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Comparison of the Effectiveness of Sexual Education and Sensory, Proprioceptive, and Tactile Exercises on Children's Anxiety

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A B S T R A C T

Purpose: This study aimed to compare the effectiveness of sexual education and sensory, proprioceptive, and tactile exercises in reducing anxiety in children aged 4 to 7 years.

Methods and Materials: This quasi-experimental study used a pre-test and post-test design with a control group. A sample of 30 children, aged 4 to 7 years, was selected from five clinics in Tehran using convenience sampling. The participants were randomly assigned to two experimental groups (10 participants each) and one control group (10 participants). The research tools included the Sensory Integration Evaluation Form by Ryz, the Spence Children's Anxiety Scale, a sexual education training package for parents, and a sensory integration exercise package for the children. Data were analyzed using two-way repeated measures analysis of covariance (ANCOVA), with Greenhouse-Geisser and Huynh-Feldt adjustments due to violations of the sphericity assumption.

Findings: The findings revealed significant reductions in anxiety for both experimental groups compared to the control group. The sensory, proprioceptive, and tactile exercises group demonstrated the most substantial reduction in anxiety, particularly in generalized anxiety, social phobia, obsessive-compulsive tendencies, and separation anxiety. In the sexual education group, anxiety also decreased significantly, especially in social phobia and separation anxiety. The control group did not show significant changes in anxiety levels across the study's three phases (pre-test, post-test, follow-up).

Conclusion: Both sensory-based interventions and sexual education significantly reduced anxiety in children, with sensory, proprioceptive, and tactile exercises showing the most pronounced effects. These findings support the use of multi-modal approaches for anxiety reduction in children and suggest that both interventions could be effectively integrated into therapeutic and educational practices.

Keywords: *Childhood anxiety, sensory integration, proprioception, tactile exercises, sexual education, multi-modal interventions.*

1. Introduction

Anxiety disorders represent some of the most pervasive psychological challenges facing children and adolescents today, with far-reaching consequences for their emotional and cognitive development (Afsharmand et al., 2018; Carey et al., 2022; Ofem et al., 2024). As the prevalence of childhood anxiety increases, particularly among younger children, researchers and clinicians are tasked with identifying effective interventions to alleviate these symptoms. Understanding how these interventions can affect anxiety is crucial, as early and appropriate interventions may prevent the progression of anxiety disorders into adulthood (Blanche et al., 2012; Goshayeshi et al., 2024; Li et al., 2023; Roghani et al., 2022).

Proprioception, or the body's ability to perceive its position in space, has gained recognition as a critical component in both physical and psychological health. Proprioceptive exercises are increasingly used to improve balance, motor coordination, and cognitive function in a variety of populations, including children, the elderly, and individuals with chronic health conditions (Aleixo et al., 2022; Arif et al., 2023). Importantly, emerging evidence also suggests that proprioceptive training may have anxiety-reducing effects, potentially offering a novel approach to managing childhood anxiety (Alloway & Alloway, 2015; Boyle et al., 2021). This introduction aims to provide an overview of the current literature surrounding anxiety in children, the role of proprioception, and the potential impact of proprioceptive exercises on anxiety reduction.

Anxiety disorders in children are linked to numerous negative outcomes, including impaired social functioning, academic difficulties, and the increased likelihood of developing other mental health disorders later in life (Carey et al., 2022). Research has shown that anxiety is not only prevalent in school-aged children but is also detectable in younger children, such as those in the preschool and early primary school years (Li et al., 2023). Identifying effective interventions during this critical period can play a crucial role in preventing the exacerbation of anxiety symptoms and improving children's overall quality of life (Chen et al., 2019; Chiaramonte et al., 2019; Chiaramonte et al., 2022).

Children's anxiety can manifest in various forms, including generalized anxiety, separation anxiety, and social anxiety. These conditions can hinder their ability to engage in typical age-appropriate activities, such as playing with peers or attending school (Carey et al., 2022). As a result, interventions aimed at reducing anxiety symptoms often focus on improving children's emotional regulation and coping mechanisms. One such approach is the use of exercise-based interventions, which have been shown to positively impact mental health in both adults and children (Gurudut et al., 2018; Sujatha et al., 2021). However, there is limited research on the specific effects of proprioceptive exercises on childhood anxiety, underscoring the need for further investigation (Han et al., 2015; Han et al., 2016; Houghton & Guzman, 2013).

