Journal of
Social Behavior and Community Health

# The Relationship between Parenting Stress Components and Childhood Anxiety in Children with Attention-Deficit/Hyperactivity Disorder: The Mediating Role of Symptom Severity

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***ARTICLEINFO***

**ORIGINAL ARTICLE**

**Article History:**
Received: 24 December 2025
Revised: 27 July 2026
Accepted: 22 August 2026

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**Citation:**
Rostami Faghlo S, Dasht Bozorgi Z, Safarzadeh S. The Relationship between Parenting Stress Components and Childhood Anxiety in Children with Attention-Deficit/ Hyperactivity Disorder: The Mediating Role of Symptom Severity. Journal of Social Behavior and Community Health. 2026; 10(1): 1823-1833.

10.18502/jsbch.v10i1.23005

***ABSTRACT***

**Background:** Attention-Deficit/Hyperactivity Disorder (ADHD) is frequently comorbid with anxiety disorders; however, the role of the familial environment in this comorbidity remains under-explored. This study aims to investigate a mediation model in which components of parenting stress predict anxiety in children with ADHD, mediated by the severity of ADHD symptoms.

**Methods:** This descriptive-correlational study employed Structural Equation Modeling (SEM). The statistical population included mothers of children aged 6–12 diagnosed with ADHD who referred to governmental comprehensive health centers and private child psychology clinics in Karaj, Iran, during 2023–2024. A convenience sample of 210 mothers was recruited, and data were collected using the Parenting Stress Index-Short Form (PSI-SF), Swanson, Nolan, and Pelham Version IV (SNAP-IV) Scale, and Spence Children's Anxiety Scale (SCAS). Finally, analyses were conducted using SPSS version 27 for descriptive statistics and correlations, and AMOS version 24 for SEM with bootstrapping (5,000 resamples) to test indirect effects.

**Results:** The components of parenting stress (parental distress, parent–child dysfunctional interaction, and difficult child characteristics) showed significant direct associations with ADHD symptom severity ($p<0.001$). Although direct paths from parenting stress components to child anxiety were non-significant, bootstrapping analyses confirmed a significant indirect effect: parenting stress predicted child anxiety through the mediating role of ADHD symptom severity ($p<0.01$).

**Conclusion:** These findings suggest that parenting stress is indirectly associated with higher levels of anxiety in children with ADHD through increased severity of ADHD symptoms. Clinically, targeted interventions such as parental stress management programs, parent training focused on improving parent-child interactions, and family-based support strategies are recommended to reduce parenting stress, thereby decreasing ADHD symptom severity and ultimately alleviating anxiety symptoms in this population.

**Keywords:** Attention deficit hyperactivity disorder, Anxiety, Parenting, Psychological stress

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[ DOI: 10.18502/jsbch.v10i1.23005 ]

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## Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) is one of the most prevalent neurodevelopmental conditions, affecting approximately 5-7% of children worldwide (Sayal et al., 2018). This disorder is characterized by persistent patterns of inattention, hyperactivity, and impulsivity that are inconsistent with the child's developmental level (Musullulu, 2025). For children diagnosed with ADHD, the challenges extend far beyond the classroom; they often struggle with significant impairments in social integration, emotional regulation, and executive functioning (Thapar & Cooper, 2016). These deficits frequently lead to chronic academic underachievement and strained interpersonal relationships with peers and family members. Furthermore, the neurobiological nature of ADHD means that these children often experience a "cascading effect" of failure, where early behavioral difficulties evolve into more complex psychological issues (Mohammadzadeh et al., 2021). The clinical picture is often complicated by the high rate of internalizing and externalizing comorbidities, which makes the management of this population a significant challenge for healthcare providers and educators alike. Consequently, understanding the ecological environment—particularly the family unit—is essential for improving the long-term developmental trajectory of these children (Bhide et al., 2023).

