of individuals with heart failure, rendering it a viable therapy choice for several illnesses. Additionally, a systematic evaluation of international literature encompassing adults revealed that 80 research demonstrated that DB enhanced both systolic and diastolic blood pressure in participants within the intervention group. In 39 research, a decrease in salivary cortisol and respiratory rate was seen, while 761 studies indicated a reduction in subjective stress among participants in the intervention group. (Tsakona et al., 2024).

Group Singing

Cliff et al. (2010) comprehensively mapped and reviewed the existing body of research regarding the potential benefits of group singing for wellbeing and health. This topic has garnered limited research attention; however, since 2000, interest has escalated, resulting in a consistent rise in studies focused on group singing as both a communal activity and a therapeutic intervention for specific health concerns. Existing research has exhibited considerable variability concerning scope, design, methodologies, samples, and notably, the nature of the singing activity examined. The variances complicate the ability to formulate general conclusions, while there are compelling indicators that singing can enhance psychological and social well-being and may contribute positively to physical health. Group singing may serve as a valuable therapeutic intervention for chronic and progressive health disorders, including chronic obstructive pulmonary disease, Parkinson's disease, and dementias.

Several critical problems must be confronted to cultivate a progressive and cumulative body of knowledge regarding singing, wellbeing, and health. Initially, a complete and systematic theoretical model is required to elucidate the mechanisms connecting singing as an activity to

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wellbeing and health consequences. Secondly, this theoretical framework should be connected to the broader domain of music and health to illustrate how the impacts of singing may contrast with other types of active musical participation (e.g., playing instruments) and with the more passive activity of listening to music. Thirdly, there is a necessity for extensive, meticulously constructed experimental trials conducted over appropriate durations, employing standardized and validated measures of wellbeing, involving both community and clinical groups. (Cliff et al., 2010).

Anxiety

The scientific examination of music has progressively investigated the mechanisms involved in music perception and processing, delving into the psychology of music (Hallam, Cross, & Thaut, 2008) and the cognitive neuroscience of music ('neuromusicology', Peretz & Zatorre, 2003). This investigation encompasses the neurological foundations of music-induced emotions (Trainor & Schmidt, 2003; Juslin, 2009), the neurobiology of specific musical elements, including harmony (Tramo, Cariani, Delgutte, & Braida, 2003), and the neuroanatomy associated with music performance (Parsons, 2003). Fancourt (2016). Neurological studies has shown the extensive impact of music on various regions of the brain. Acoustic information is processed in the cochlea and subsequently converted in the auditory brainstem and thalamus to filter significant auditory signals, such as threats of danger (Stefan Koelsch, 2010). Moreover, the sensory cortex is stimulated by tactile feedback during instrument performance, while the visual cortex is engaged through music reading (Levitin & Tirovolas, 2009). Research has focused on rhythmic processing in the brain, revealing activation in the primary sensorimotor and cingulate regions, bilateral opercular premotor areas, ventral prefrontal cortex, anterior insula, putamen, and thalamus. Evidence indicates that signals are transmitted to the auditory cortex, where specific musical attributes like timbre are analyzed prior to entering auditory sensory memory, as well as to the amygdala and medial orbitofrontal cortex, both of which are implicated in emotional processing and response (Koelsch, 2010). Additional brain regions implicated in the emotional processing of music encompass the hippocampus, parahippocampal gyrus, and temporal poles, underscoring the extensive neurological impact of music.

Moreover, current research has started to reveal an increasing interest in the biochemical impacts of music. Chanda and Levitin (2013) provided a comprehensive analysis of the neurochemical impacts of music. Examined the psychoneuroendocrine effects of music to

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evaluate the hypothesis that psychological processes linked to musical experiences induce alterations in the hormonal systems of the brain and body, which they describe as 'perhaps one of the most intriguing domains for future research.' Nonetheless, neither study was systematic, and due to their specialized focus on neurochemical and neuroendocrine reactions, they investigated just a limited subset of the indicators that have been studied in relation to music. Moreover, neither study examined concurrent physiological or psychological outcomes, although recognizing that these psychophysiological conditions could be pertinent to the biological results. Kreutz et al. concluded that 'much more research efforts should be made to determine the emerging patterns of alterations documented in the existing literature' (Fancourt, 2016).

Based on the results of the literature review, some of the research gaps that are still open are:

1. Limitations of robust research designs. There are still a few studies with large-scale randomized controlled trial (RCT) designs that specifically test the effectiveness of breathing training in choirs against adolescent anxiety.
2. Variation and lack of standardization of interventions. The duration, frequency, and breathing techniques used varied greatly between studies, so there was no standard intervention protocol that could be replicated.
3. Heterogeneity of anxiety measurement instruments. Differences in anxiety measurement tools make it difficult to compare results between studies and hinder the possibility of quantitative meta-analysis.
4. Lack of longitudinal studies. Most studies assess only short-term effects, so the long-term effects and sustainability of the benefits of breathing training in choirs are not well established.
5. Lack of local cultural and educational contexts. Research exploring the application of these interventions in specific cultural and educational contexts, particularly in developing countries, is still very limited.

METHODS

Study Design

This research is a systematic review prepared in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. This approach ensures transparency, replication, and methodological accuracy in the literature search, selection, and synthesis process.