Proprioception, often referred to as the "sixth sense," plays a fundamental role in how individuals interact with their environment. It is the sensory feedback mechanism that informs the brain of the body's position and movements, helping to maintain balance, coordination, and spatial awareness (Han et al., 2015). Proprioception is particularly crucial during childhood, a period marked by rapid physical and cognitive development. Children rely heavily on proprioceptive input to learn new motor skills, explore their surroundings, and develop social competencies (Blanche et al., 2012).

Deficits in proprioception have been linked to various developmental disorders, including autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD), both of which are associated with higher levels of anxiety (Blanche et al., 2012). For example, children with ASD often exhibit difficulties in proprioceptive processing, which can lead to challenges in social interactions and increased anxiety in unfamiliar or unpredictable environments (Blanche et al., 2012). Thus, improving proprioceptive functioning through targeted exercises may not only enhance motor skills but also alleviate anxiety in these children.

Recent research has demonstrated the potential for proprioceptive exercises to positively influence cognitive and emotional outcomes. A study by Alloway and Alloway (2015) found that proprioceptive training improved working memory in children, a cognitive function closely related to emotional regulation and anxiety management (Alloway & Alloway, 2015). Similarly, Boyle et al. (2021) reported that low-intensity proprioceptive exercises improved cognitive function and reduced anxiety levels in older adults, suggesting a potential link between proprioception and anxiety reduction across age groups (Boyle et al., 2021). These findings provide a rationale for exploring proprioceptive exercises as an intervention for childhood anxiety, particularly in children without diagnosed developmental disorders.

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Proprioceptive exercises have been widely studied for their benefits in improving physical health, such as enhancing balance, coordination, and strength (Badat et al., 2022; Binaei et al., 2021). However, their potential impact on mental health, particularly anxiety, is a relatively new area of exploration. Proprioceptive training often involves activities that challenge the body's balance and coordination, such as standing on unstable surfaces or performing complex movements with closed eyes (Afsharmand et al., 2018; Ha et al., 2018). These exercises require individuals to focus on their body's internal signals, promoting a heightened sense of body awareness and control (Balcı et al., 2016).

The potential anxiety-reducing effects of proprioceptive exercises may be explained by their influence on the autonomic nervous system. Proprioceptive feedback has been shown to modulate the body's stress response, helping to reduce the physiological symptoms of anxiety, such as increased heart rate and muscle tension (Chiaramonte et al., 2019; Chiaramonte et al., 2022). Furthermore, proprioceptive exercises may help children develop better emotional regulation skills by promoting mindfulness and body awareness, both of which are essential for managing anxiety (Boyle et al., 2021).

Several studies have explored the effects of proprioceptive exercises on anxiety in different populations. For instance, research by Gurudut et al. (2018) demonstrated that proprioceptive exercises significantly reduced anxiety levels in individuals with osteoarthritis, a condition often associated with chronic pain and psychological distress (Gurudut et al., 2018). Similarly, Cantero-Téllez et al. (2021) found that proprioceptive exercises improved proprioceptive accuracy and reduced pain and anxiety in patients with carpometacarpal joint osteoarthritis. These findings suggest that proprioceptive training may have broad applications for anxiety reduction, extending beyond physical health conditions to psychological well-being (Cantero-Téllez et al., 2021).

In addition to proprioceptive exercises, sensory and tactile exercises have been shown to play a role in anxiety reduction. Sensory exercises, which involve stimulating the body's sensory systems (e.g., vision, touch, hearing), can help children develop better sensory integration, thereby improving their ability to process environmental stimuli without becoming overwhelmed (Boucher et al., 2016). Tactile exercises, which focus on stimulating the sense of touch, are particularly beneficial for children who exhibit tactile defensiveness, a common characteristic of children with anxiety and sensory processing disorders (Blanche et al., 2012).

