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ADHD, Anxiety, and Emotion Regulation in Children: Unraveling Mechanisms Through SEM Study

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Abstract

Background: This study aimed to examine the mediating role of emotion regulation strategies in the relationship between attention-deficit/hyperactivity disorder (ADHD) symptoms and anxiety symptoms in children.

Methods: This applied research employed a descriptive, cross-sectional design for data collection and analysis. The statistical population included all elementary school students in Neyshabur, Iran, in 2024 (N > 35,000). A sample of 450 participants was selected via clustered random sampling with stratified randomization by gender and grade. Measurement tools included the Spence Children's Anxiety Scale (SCAS), the Swanson, Nolan, and Pelham (SNAP-IV) ADHD Rating Scale, and the Emotion Regulation Questionnaire (ERQ), all culturally adapted for the Iranian population. Structural equation modeling (SEM) was used to analyze relationships.

Results: The path coefficient for the relationship between ADHD symptoms and anxiety symptoms was positive and significant ($\beta = 0.45$, $p < 0.01$). The path coefficient between ADHD symptoms and emotion regulation was negative and significant ($\beta = -0.38$, $p<0.01$), indicating an inverse relationship. Emotion regulation showed a negative, significant correlation with anxiety symptoms ($\beta = -0.32$, $p < 0.01$). The indirect effect of ADHD symptoms on anxiety symptoms through emotion regulation was significant ($\beta = 0.12$, $p < 0.01$), confirming mediation. SEM fit indices (CFI = 0.92, TLI = 0.90, RMSEA = 0.06) indicated good model fit.

Conclusions: Emotion regulation strategies significantly mediate the relationship between ADHD symptoms and anxiety symptoms in children. Enhancing emotion regulation can reduce both ADHD and anxiety symptoms, improving emotional adjustment.

Key Words: Anxiety Symptoms, Attention Deficit Disorder with Hyperactivity, Child, Emotion Regulation Strategies.

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1- INTRODUCTION

Attention-Deficit/Hyperactivity Disorder (ADHD) is one of the most prevalent neurodevelopmental disorders, affecting approximately 5% of children globally and 6.4 million youth in the United States (1, 2). Characterized by persistent inattention and/or hyperactivity-impulsivity, ADHD impairs functioning in academic, social, and occupational domains (3). Children with ADHD face increased risks of academic impairment, social difficulties, peer rejection, and physical health issues such as obesity and asthma (4-6). The annual societal economic burden of ADHD in youth is estimated at $124.5 billion, highlighting the need for research to inform early identification and tailored interventions (7).

Based on the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), ADHD symptoms typically manifest before age 12 (3). Grounded in Gross's emotion regulation model (8), children with ADHD exhibit deficits in emotion regulation processes (appraisal, modulation, and expression). Studies suggest that emotion regulation strategies may mediate the relationship between ADHD and anxiety symptoms, though this is understudied in Iranian populations (9). Neuropsychological evidence indicates deficits in negative emotion regulation (e.g., anger, fear) linked to impaired fronto-parietal circuitry, which may exacerbate anxiety (10, 11).

Anxiety symptoms are highly prevalent among children with ADHD, with 65% experiencing concurrent anxiety symptoms (14). Longitudinal data suggest anxiety may mediate the link between ADHD and suicidal behaviors (12). Approximately two-thirds of children with ADHD have at least one comorbid psychiatric condition, influencing the ADHD-anxiety relationship (13). Neuroimaging studies show a 25% reduction in amygdala volume and disrupted neural connectivity in these children, contributing to emotion dysregulation (10).

2- MATERIALS AND METHODS

2-1. Participants

The statistical population consisted of all elementary school students in Neyshabur, Iran, in 2024 (N > 35,000). A sample of 450 participants (52% male, 48% female; grades 1–6) was selected using clustered random sampling with stratified randomization by gender and grade to ensure representativeness. Participants were aged 6–12 years, with informed consent obtained from parents/guardians.

2-2. Measurements

2-2-1. Spence Children's Anxiety Scale (SCAS)

The SCAS, developed by Spence (1998), is a 39-item questionnaire (38 multiple-choice, 1 open-ended) assessing anxiety symptoms across six subscales: Separation Anxiety, Social Phobia, Generalized Anxiety, Panic Attacks/Agoraphobia, Obsessive-Compulsive Symptoms, and Physical Injury Fears. Responses use a 4-point Likert scale (0 = Never, 3 = Always; total score: 0–114). The Persian version was validated for Iranian children, with Cronbach's alpha of 0.89 (full scale) and 0.52–0.76 (subscales) (Sadeghi et al., 2015).