Parenting stress is a specific form of psychological distress that arises when the perceived demands of the parenting role exceed the available resources and coping mechanisms (Shafighi et al., 2024). In families of children with ADHD, this stress is notably higher than in families of typically developing children due to the chronic nature of the child's behavioral dysregulation (Yaghmaei et al., 2019). In this vein, research consistently identifies three core dimensions of this stress: parental distress, dysfunctional parent-child interactions, and the perception of the child as "difficult" (Shafighi et al., 2024). Studies have shown that high levels of parenting stress can create a coercive family environment, where parents may resort to harsh or inconsistent discipline, which paradoxically reinforces the child's problematic behaviors (Crouch et al., 2019). Chronic parental stress not only undermines the parent's mental health but also serves as a potent environmental stressor that exacerbates the child's underlying neurodevelopmental vulnerabilities (Zhou et al., 2025).

Childhood anxiety is one of the most frequent comorbid conditions associated with ADHD. Clinical estimates suggest that up to 30-50% of the children diagnosed with ADHD also meet the criteria for an anxiety disorder (León-Barriera et al., 2022). Anxiety in this population often manifests as excessive worry, social withdrawal, or somatic complaints, which can further impair the child's cognitive flexibility and attention (Bishop et al., 2019). Existing literature suggests that the link between ADHD and anxiety is multifaceted, involving shared genetic predispositions and neurophysiological pathways, such as dysregulation in the hypothalamic-pituitary-adrenal (HPA) axis (Fuller-Thomson et al., 2022). However, social and environmental factors, such as repeated experiences of social rejection and academic failure, also play a critical role in fostering a sense of generalized apprehension and low self-efficacy in these children (Jakobsson Støre et al., 2024).

The severity of ADHD symptoms—encompassing both inattentive and hyperactive-impulsive domains—is a critical factor in determining the overall level of functional impairment (Ceruti & Marzocchi, 2025). Symptom severity is not static; it is influenced by a complex interplay between biological factors and environmental feedback loops. Moreover, research indicates that children with more severe symptoms often face higher levels of stigmatization and more frequent negative interactions with caregivers and teachers (Chang et al., 2020). In many structural models, symptom severity is positioned as a key mediator that explains how external stressors, such as family dysfunction, are translated into internalizing problems like anxiety (Yurdakul et al.,

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2024). When a child's ADHD symptoms are severe, their ability to regulate emotions is significantly diminished, making them more susceptible to the development of secondary psychological disorders (Doulou et al., 2025).

The present study specifically focuses on the three core components of parenting stress—parental distress, parent-child dysfunctional interaction, and difficult child characteristics—because these dimensions, as conceptualized by Abidin (1995), represent distinct yet interrelated sources of stress that are particularly salient in families of children with ADHD; they have been theoretically and empirically linked to child behavioral and emotional outcomes (Abidin, 1995).

Although numerous studies have investigated the associations between parenting stress, ADHD symptoms, and anxiety, most have adopted a child-centric approach or examined global parenting stress rather than its distinct components. Furthermore, few studies have tested integrated mediation models in which ADHD symptom severity serves as a mediator between specific parenting stress dimensions and child anxiety, particularly in non-Western cultural contexts such as Iran. This gap is significant because cultural, socioeconomic, and familial factors may influence the expression and impact of parenting stress in unique ways. Therefore, the current study addresses this research gap by examining a comprehensive mediation model in an Iranian clinical sample.

The importance of this investigation lies in its potential to provide a more nuanced understanding of family processes in ADHD. Even though similar associations have been explored in Western samples, replicating and extending these findings in a different cultural context can reveal both universal and culture-specific mechanisms. Such knowledge is crucial for developing culturally informed interventions that target parenting stress reduction, which may subsequently decrease ADHD symptom severity and comorbid anxiety.

The selection of children aged 6 to 12 years was guided by developmental psychopathology and diagnostic frameworks (e.g., DSM-5). This age range represents the peak period of ADHD symptom expression in school-aged children, before the additional developmental and hormonal changes associated with adolescence and when academic and social demands intensify, and. Children younger than 6 years were excluded due to differences in diagnostic criteria and symptom presentation in preschoolers.

Therefore, this study aimed to investigate a structural model of childhood anxiety based on the three components of parenting stress with the mediating role of ADHD symptom severity in children with ADHD.