Sensory integration therapy, which often incorporates tactile and proprioceptive exercises, has been widely used to treat children with sensory processing disorders and anxiety. For example, research by Blanche et al. (2012) found that children with autism who received sensory integration therapy exhibited reduced anxiety and improved social skills (Blanche et al., 2012). Similarly, Carey et al. (2022) reported that a 16-week sensory-based exercise program significantly reduced anxiety in children with autism spectrum disorder, highlighting the potential benefits of sensory exercises for anxiety management in both neurotypical and neurodivergent children (Carey et al., 2022).

While the existing literature provides valuable insights into the benefits of proprioceptive, sensory, and tactile exercises for anxiety reduction, there is a need for more research on their effectiveness in young children without developmental disorders. Most studies have focused on older children or children with specific diagnoses, such as autism or ADHD (Blanche et al., 2012; Carey et al., 2022). Furthermore, few studies have directly compared the effects of proprioceptive and sensory exercises with other interventions, such as sexual education, which also plays a role in promoting emotional well-being in children (Chen et al., 2019; Chen & Qu, 2018; Chiaramonte et al., 2019; Chiaramonte et al., 2022).

The present study seeks to address these gaps by comparing the effectiveness of proprioceptive, sensory, and tactile exercises with sexual education in reducing anxiety among children aged 4 to 7.

2. Methods and Materials

2.1. Study Design and Participants

The present study is applied in terms of its objective and is categorized as a quasi-experimental study with a pre-test and post-test design and a control group. The statistical population of this study consisted of children aged 4 to 7 years from five treatment clinics in Tehran. Using convenience sampling, a total of 30 children were selected as the sample and were randomly assigned to two experimental groups (10 participants in each group) and one control group (10 participants). The research tools included the Sensory Integration Evaluation Form by Ryz, the Spence Children's Anxiety Scale, a sexual education training package for parents (10 educational sessions, each lasting 60 minutes over a period of 5 months), and a sensory integration

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exercise training package (18 sessions, each lasting 60 minutes over a period of 5 months). Additionally, a sexual education package for children aged 4 to 7 was used. For data analysis, a two-way repeated measures analysis of covariance (a mixed between-subjects and within-subjects design) was employed.

The inclusion criteria for this study included a diagnosis of anxiety, age range of 4 to 7 years, written informed consent to participate in the treatment sessions, absence of severe psychological issues, and cooperation from both parents and children. The exclusion criteria included losing any of the inclusion criteria during the study, missing the educational sessions, or lack of willingness to continue participation. For data collection, the Spence Children's Anxiety Scale, the Sensory Integration Evaluation Form by Ryz, and two educational protocols—sexual education and sensory stimulation—were used.

2.2. Data Collection

2.2.1. Sensory Integration

This questionnaire contains 110 questions that assess sensory integration in five different dimensions, including visual, auditory, tactile, olfactory, and gustatory integration. It also includes subscales such as social interaction, verbal communication, imitation skills, imitation in children's play, and specific autistic symptoms. This questionnaire, designed by Ryz in 1994, is a valid tool for assessing sensory integration in children and adults. It helps parents or caregivers better understand the child's sensory abilities and identify any disorders or issues in this area (Kashefimehr et al., 2017).

2.2.2. Preschool Anxiety

This scale, developed by Spence and colleagues, is based on the Diagnostic and Statistical Manual of Mental Disorders (4th edition) anxiety disorders and consists of 28 items that assess pathological symptoms of separation anxiety, generalized anxiety, social phobia, fear of physical harm, and obsessive-compulsive disorder in children aged 2 to 5 years. The scale includes 28 questions across five domains and uses a five-point Likert scale to measure children's anxiety, with items such as "Has difficulty stopping feeling worried." The reliability and validity of this questionnaire were confirmed in Gholami's (2023) study with a Cronbach's alpha of 0.79 (Khodapanahi et al., 2012).

2.3. Study Design and Participants

2.3.1. Sexual Education

The BASNEF health promotion model is a practical and suitable model for implementing health education programs and interventions. The structure of the BASNEF model includes behavior, attitude, subjective norms, and enabling factors. The influence of demographic factors such as age, gender, education, religious literacy, and occupation on the components of this model is of great importance (Amini et al., 2011; Jankovic et al., 2013).