2-2-2. Swanson, Nolan, and Pelham ADHD Rating Scale (SNAP-IV)

Developed in 1980, this 18-item parent-report scale assesses ADHD symptoms (inattention, hyperactivity-impulsivity) using a 3-point Likert scale. The Persian version, validated by Sadrasadat et al. (2007), showed adequate content, face, and criterion validity, with Cronbach's alpha > 0.7.

2-2-3.Emotion Regulation Questionnaire (ERQ)

The 10-item ERQ (Gross & John, 2003) measures emotion regulation via two subscales: Cognitive Reappraisal (6–42) and Expressive Suppression (4–28). Responses use a 7-point Likert scale (1 = Strongly Disagree, 7 = Strongly Agree; total score: 10–70). The Persian version, standardized by Ghasempour et al. (2012), showed reliability coefficients of 0.48–0.68 (Cognitive Reappraisal) and 0.42–0.63 (Expressive Suppression).

2-3. Procedure

Data was collected in 2024 via questionnaires distributed to parents/guardians of participating students. Schools were selected via cluster sampling, and stratified randomization ensured balanced representation by gender and grade. Ethical approval was obtained (IR.IAU.NEYSHABUR.REC.1404.002), and informed consent was obtained.

2-4. Data Analysis

Structural equation modeling (SEM) was conducted using AMOS software to test the mediation model. Control variables included age, gender, socioeconomic status (SES measured via parental education and income), and comorbid conditions (e.g., depression reported by parents). Normality was assessed using Kolmogorov-Smirnov tests and Mardia's coefficient. Model fit was evaluated using CFI, TLI, and RMSEA.

3- RESULTS

3-1. Descriptive Statistics

Table 1 presents the descriptive statistics of scores for research variables including attention-deficit/hyperactivity symptoms, emotion regulation, and anxiety problems. These statistics include skewness and kurtosis indices as well as mean scores and standard deviations. In terms of attention-deficit/hyperactivity symptoms, the mean score for inattention was 24.34, for hyperactivity it was 25.82, and the overall mean score for ADHD symptoms was 50.16. For emotion regulation, the mean score for cognitive reappraisal was 16.14, for suppression it was 10.15, and the total emotion regulation score averaged 26.29. Regarding anxiety problems, mean scores across dimensions were as follows: agoraphobia (20.03), separation anxiety (22.07), physical injury fears (18.65), social phobia (21.66), obsessive-compulsive symptoms (19.76), and generalized anxiety (19.46), with the total anxiety problems score averaging 121.64. Notably, all variables demonstrated skewness and kurtosis values between +2 and -2, confirming normal distribution at $p<0.05$.

Table-1. Descriptive statistics of research variables.

Variable	Subscale	Mean	SD	Skewness	Kurtosis
ADHD Symptoms	**Inattention**	24.34	4.689	0.435	-0.544
	Hyperactivity	25.82	4.694	0.649	-0.691
	Combined	50.16	8.299	0.998	-0.687
Emotion Regulation	**Cognitive Reappraisal**	16.14	4.940	0.545	0.621
	Expressive Suppression	10.15	4.943	-0.434	0.410
	Total	26.29	8.988	0.118	0.482
Anxiety Symptoms	**Separation Anxiety**	22.07	3.819	1.272	-0.557
	Social Phobia	21.66	3.848	0.400	-0.839
	Generalized Anxiety	19.46	5.035	-0.400	-0.440
	Panic Attacks/Agoraphobia	20.03	3.056	0.421	-0.105
	Obsessive-Compulsive Symptoms	19.76	3.937	0.138	-0.453
	Physical Injury Fears	18.65	3.271	1.212	-0.596
	Total	121.64	18.389	0.455	-0.459

Table 2 displays Kolmogorov-Smirnov test results assessing the normality of variable distributions in the model. Results indicate significance levels for all variables exceeded 0.05, supporting univariate normality. Mardia's multivariate kurtosis coefficient was 2.645, falling within the ±3 range, thus confirming multivariate normality.

Table-2. Kolmogorov-Smirnov test for normality.

Variable	Kolmogorov-Smirnov	Significance	Mardia's Statistic
ADHD Symptoms	0.107	0.461	2.645
Emotion Regulation	0.139	0.177	0.132
Anxiety Symptoms	0.141	0.132	0.132

3-2. SEM Results

Figure 1 displays unstandardized path coefficients for the mediation model, showing the relationships between ADHD symptoms, emotion regulation, and anxiety symptoms. Paths include ADHD symptoms to emotion regulation (b= -0.65, p<0.01), ADHD symptoms to anxiety symptoms (b=0.78, p < 0.01), and emotion regulation to anxiety symptoms (b = -0.49, p < 0.01).