## Methods

This study employed a descriptive-correlational design using Structural Equation Modeling (SEM) to examine the proposed relationships. The statistical population comprised all mothers of children diagnosed with ADHD who referred to both governmental comprehensive health centers and private child psychology clinics in Karaj, Iran, during 2023–2024. Data collection was carried out over a period of approximately seven months (from September 2023 to March 2024). A convenience sample of 210 mothers was recruited through non-probability convenience sampling based on their accessibility during clinic visits and willingness to participate. Inclusion criteria for children were a formal diagnosis of ADHD by a psychiatrist and being aged between 6 and 12 years. This age range was selected because it represents the peak period of ADHD symptom expression in school-aged children and precedes the additional developmental and hormonal changes associated with adolescence; children younger than 6 years were excluded due to differences in diagnostic criteria and symptom presentation in preschoolers. Inclusion criteria for mothers included a minimum of secondary education and the absence of severe psychiatric disorders. On the other hand, exclusion criteria involved the presence of comorbid neurodevelopmental disorders (e.g., autism spectrum disorder) in the child or incomplete questionnaire responses. Regarding ethical considerations, the study protocol was reviewed and approved by the Ethics Committee of

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Islamic Azad University, Ahvaz Branch (Code: IR.IAU.AHVAZ.REC.1403.267). All procedures adhered to the ethical principles of the Declaration of Helsinki. Accordingly, written informed consent was obtained from all participating mothers after a thorough explanation of the study objectives, voluntary participation, the right to withdraw at any time without consequence, and assurance of data confidentiality.

***Procedure***

Data collection was carried out in coordination with clinical centers and private practices. After obtaining the necessary permissions, mothers of children with ADHD were invited to participate in the research. During brief individual sessions, the researcher explained the study's objectives and the importance of honest responses. Participants then completed the research instruments, which included assessments of parenting stress, the child's ADHD symptom severity, and the child's anxiety levels. Due to the clinical nature of the sample, the researcher remained available to clarify any ambiguities regarding the questionnaire items. On average, the completion of the survey battery took approximately 30 to 45 minutes per participant.

***Instruments***

Parenting Stress Index-Short Form (PSI-SF): This 36-item self-report instrument, developed by Abidin (1995), measures the stress associated with the parenting role. It consists of three subscales: Parental Distress (PD), Parent-Child Dysfunctional Interaction (P-CDI), and Difficult Child (DC). Items are scored on a 5-point Likert scale (from 1=strongly disagree to 5=strongly agree), with total scores ranging from 36 to 180; higher scores indicate greater parenting stress (Abidin, 1995). Previous studies in the Iranian population have reported excellent psychometric properties, with Cronbach's alpha coefficients exceeding 0.90 (Shirzadi et al., 2015). In the current study, the Cronbach's alpha for the total scale was 0.92.

*Swanson, Nolan, and Pelham Version IV (SNAP-IV) Scale:* The severity of ADHD symptoms was assessed using the 18-item SNAP-IV scale. This tool includes two 9-item subscales corresponding to the DSM-IV criteria for inattention and hyperactivity/impulsivity. Parents rate each item on a 4-point scale (0=not at all to 3=very much). Moreover, higher average scores signify more severe clinical symptoms (Hall et al., 2020). The Persian version of this scale has demonstrated high validity and reliability in clinical settings (Kiani & Hadianfard, 2016). For the present study, the internal consistency (Cronbach's alpha) for the total symptom severity was calculated at 0.88.

Spence Children's Anxiety Scale (SCAS): Childhood anxiety was measured using the parent-report version of the SCAS. This scale comprises 38 items covering six domains: separation anxiety, social phobia, obsessive-compulsive problems, panic/agoraphobia, generalized anxiety, and fears of physical injury. Items are rated on a 4-point Likert scale (0=never to 3=always), with a total score range of 0 to 114. Higher scores reflect higher levels of anxiety (Spence et al., 2001). Moreover, the SCAS is widely used in Iranian clinical research, showing robust reliability (Hoseini et al., 2023). In this study, the Cronbach's alpha for the total anxiety score was found to be 0.89.

**Data Analysis**

Analyses were conducted in two stages. Descriptive statistics (means and standard deviations) and Pearson correlation coefficients were computed using SPSS version 27. In addition, the hypothesized mediation model was tested using SEM in AMOS version 24. Model fit was also assessed with the following indices: $\chi^2$/df ratio, Comparative Fit Index (CFI), Goodness-of-Fit Index (GFI), Tucker–Lewis Index (TLI), Incremental Fit Index (IFI), and Root Mean Square Error of Approximation (RMSEA). The significance of indirect (mediated) effects was evaluated using bootstrapping with 5,000 resamples. Furthermore, no control variables (such as child age, sex, medication status, or socioeconomic factors) were included in the structural model.