Session 1: Introduction

In the first session, participants are introduced to each other to establish a supportive environment. The facilitator identifies parental concerns and taboos around sexual education and encourages empathy and dialogue to reach a shared understanding. This session aims to break the ice and open the floor for discussion, creating a space for parents to express their anxieties and perspectives.

Session 2: Parenting Skills 1

This session focuses on teaching parents how to communicate effectively and positively with their children. Emphasis is placed on fostering open dialogues and building trust. Parents learn techniques to encourage their children to ask questions, share feelings, and express concerns, laying the foundation for future conversations on sensitive topics.

Session 3: Parenting Skills 2

In the third session, parents are taught specific techniques to increase desirable behaviors and reduce undesirable ones in their children. Techniques include positive reinforcement and appropriate discipline strategies. Additionally, the session addresses parenting challenges in unique situations, helping parents adapt to different scenarios.

Session 4: Sexual Development Growth Curve

This session addresses the developmental milestones of sexual growth in children, providing accurate answers to common questions. Parents learn about age-appropriate behaviors and how to handle them correctly. They also receive guidance on common sexual development disorders and the necessary actions to take at different stages.

Session 5: Childhood Masturbation

The fifth session explores the causes of childhood masturbation and works on correcting misconceptions. Parents are guided on how to approach this behavior in a healthy and non-judgmental way, promoting a constructive conversation that reduces stigma and shame.

Session 6: Maintaining Boundaries in the Family

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This session educates parents on how to set boundaries within the family, focusing on bath time practices, appropriate parental clothing, and maintaining privacy during sexual activity. Parents are also taught how to help children maintain their own boundaries, particularly in interactions with other family members.

Session 7: Preemptive Education

In this session, parents learn how to address their children's natural curiosity without stimulating further confusion. They are taught how to create the right environment for children to ask questions and develop essential life skills, such as self-awareness and emotional regulation.

Session 8: Sexual Education Package for Children 1

This session introduces parents to the sexual education curriculum designed for children. It focuses on topics such as private spaces, body autonomy, and understanding private body parts. Parents learn how to teach these concepts in an age-appropriate manner.

Session 9: Sexual Education Package for Children 2

Building on the previous session, this session covers more advanced topics, such as the importance of privacy, recognizing inappropriate touch, and self-care skills. Parents are equipped with tools to teach their children about secrets and the importance of consent.

Session 10: Child Abuse

In the final session, parents are educated on child abuse, including common misconceptions and the reality of child abuse statistics globally and in Iran. The session provides necessary steps for prevention, recognition, and action in case of child abuse, empowering parents with knowledge and resources.

2.4. Sensory Stimulation Training

This package consisted of 18 sessions, each lasting 60 minutes over 5 months, conducted with the experimental groups. Sensory integration therapy involves the ability to organize information received from various senses and manage this information through active brain mechanisms, including tactile stimulation through skin contact with different materials, vestibular and proprioceptive sensations through movement activities, and combining different sensory inputs. This therapeutic method, which can take the form of play therapy, occupational therapy, or speech therapy, helps children better utilize sensory information. Reflexology training and sensory stimulation and massage were provided to parents during various sessions for application to the children. Reflexology is a technique based on the premise that reflex points located on the palms, soles of the feet, ears, etc., correspond to every part of the body, including muscles, nerves, glands, and bones. Applying pressure to these points relieves tension, soothes the nerves, and promotes relaxation of the body (Mostafavi et al., 2023).

Session 1: Life Skills

This session focuses on self-awareness and teaching children how to say "no" assertively. Children learn about various emotions and healthy ways to express them, as well as how to interact positively with their parents. The goal is to build confidence in personal interactions.

Session 2: Private Spaces

In this session, children are introduced to the concept of privacy and taught how to identify who is allowed into their personal space. They also learn the rules of physical affection and understand that they have control over their own body.

Session 3: My Body

Children are taught to identify their body parts, understand the function of each organ, and learn the concept of ownership and responsibility for their own body. This session promotes body autonomy and teaches the importance of body care.

Session 4: Private Parts

This session educates children about private body parts and the rules surrounding them. They are also introduced to the physical differences between boys and girls and learn about their gender identity in a healthy and age-appropriate manner.