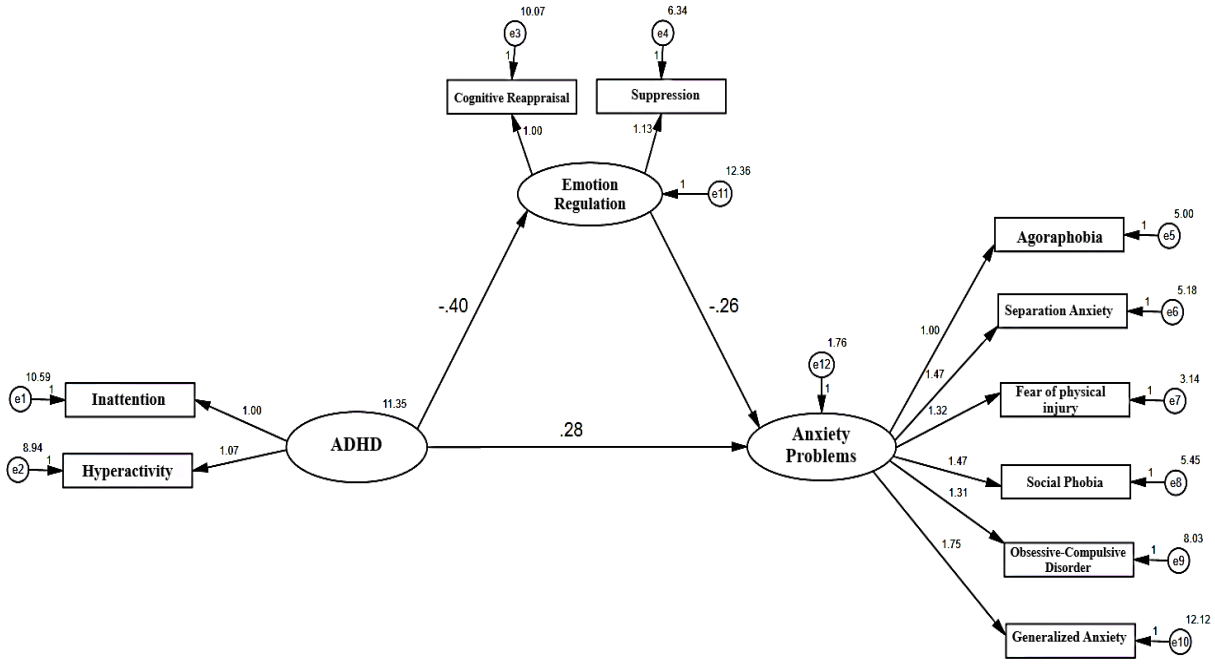

Figure-1: Unstandardized coefficients of mediation model caption.

Figure 2 displays standardized path coefficients for the mediation model, illustrating the mediating role of emotion regulation (β=0.12, p<0.01) in the relationship between ADHD symptoms (β= 0.45, p < 0.01) and anxiety symptoms (β= -0.32, p < 0.01). Model fit indices: CFI= 0.92, TLI = 0.90, RMSEA = 0.06.

The SEM analysis confirmed a significant indirect effect of ADHD symptoms on anxiety symptoms through emotion regulation (β= 0.12, p < 0.01). Model fit indices (CFI = 0.92, TLI = 0.90, RMSEA= 0.06) indicated good fit.