## Results

The sample consisted of 210 mothers of children

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diagnosed with ADHD, aged 28–48 years (M=36.74, SD=4.82). The majority (62.4%) held a bachelor's degree or higher, while 37.6% had completed secondary education. Furthermore, the children were aged 6–12 years (M=8.91, SD=1.67), with 68.1% being boys and 31.9% girls.

Table 1 presents the descriptive statistics, normality indices, and intercorrelations among the study variables. Means indicated moderate-to-high levels of parenting stress components and child anxiety, with ADHD symptom severity in the clinical range. Skewness and kurtosis values fell within acceptable limits (|skewness| < 2, |kurtosis| < 3), supporting the assumption of univariate normality. To address potential concerns regarding common method variance due to single-informant (maternal) data collection, Harman's single-factor test was conducted. The results showed that the first factor explained 28.4% of the total variance, which is well below the 50% threshold, suggesting that common method variance was not a substantial concern in this study.

As shown in Table 1, the three components of parenting stress were positively and significantly correlated with ADHD symptom severity (r = 0.39 for parental distress, r=0.37 for parent-child dysfunctional interaction, and r=0.34 for difficult child characteristics, all p<0.05). Additionally, ADHD symptom severity showed a moderate positive correlation with child anxiety (r=0.41, p<0.05). The direct correlations between parenting stress components and child anxiety were positive but relatively weak and mostly non-significant(Table 1).

**Table 1.** Descriptive statistics, normality indices and intercorrelations among study variables (N=210)

| Variables | Mean | SD | Skewness | Kurtosis | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|
| 1- Parental distress | 35.41 | 6.52 | 0.42 | -0.31 | - | | | | |
| 2-Parent-child dysfunctional interaction | 34.56 | 5.79 | 0.28 | -0.45 | 0.48** | - | | | |
| 3- Difficult child | 32.71 | 5.91 | 0.35 | -0.22 | 0.42** | 0.55** | - | | |
| 4- ADHD symptom severity | 29.72 | 4.63 | 0.19 | -0.68 | 0.39** | 0.37** | 0.34** | - | |
| 5- Child anxiety | 51.87 | 10.67 | 0.51 | -0.14 | 0.22* | 0.19* | 0.18* | 0.41** | - |

**: P<0.01; *: P<0.05;

The hypothesized structural model was first specified based on theoretical foundations and previous empirical evidence. This model posited direct paths from the three components of parenting stress (parental distress, parent–child dysfunctional interaction, and difficult child characteristics) to ADHD symptom severity, as well as direct paths from parenting stress components to child anxiety, with ADHD symptom severity also directly predicting child anxiety (Figure 1).