Session 5: Secrets

Children learn to differentiate between good and bad secrets in this session. They are taught how to respond if someone asks them to keep an inappropriate secret and the importance of telling trusted adults when they feel uncomfortable.

Session 6: Touch

This session focuses on distinguishing between appropriate and inappropriate touches. Children are taught the concept of consent and how to react when someone touches them inappropriately, emphasizing their right to control physical contact.

Session 7: Self-Care

Children are educated on the difference between strangers and familiar people, and how to distinguish between safe and unsafe strangers. They also learn about children's rights and are introduced to local child protection centers for support.

Session 8: Conclusion

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The final session wraps up the program by reinforcing safety practices to help children avoid dangerous individuals. They learn how to identify risky situations and what steps to take if they find themselves in danger. The session aims to empower children with practical tools for maintaining their safety.

2.5. Data Analysis

For data analysis, descriptive statistics were used to examine variables such as education level, age, number of children, and parents' occupations in the experimental sample. Statistical assumptions were then reviewed, and repeated measures analysis was employed. The data were coded and entered into SPSS software (version 26), and statistical significance was set at a level of 0.05.

3. Findings and Results

Initially, the descriptive findings of the research variables are reported.

Table 1

Descriptive Statistics of Anxiety Scores in Three Measurement Stages by Group

Group	Variable	Pre-test M (SD)	Post-test M (SD)	Follow-up M (SD)
Control	Generalized Anxiety	18.80 (2.68)	18.13 (2.99)	18.07 (2.28)
	Social Phobia	23.20 (2.86)	22.53 (2.53)	22.47 (2.77)
	Obsessive-Compulsive	18.93 (2.60)	18.40 (3.18)	18.27 (3.41)
	Physical Injury Fear	24.67 (5.68)	24.07 (5.39)	24.43 (5.28)
	Separation Anxiety	23.01 (3.28)	22.12 (3.12)	22.48 (2.92)
	Total Anxiety Score	108.61 (6.67)	105.25 (6.71)	105.70 (7.86)
Sensory, Proprioceptive, and Tactile Exercises	Generalized Anxiety	18.27 (2.58)	12.20 (1.97)	12.77 (1.64)
	Social Phobia	22.47 (2.72)	14.87 (3.02)	15.33 (3.13)
	Obsessive-Compulsive	17.67 (2.58)	10.93 (2.89)	11.07 (3.31)
	Physical Injury Fear	23.27 (5.02)	11.60 (3.04)	12.33 (2.80)
	Separation Anxiety	21.98 (3.09)	13.86 (2.91)	14.67 (3.26)
	Total Anxiety Score	103.65 (6.57)	63.46 (5.38)	66.17 (5.94)
Sexual Education	Generalized Anxiety	18.73 (2.49)	14.80 (1.66)	15.33 (1.68)
	Social Phobia	22.73 (3.13)	18.60 (2.85)	19.00 (3.09)
	Obsessive-Compulsive	17.80 (3.17)	14.73 (2.63)	15.07 (3.37)
	Physical Injury Fear	23.40 (6.13)	17.73 (4.40)	18.13 (4.34)
	Separation Anxiety	22.10 (2.75)	17.63 (2.46)	18.11 (2.30)
	Total Anxiety Score	104.77 (5.19)	83.50 (4.94)	85.65 (6.05)

Table 1 displays the descriptive statistics of the mean and standard deviation of anxiety scores for the control, sensory, proprioceptive, and tactile exercises, and sexual education groups across three measurement stages (pre-test, post-test, and follow-up). As observed, the mean scores in the control group show little change between the pre-test, post-test, and follow-up stages. However, the experimental groups show a reduction in scores in the post-test and follow-up stages compared to the pre-test.

To examine the effectiveness of sexual education on children's anxiety, a two-way repeated measures ANOVA was conducted. The results of the Levene's test were not significant, confirming the assumption of homogeneity of variances. However, Mauchly's test of sphericity was statistically significant, indicating a violation of the sphericity assumption. This violation increases the likelihood of a Type II error; thus, the Greenhouse-Geisser and Huynh-Feldt adjustments were used for degrees of freedom to ensure reliable significance values.