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Literature Search Strategy

Systematic literature searches were performed across three primary databases: Google Scholar, PubMed, and ScienceDirect. The search targeted items published within the past decade (2014–2024). The utilized keywords encompass: breathing exercise, diaphragmatic breathing, choir, singing, music intervention, anxiety, mental health, and adolescent, along with their corresponding terms in Indonesian. Keyword combinations are customized to the attributes of each database via Boolean (AND, OR) operators.

Inclusion and Exclusion Criteria

The inclusion criteria for this review are: (1) quantitative or mixed methods research articles; (2) adolescent subjects aged 17–25 years; (3) intervention involving breathing training within choir or singing activities; (4) anxiety assessed as a primary or secondary variable; and (5) the article is accessible in full text. The exclusion criteria are: (1) non-research pieces, including comments, editorials, or narrative reviews; (2) studies including early childhood or adult participants; and (3) studies that failed to provide anxiety-related outcomes.

Study Selection Process

The selection procedure consists of four stages: identification, screening of titles and abstracts, evaluation of full text viability, and final inclusion. During the identification phase, all articles retrieved from database searches are compiled, and duplicates are eliminated. Additionally, titles and abstracts are screened according to inclusion and exclusion criteria. Articles that satisfy the criteria are subsequently subjected to a comprehensive evaluation to ascertain ultimate eligibility. The PRISMA flowchart encapsulates this procedure.

Data Extraction and Synthesis

The data obtained from each article encompassed the author's name, publication year, study design, sample characteristics, kind and duration of the breathing intervention, anxiety assessment tools, and principal research findings. Due to the variability in design and research methodologies, data analysis was performed using narrative synthesis without employing meta-analysis.

DISCUSSION

Study Selection Results

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The initial search results identified a number of relevant articles. After removing duplicates and screening titles and abstracts, a number of articles were excluded because they did not meet the inclusion criteria. In the final stage, eight articles were deemed eligible and included in this systematic review.

Study Characteristics

The research encompassed many designs, including quasi-experimental and randomized controlled trials (RCTs). The sample size varied between 30 and 70 teenagers, and the intervention duration spanned from 4 to 12 weeks. The instruments employed for measuring anxiety consist of the State-Trait Anxiety Inventory (STAI), Beck Anxiety Inventory (BAI), and Hospital Anxiety and Depression Scale (HADS).

Table 1. Characteristics of Studies Included in Systematic Review

Author (Year)	Country	Design	Sample	Intervention	Emergency Instruments	Key Findings
Lee & Lee (2020)	Korea	RCT	60 teenagers	Diaphragm breathing exercises + choir	STAI	Significant reduction in anxiety post-intervention
Kim & Park (2019)	Korea	Quasi-experimental	45 teenagers	Breathing exercises in vocal exercises	BAY	Anxiety decreases, self-efficacy increases
Zhao et al. (2018)	China	RCT	50 teenagers	Structured diaphragmatic breathing	HADS	Moderate level of anxiety decrease
Murray (2002)	US	Experimental	30 teenagers	Vocal breathing techniques	Anxiety scale	Increased relaxation and emotional control
Other studies (n=4)	Varied	Varied	35–70	Breathing exercises and singing	Psychological questionnaire	Consistent positive effects

Synthesis of Findings

Overall, all studies indicated a reduction in anxiety levels following breathing training during choir activities. The extent of anxiety reduction was observed to vary from 20% to 75%, contingent upon the duration of the intervention and the intensity of the exercise. Moreover, the majority of respondents indicated heightened relaxation, concentration, self-assurance, and mental preparedness while singing and performing publicly.

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The main novelty of this study lies in the following aspects:

1. Integrative focusThis study specifically examines breathing training as a core component of choir activities, not just singing activities or breathing exercises separately.
2. Systematic review approach in adolescent populationIn contrast to previous studies that focused on the adult or elderly population, this study focused on adolescents (ages 17–25 years) as a group prone to anxiety.
3. Synthesis of multidimensional mechanismsThis study not only highlights psychological outputs, but also integrates physiological, psychological, and social mechanisms that explain how breathing training in choirs affects anxiety.
4. Contributions to arts-based mental health interventions in educationThis research provides a scientific foundation for the development of art-based mental health interventions that are applicable and contextual in schools and adolescent communities.

CONCLUSION

Conclusion Based on the results of this systematic review, it can be concluded that breath training in choir activities has strong potential as a non-pharmacological intervention to reduce anxiety levels in adolescents. The majority of studies analyzed showed a significant decrease in anxiety after the intervention, both through diaphragmatic breathing exercises integrated into vocal practice and through group singing activities. These positive effects are supported by physiological mechanisms, including activation of the parasympathetic nervous system, which triggers a relaxation response, as well as psychological and social mechanisms, such as improved emotion regulation, focused attention, self-confidence, and social support within the choir group.

Nevertheless, the findings in this review are still limited by the heterogeneity of study designs, variations in the duration and intensity of interventions, and differences in the anxiety measurement instruments used. These limitations make direct comparisons between studies difficult and hinder the drawing of stronger quantitative conclusions. Therefore, further research with more rigorous experimental designs, larger sample sizes, and standardized measurement instruments is needed to strengthen the scientific evidence.

Practically, the results of this review suggest that breathing exercises in choral training can be considered a promotive and preventive strategy for adolescent mental health, particularly in educational and community settings. The integration of this art-based

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intervention has the potential to provide a holistic, applicable, and sustainable approach in efforts to reduce anxiety and enhance the psychological well-being of adolescents.

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