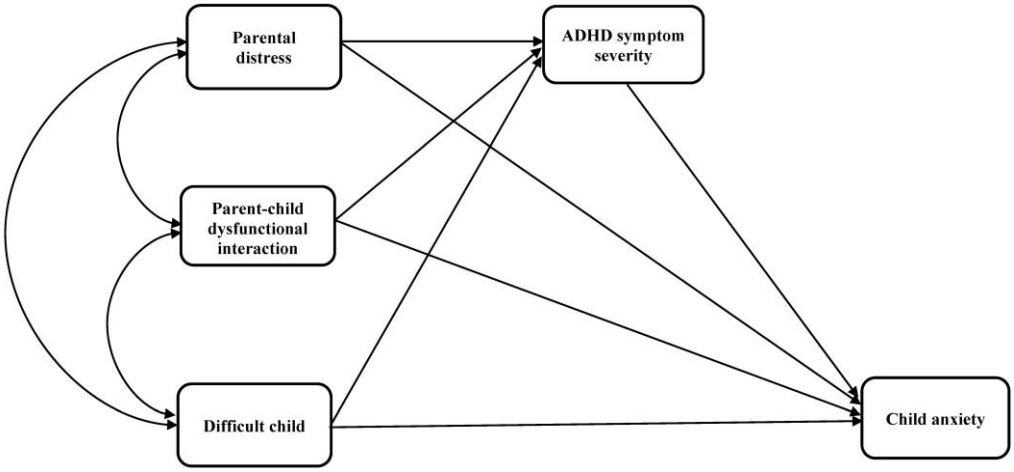



**Figure 1.** Hypothesized structural equation model


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Prior to testing the structural model, a confirmatory factor analysis (CFA) was performed to evaluate the measurement model. The CFA results indicated acceptable fit to the data ($\chi^2$/df=1.67, CFI=0.94, TLI=0.93, RMSEA=0.056, SRMR=0.062). Moreover, all factor loadings were statistically significant and above 0.50 (ranging from 0.52 to 0.89). The Average Variance Extracted (AVE) values for the constructs ranged from 0.51 to 0.68, and Composite Reliability (CR) coefficients were all above 0.80, supporting adequate convergent validity. Discriminant validity also confirmed as the square root of AVE for each construct exceeded its correlations with other constructs.

Table 2 presents the fit indices for the final structural model. The chi-square to degrees of freedom ratio ($\chi^2$/df=1.28) was well below the recommended threshold of 3, indicating excellent fit. Comparative Fit Index (CFI=0.96), Tucker–Lewis Index (TLI=0.95), Goodness-of-Fit Index (GFI=0.95), and Incremental Fit Index (IFI=0.96) all exceeded the recommended criterion of 0.95. Additionally, the Root Mean Square Error of Approximation (RMSEA=0.038) was below 0.08, with a narrow 90% confidence interval, further confirming that the model adequately represented the observed covariance structure (Table 2).

**Table 2.** Fit indices for the final structural model

| Fit indicators | $\chi^2$ | df | ($\chi^2$/df) | GFI | TLI | CFI | IFI | RMSEA |
|---|---|---|---|---|---|---|---|---|
| Final model | 52.46 | 41 | 1.28 | 0.95 | 0.95 | 0.96 | 0.96 | 0.038 |
| Acceptable range | - | - | <3 | >0.95 | >0.95 | >0.95 | >0.95 | <0.08 |

Table 3 presents the direct paths in the final model (Table 3). All the three components of parenting stress showed significant positive direct effects on ADHD symptom severity: parental distress (β=0.58, p=0.001), parent–child dysfunctional interaction (β=0.50, p=0.001), and difficult child characteristics (β=0.46, p=0.001). Furthermore, ADHD symptom severity significantly predicted child anxiety (β=0.37, p=0.043). No significant direct paths were observed from parenting stress components to child anxiety, suggesting that the influence of parenting stress on anxiety operated primarily through symptom severity (Table 3).

Table 3. Direct paths in the final model

| Paths | B | β | SE | P |
|---|---|---|---|---|
| Parental distress → ADHD symptom severity | 0.77 | 0.58 | 0.14 | 0.001 |
| Parent-child dysfunctional interaction → ADHD symptom severity | 0.74 | 0.50 | 0.15 | 0.001 |
| Difficult child → ADHD symptom severity | 0.58 | 0.46 | 0.13 | 0.001 |
| ADHD symptom severity → Child anxiety | 0.50 | 0.37 | 0.25 | 0.043 |

Table 4 presents the bootstrapped indirect effects for the mediation model with 5,000 resamples. The results confirmed significant indirect effects for all the three pathways. Specifically, parental distress had a significant standardized indirect effect on child anxiety via ADHD symptom severity (β=0.17, 95% bias-corrected bootstrap confidence interval [0.07, 0.21], p=0.003). Parent-child dysfunctional interaction also showed a significant standardized indirect effect on child anxiety through ADHD symptom severity (β=0.22, 95% bias-corrected bootstrap confidence interval [0.08, 0.38], p=0.006). Similarly, difficult child characteristics exerted a significant standardized indirect effect on child anxiety via ADHD symptom severity (β=0.19, 95% bias-corrected bootstrap confidence interval [0.08, 0.32], p=0.004) (Table 4). These

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findings indicate that all three components of parenting stress were indirectly associated with child anxiety through the mediating role of ADHD symptom severity(Table 4).