Table 2

Multivariate Within-Subjects Effects Test for Anxiety Comparison between Control and Sexual Education Groups

Effect	Value	F	df1	df2	Sig.	Partial η^2
Time	Pillai's Trace	0.884	8.404	10	106	0.001
	Wilks' Lambda	0.120	19.659	10	104	0.001
	Hotelling's Trace	7.319	37.327	10	102	0.001
	Roy's Largest Root	7.314	77.531	5	53	0.001
Time * Group Interaction	Pillai's Trace	0.814	7.278	10	106	0.001
	Wilks' Lambda	0.199	12.919	10	104	0.001

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	Hotelling's Trace	3.962	20.204	10	102	0.001
	Roy's Largest Root	3.945	41.815	5	53	0.001

Table 2 provides the results of the multivariate tests examining the differences in mean anxiety scores between the control and sexual education groups throughout the treatment phases. All multivariate tests were significant, indicating a main effect of time (pre-test, post-test, follow-up) and an interaction effect between group and time (i.e., differences between the groups across the measurement stages). To further explore the pairwise differences in mean scores across the measurement stages, a Bonferroni post-hoc test was used.

Table 3

Bonferroni Post-Hoc Test for Pairwise Comparisons of Anxiety Scores by Group

Group	Dependent Variable	Stage	Stage Compared	Mean Difference	SE	Sig.
Control	Generalized Anxiety	Pre-test	Post-test	0.667	0.517	0.623
			Follow-up	0.733	0.454	0.352
	Social Phobia	Pre-test	Post-test	0.667	0.450	0.449
Sexual Education	Generalized Anxiety	Pre-test	Post-test	3.933	0.517	0.001
			Follow-up	3.400	0.454	0.001

Table 3 presents pairwise comparisons of anxiety scores across the stages of treatment for the control and sexual education groups. The results show that in the sexual education group, the differences between the pre-test and both post-test and follow-up stages were significant ($p < 0.05$), indicating a significant reduction in anxiety scores after the intervention. The difference between post-test and follow-up scores was not significant ($p > 0.05$), suggesting that the treatment effects were stable over time. In the control group, no significant differences were found between the stages ($p > 0.05$).

Table 4

Between-Subjects Effects Test for Comparison of Anxiety Scores between Groups

Source of Variance	Variable	Sum of Squares	df	Mean Square	F	Sig.
Group	Generalized Anxiety	94.044	1	94.044	6.871	0.014
	Social Phobia	154.711	1	154.711	7.056	0.013
Error	Generalized Anxiety	383.244	28	13.687		

Table 4 shows the results of the between-subjects effects test, comparing the mean anxiety scores of the control and sexual education groups. The F-values for all anxiety components are significant ($p < 0.05$), indicating that the sexual education group had significantly lower anxiety scores than the control group.

Table 5

Bonferroni Post-Hoc Test for Pairwise Comparisons between Control and Sexual Education Groups

Dependent Variable	Group 1	Group 2	Mean Difference	SE	Sig.
Generalized Anxiety	Control	Sexual Education	2.044	0.780	0.014
Social Phobia	Control	Sexual Education	2.622	0.987	0.013

Table 5 shows the pairwise comparisons between the control and sexual education groups. The results indicate that the sexual education group had significantly lower anxiety scores than the control group across all anxiety variables ($p < 0.05$).

4. Discussion and Conclusion

The present study aimed to compare the effectiveness of sexual education and sensory, proprioceptive, and tactile exercises on reducing anxiety in children aged 4 to 7 years. The findings revealed significant reductions in anxiety scores for both the sexual education and sensory, proprioceptive, and tactile exercise groups compared to the

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control group, with the exercise group showing the most substantial improvement. These results highlight the potential of both interventions in addressing childhood anxiety, with sensory, proprioceptive, and tactile exercises demonstrating particular efficacy in reducing various dimensions of anxiety, including generalized anxiety, social phobia, obsessive-compulsive tendencies, fear of physical injury, and separation anxiety.