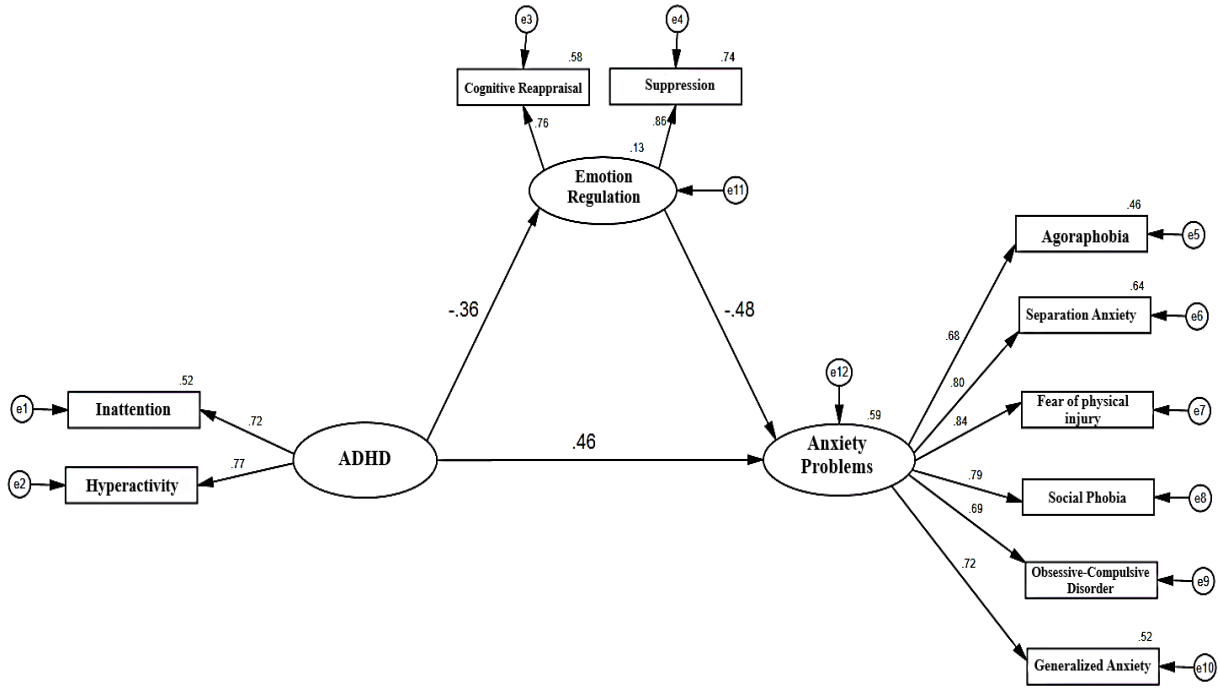

Figure-2: Standardized coefficients of mediation model caption.

4- DISCUSSION

4-1. Interpretation of Findings

The study confirmed that emotion regulation strategies mediate the relationship between ADHD symptoms and anxiety symptoms in children. The negative association between ADHD symptoms and emotion regulation ($\beta = -0.38$, $p < 0.01$) suggests that higher ADHD severity impairs emotion regulation capacity, consistent with prior research (9, 11). The significant indirect effect ($\beta = 0.12$, $p < 0.01$) highlights emotion regulation as a key mechanism linking ADHD and anxiety, supporting Gross's model (8).

4-2. Clinical Implications

Interventions targeting emotion regulation (e.g., cognitive reappraisal, mindfulness) could reduce both ADHD and anxiety symptoms. Programs like mindfulness-based cognitive therapy or parent training in emotion coaching may enhance emotional adjustment in children with ADHD. These findings underscore the need for integrated treatment approaches addressing both ADHD and comorbid anxiety.

4-3. Limitations

The cross-sectional design limits causal inferences, as longitudinal data are needed to establish directionality. The reliance on parent-reported measures may introduce bias, and self-reports from children could provide additional insights. The study controlled for age, gender, SES, and comorbid conditions, but other unmeasured confounders (e.g., parenting style) may influence results.

4-4. Future Directions

Future research should employ longitudinal designs to explore causal pathways. Including child self-reports and multi-informant data could enhance validity. Investigating specific emotion regulation strategies (e.g., reappraisal vs. suppression) in diverse cultural contexts may further clarify their role in ADHD-anxiety comorbidity.

5- CONCLUSION

The present study revealed significant relationships between ADHD symptoms, anxiety problems, and emotion regulation in children from Neyshabur. ADHD symptoms, including inattention and impulsivity, were associated with increased anxiety, likely due to executive dysfunction and repeated failures that heighten stress and emotional dysregulation.

Furthermore, a significant link was found between ADHD symptoms and emotion regulation difficulties. Children with ADHD tend to rely on maladaptive strategies such as avoidance and impulsivity, which intensify negative emotions and worsen ADHD-related behaviors.

A bidirectional relationship was also observed between anxiety and emotion regulation. Anxiety impairs the use of effective emotion regulation strategies, while poor regulation strategies further contribute to anxiety. However, teaching adaptive strategies can improve neurocognitive functioning and reduce anxiety symptoms.

Importantly, emotion regulation was identified as a mediating factor between ADHD symptoms and anxiety. It acts as a neurocognitive-emotional bridge, where deficits in executive functioning contribute to emotional dysregulation and perpetuate a cycle of stress and anxiety. Interventions focused on enhancing emotion regulation, such as Cognitive Behavioral Therapy (CBT) and mindfulness-based approaches, not only reduce ADHD symptoms but also help disrupt this anxiety cycle, leading to improved psychological outcomes in children.

6- ACKNOWLEDGEMENTS

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7- FUNDING

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8- ETHICAL CONSIDERATIONS

Informed consent was obtained from all participants' parents/guardians. The study was approved by the Ethics Committee of Islamic Azad University, Neyshabur Branch (IR.IAU.NEYSHABUR.REC.1404.002).

9- CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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