**Table 4.** Indirect effects (bootstrapped, 5,000 resamples)

| Paths | β | Lower Limit | Upper Limit | P |
|---|---|---|---|---|
| Parental distress → ADHD symptom severity through child anxiety | 0.17 | 0.07 | 0.21 | 0.003 |
| Parent-child dysfunctional interaction → ADHD symptom severity through child anxiety | 0.22 | 0.08 | 0.38 | 0.006 |
| Difficult child → ADHD symptom severity through Child anxiety | 0.19 | 0.08 | 0.32 | 0.004 |

Figure 1 illustrates the final structural equation model with standardized path coefficients. In this model, the three components of parenting stress (parental distress, parent-child dysfunctional interaction, and difficult child characteristics) are shown as exogenous variables on the left, with direct paths leading to the mediator (ADHD symptom severity) in the center. ADHD symptom severity then has a direct path to the endogenous outcome variable (child anxiety) on the right. All paths are statistically significant, and the model accounts for the intercorrelations among the parenting stress components (Figure 2).

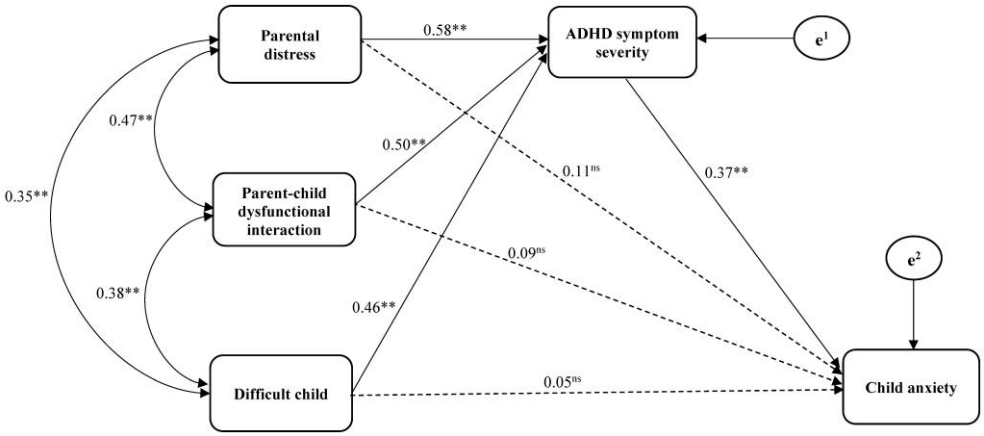



**Figure 2.** Final structural equation model with standardized coefficients

## Discussion

The present study aimed to investigate the complex interplay between parenting stress components, ADHD symptom severity, and childhood anxiety through a structural equation modeling. The findings indicated that the three components of parenting stress—parental distress, parent–child dysfunctional interaction, and difficult child characteristics—were significantly associated with higher levels of ADHD symptom severity, which in turn was associated with greater child anxiety.

These results suggest an indirect association between parenting stress components and child anxiety, with ADHD symptom severity functioning as a mediator. Importantly, due to the cross-sectional nature of the data, causal interpretations cannot be drawn. The observed relationships are likely bidirectional; severe ADHD symptoms may also contribute to heightened parenting stress, creating a potential reciprocal cycle within the family system.

Moreover, there was a significant association between all the three dimensions of parenting stress and ADHD symptom severity. This pattern is consistent with previous research demonstrating that elevated parental stress is related to greater


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behavioral and attentional difficulties in children with ADHD (Evans et al., 2020; Johnston & Mash, 2001). The current study extends the literature by simultaneously examining the unique contributions of the three parenting stress components within a single structural model. Parental distress, parent–child dysfunctional interaction, and difficult child characteristics each showed substantial associations with symptom severity, highlighting the multifaceted nature of parenting stress in families with ADHD children

The results also confirmed a robust and significant association between ADHD symptom severity and childhood anxiety. This finding aligns with existing evidence indicating that greater functional impairment stemming from ADHD symptoms increases the risk of internalizing problems, including anxiety (Becker & Fogleman, 2020; Zayed et al., 2025). Children with more severe inattentive and hyperactive-impulsive symptoms often experience repeated academic failure, social rejection, and negative feedback, which may contribute to heightened emotional distress and anxiety symptoms.