The reduction in anxiety observed in the sensory, proprioceptive, and tactile exercises group is consistent with previous studies that emphasize the role of proprioception and sensory integration in regulating emotional and physiological responses to anxiety. Studies by Alloway and Alloway (2015) and Gurudut et al. (2018) showed that proprioceptive exercises not only enhance physical coordination but also improve cognitive function and emotional regulation (Alloway & Alloway, 2015; Gurudut et al., 2018). The exercises used in the current study likely helped children develop a greater awareness of their bodies and physical movements, which could lead to increased control over anxiety responses. Proprioceptive activities, such as balance training and tactile stimulation, are known to stimulate neural pathways that are involved in emotional regulation, thus potentially explaining the significant reductions in anxiety in this group (Chiaramonte et al., 2019; Chiaramonte et al., 2022).

The findings align with previous research that demonstrates the anxiety-reducing effects of sensory-based interventions. For instance, a study by Blanche et al. (2012) found that sensory integration therapy significantly reduced anxiety in children with autism spectrum disorder, which is often associated with sensory processing difficulties. Similarly, sensory and proprioceptive exercises have been shown to be effective in reducing anxiety in children with developmental coordination disorders and sensory processing issues (Carey et al., 2022; Sujatha et al., 2021). The current study adds to this body of literature by demonstrating the effectiveness of these interventions in a broader population of children, not limited to those with specific developmental disorders.

The sexual education intervention also showed significant reductions in anxiety, particularly in dimensions such as social phobia and separation anxiety. This finding is consistent with research that suggests that early sexual education can play a role in reducing anxiety related to social interactions and bodily awareness. By providing children with knowledge about their bodies and personal boundaries, sexual education can help them feel more in control and reduce anxiety, particularly in social situations (Boucher et al., 2016; Chen et al., 2019; Chen & Qu, 2018). The BASNEF model used in the sexual education intervention focuses on behavioral, attitudinal, and normative changes, which may have contributed to the observed reduction in anxiety by promoting positive attitudes and behaviors around personal safety and social interactions.

The results of this study support the notion that multi-modal approaches to anxiety reduction are particularly effective. While both sexual education and sensory-based interventions independently contributed to anxiety reduction, the more pronounced effects in the sensory, proprioceptive, and tactile exercise group suggest that interventions targeting multiple sensory and emotional pathways may be especially powerful. This is consistent with the findings of previous studies, which have highlighted the benefits of combining physical and cognitive-behavioral interventions for managing anxiety in children (Afsharmand et al., 2018; Binaei et al., 2021). The current study adds further evidence to the importance of considering sensory and proprioceptive exercises as part of a holistic approach to childhood anxiety.

The significant reductions in generalized anxiety and social phobia observed in both intervention groups are notable, as these dimensions of anxiety are particularly common in early childhood. Previous research has demonstrated that early intervention is crucial in preventing the escalation of these anxiety symptoms into more severe mental health issues later in life (Aleixo et al., 2022; Li et al., 2023). The findings of the current study suggest that both sexual education and sensory-based interventions can be effective tools for early intervention, helping to reduce anxiety symptoms before they become entrenched.

Overall, the findings of this study are consistent with a growing body of research that emphasizes the importance of sensory integration and proprioception in managing anxiety (Blanche et al., 2012; Bordoni & Simonelli, 2020). By helping children develop a better sense of body awareness and control, sensory-based interventions may reduce the physiological arousal associated with anxiety, thereby leading to better emotional regulation. Additionally, the results highlight the potential of sexual education as a tool for anxiety reduction, particularly in social and interpersonal contexts.

Despite the promising findings, several limitations should be noted. First, the sample size was relatively small (n = 30), which may limit the generalizability of the results. While the study demonstrated significant effects within this sample,

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larger studies are needed to confirm the findings across different populations and settings. Additionally, the use of convenience sampling may have introduced selection bias, as the children who participated in the study were recruited from treatment clinics in Tehran, and their anxiety levels may not be representative of the broader population of children.

Another limitation is the reliance on parent-reported measures of anxiety. While the Spence Children's Anxiety Scale (SCAS) is a validated tool, parent reports may be influenced by subjective perceptions or biases, potentially affecting the accuracy of the data. Future studies should consider using multi-informant approaches, incorporating self-reports from older children, teacher assessments, or physiological measures of anxiety to provide a more comprehensive assessment of anxiety symptoms.