The most notable finding of this study was the significant indirect associations between all three parenting stress components and child anxiety through ADHD symptom severity. Specifically, bootstrapping analyses confirmed indirect effects for parental distress, parent–child dysfunctional interaction, and difficult child characteristics. Although these mediation effects reached statistical significance, they should be interpreted with caution given the moderate bivariate correlations observed in the correlational analyses and the sample size of 210 participants. This mediation pattern suggests that parenting stress may act as a distal factor that is associated with child anxiety largely by intensifying the core symptoms of ADHD. These results are broadly consistent with family systems and ecological models that emphasize the dynamic interplay between parental emotional functioning and child psychological adjustment (Bunford et al., 2015; Graziano & Garcia, 2016).

With respect to the parent–child dysfunctional interaction component, the findings underscore the interaction's particular relevance to the emotional security of children with ADHD. When parent-child relationships are characterized by conflict and reduced positive reinforcement, children may develop greater anxiety, a pattern supported by previous studies on relational stress in ADHD families (Koyuncu et al., 2018; Phillips et al., 2025). This highlights the importance of interaction quality as a potential intervention target.

This study had several limitations. First, the cross-sectional design precluded any conclusions regarding temporal precedence or causality. Second, reliance on a single informant (mothers) raises the possibility of common method bias, although Harman's single-factor test indicated that this was not a substantial concern. Third, the use of convenience sampling limited to mothers in one urban area (Karaj, Iran), which significantly restricted the generalizability of the findings to other populations, including fathers, rural families, or different cultural contexts. Fourth, several important potential confounding variables such as child age, child sex, medication status, family's socioeconomic status, and parental psychopathology were not controlled in the structural model. These uncontrolled factors could have influenced both the predictor and outcome variables and should be carefully addressed in future research.

Despite these limitations, the study had notable strengths; they included the use of well-validated instruments, the application of rigorous SEM procedures with bootstrapping, and the examination of distinct parenting stress components in a clinical Iranian sample. Future studies should employ longitudinal designs, multi-informant data collection (mothers, fathers, and teachers), and include relevant covariates to provide stronger evidence regarding the directionality and mechanisms of these associations.

In summary, the present findings contribute to a growing body of literature emphasizing the importance of family processes in understanding comorbid anxiety in children with ADHD. They suggest that parenting stress is indirectly associated

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with child anxiety via ADHD symptom severity, supporting the value of systemic, family-oriented approaches in clinical practice.

## Conclusion

The components of parenting stress were indirectly associated with childhood anxiety in children with ADHD through their association with ADHD symptom severity. These findings highlight the interconnectedness of family environment and child symptomatology, although causal directionality cannot be inferred due to the cross-sectional design. From a clinical perspective, the results suggest the potential value of family-based interventions that target parenting stress reduction—such as parental stress management programs and parent-child interaction training—to help alleviate ADHD symptoms and associated anxiety. Such recommendations, however, should be considered tentative pending replication with stronger methodological designs. Ultimately, supporting parental well-being within a systemic framework may contribute to improved psychological outcomes for children with ADHD, though further longitudinal and multi-informant research is needed to confirm and extend these associations.

## Acknowledgements

The authors would like to express their sincere gratitude to all the mothers who participated in this study for their time and valuable contributions. They would also like to thank the staff and administrators of the governmental comprehensive health centers and private child psychology clinics in Karaj for their cooperation and support during data collection.

## Conflicts of Interest

The authors declared no conflicts of interest.

## Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

## Ethical considerations

The study was reviewed and approved by the Ethics Committee of Islamic Azad University, Ahvaz Branch (Approval Code: IR.IAU.AHVAZ.REC.1403.267). Then, written informed consent was obtained from all the participating mothers after a complete explanation of the study objectives, procedures, voluntary nature of participation, right to withdraw at any time without any consequences, and assurance of data confidentiality and anonymity.

## Code of Ethics

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## Authors' contributions

S.R.F. conceptualized the study, designed the research methodology, conducted the statistical analyses (including SEM), interpreted the results, and drafted the initial manuscript; Z.D.B. contributed to the literature review, data collection, and revision of the manuscript; S.S. participated in data collection, assisted with the literature search, and contributed to the editing and finalization of the manuscript. All the three authors read and approved the final version of the manuscript for submission.

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