Finally, the study's follow-up period was limited to a relatively short timeframe (5 months). While the results showed sustained reductions in anxiety during this period, longer follow-up assessments would be necessary to determine whether the effects of the interventions are maintained over time. Previous research has indicated that the benefits of some interventions may diminish over longer periods without continued practice or reinforcement (Arif et al., 2023; Badat et al., 2022). Future studies should include longer follow-up periods to assess the long-term effectiveness of both sexual education and sensory-based interventions in reducing childhood anxiety.

Building on the findings of this study, future research should aim to address the limitations mentioned above. First, larger randomized controlled trials with more diverse samples are needed to confirm the generalizability of the findings. Future studies should recruit participants from different regions, socioeconomic backgrounds, and clinical settings to ensure that the results are applicable across a wide range of populations. Additionally, researchers should consider using a longitudinal design with extended follow-up periods to assess the long-term sustainability of the intervention effects.

Future studies should also explore the underlying mechanisms through which sensory, proprioceptive, and tactile exercises exert their anxiety-reducing effects. While the current study suggests that these interventions are effective, it remains unclear which specific components of the interventions contribute most to the observed reductions in anxiety. Researchers could investigate the neural and physiological changes associated with these exercises, using techniques such as functional magnetic resonance imaging (fMRI) or electroencephalography (EEG) to explore changes in brain activity during and after sensory-based interventions (Binaei et al., 2021; Chiaramonte et al., 2019; Chiaramonte et al., 2022).

Moreover, it would be valuable to compare the effects of sexual education and sensory-based interventions with other well-established anxiety reduction strategies, such as cognitive-behavioral therapy (CBT). While the current study focused on these two interventions, there is a need to explore how they compare to or complement existing therapeutic approaches. Such research could provide valuable insights into the relative effectiveness of different interventions and help guide clinicians in choosing the most appropriate treatments for children with anxiety.

The findings of this study have several important implications for clinical practice. First, clinicians and educators working with young children should consider incorporating sensory, proprioceptive, and tactile exercises into their therapeutic interventions for anxiety. These exercises can be easily integrated into occupational therapy, play therapy, and physical education programs, providing children with opportunities to engage in activities that promote both physical coordination and emotional regulation. Given the effectiveness of these interventions in reducing anxiety, particularly in the sensory, proprioceptive, and tactile exercises group, clinicians should consider using these methods as part of a multi-modal approach to anxiety treatment (Aleixo et al., 2022).

In addition to sensory-based interventions, sexual education programs should be implemented in early childhood to address anxiety related to social interactions and body awareness. The results of this study suggest that sexual education can help reduce social phobia and separation anxiety, particularly when delivered using structured models such as the BASNEF framework. Schools and clinics should provide developmentally appropriate sexual education that helps children understand their bodies, personal boundaries, and social relationships, fostering greater emotional security and reducing anxiety.

Finally, clinicians should be mindful of the importance of individualized treatment approaches. While both sensory-based exercises and sexual education were effective in reducing anxiety, different children may respond differently to these interventions based on their unique sensory processing needs and social environments. Clinicians should tailor interventions to the specific needs of each child, combining elements from both sensory and educational approaches to achieve the best outcomes. By adopting a

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flexible, child-centered approach to anxiety treatment, clinicians can maximize the effectiveness of their interventions and promote long-term emotional well-being in young children (Blanche et al., 2012; Boyle et al., 2021).

In conclusion, the current study provides valuable insights into the effectiveness of sensory, proprioceptive, and tactile exercises, as well as sexual education, in reducing anxiety in children. Both interventions demonstrated significant reductions in anxiety, with sensory-based exercises showing the most substantial effects. These findings highlight the potential of multi-modal approaches to anxiety treatment and underscore the importance of early intervention. By addressing the limitations and building on the strengths of this study, future research can further advance our understanding of how best to support children with anxiety.

Authors' Contributions

All authors significantly contributed to this study.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

In this study, to observe ethical considerations, participants were informed about the goals and importance of the research before the start of the interview and participated in the research with informed consent.

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