

Prediction of Anxiety in Adolescent Girls Based on Self-Awareness and Metacognitive Beliefs: Using a Multilayer Perceptron Model

Maryam Mombeini¹ , Belgheis Beit Mashal^{2*} 

¹ Department of Psychology, Ahv.C., Islamic Azad University, Ahvaz, Iran

² Department of Psychology, So.C., Islamic Azad University, Susangerd, Iran

*Corresponding Author: Belgheis Beit Mashal, Ph.D., Department of Psychology, So.C., Islamic Azad University, Susangerd, Iran. Tel: +986136742325, Email: mashabms52@gmail.com

Received February 14, 2025; Accepted April 29, 2025; Online Published June 20, 2025

Abstract

Background: Anxiety disorders are highly prevalent among adolescents, particularly girls. These disorders can significantly impair academic performance, social relationships, and overall quality of life, with long-term consequences into adulthood.

Objectives: The research aimed to predict anxiety in adolescent girls using a multilayer perceptron model based on self-awareness and metacognitive beliefs.

Methods: In this correlational study, the statistical population consisted of adolescent girls aged 16-18 enrolled in secondary schools in Ahvaz during the academic year 2022-2023. A total of 215 individuals were selected using multi-stage cluster sampling. Data were collected using the Beck Anxiety Inventory (BAI), the Five Facet Mindfulness Questionnaire (FFMQ), and the Metacognitions Questionnaire (MCQ-30) to assess anxiety, self-awareness, and metacognitive beliefs, respectively. The data were analyzed using Pearson's correlation coefficient, simultaneous regression, and a multilayer perceptron model, performed with SPSS version 27 and MATLAB version 2019.

Results: The results revealed a significant negative correlation between self-awareness and anxiety in adolescent girls ($r = -0.60$). Furthermore, metacognitive beliefs also showed a significant negative correlation with anxiety in adolescent girls ($r = -0.53$). Additionally, a significant combined predictive effect was found for self-awareness and metacognitive beliefs on anxiety in adolescent girls ($P < 0.001$). The results of the multilayer perceptron model indicated that self-awareness had the strongest predictive power in relation to anxiety in adolescent girls.

Conclusion: Higher self-awareness and stronger metacognitive beliefs correlate with lower anxiety levels in adolescent girls. Interventions aimed at improving these cognitive factors, such as mindfulness and cognitive restructuring, could effectively reduce anxiety. Integrating these strategies into clinical and educational settings can empower adolescent girls with crucial coping mechanisms. By fostering self-awareness and healthier metacognitive beliefs, we can equip them to manage anxiety, improve their overall mental well-being, and enhance their academic and social functioning.

Keywords: Anxiety, Self-awareness, Metacognitive Beliefs, Adolescence

1. Background

Adolescence, a critical period of development marked by significant physical and psychological changes, presents unique challenges, particularly for girls.^{1,2} Anxiety disorders, including generalized anxiety disorder, social anxiety disorder, and panic disorder, are among the most prevalent mental health issues experienced by adolescents.^{3,4} Anxiety, defined as a complex emotion involving affective, sensory, and cognitive components, manifests as apprehensive expectations and persistent fear.⁵ Elevated anxiety levels can lead to excessive worry and avoidance behaviors aimed at reducing negative emotions.⁴ Severe anxiety can impair executive functions, negatively affecting learning and academic performance.⁶ Therefore, understanding the factors contributing to

anxiety in adolescent girls is crucial for developing effective interventions.

Adolescence, a period marked by significant physical and psychological transformations, including puberty and identity formation, plays a crucial role in an individual's developmental trajectory. Given its profound impact on future well-being, mitigating anxiety in adolescents is of paramount importance.⁷ Self-awareness, a key factor influencing adolescent anxiety, can be cultivated through various methods, including mindfulness exercises, reflective practices, and emotional regulation strategies.⁸ By enhancing self-awareness, adolescents can better recognize and understand their emotional triggers, identify maladaptive thought patterns, and develop healthier coping mechanisms. This improved understanding

allows them to manage anxiety by proactively addressing its root causes and responding to stressors in a more adaptive manner. This process fosters metacognitive awareness – the ability to observe one's own thought processes.^{9,10} Self-awareness, denoting a state of conscious awareness encompassing all internal and external experiences in the present moment, aids in managing anxiety by increasing present moment focus.¹¹

Building upon the foundation of self-awareness, metacognitive beliefs also play a significant role in anxiety regulation.¹² Metacognition, simply put, is "thinking about thinking." It involves our awareness and understanding of our own thought processes, enabling us to monitor and control them.^{13,14} Specifically, metacognition involves understanding how to use information to achieve goals, judging the effectiveness of our cognitive strategies, and evaluating our progress during and after completing tasks.^{15,16} In the context of anxiety, healthy metacognitive beliefs allow individuals to recognize and challenge anxious thoughts, preventing them from escalating into overwhelming feelings. For example, rather than believing every anxious thought is a fact, an individual with strong metacognitive skills might recognize the thought as a product of anxiety and choose to engage in a coping strategy.

Studies have demonstrated that the persistence of anxiety disorders in childhood and adolescence leads to clinically significant impairment or deterioration in social, academic, occupational, and other key areas of individual functioning.^{3,17} Consequently, in addition to the substantial harm inflicted upon children in terms of development, personality, and other aspects, this disorder also exerts adverse effects on parent-child relationships and those with siblings.¹⁸ Furthermore, research investigating the link between childhood anxiety disorders and adult disorders has revealed that a history of childhood anxiety is predictive of depressive disorders in adulthood.¹⁹

Given that adolescents constitute a substantial proportion of the population in developing countries, recognizing the psychological and emotional issues of this significant demographic and striving to identify and disseminate effective and sustainable treatment methods is of paramount importance. Anxiety disorders, if treated promptly, can improve, preventing detrimental effects on the child's psychological and personality development, as well as their social and academic functioning; however, untreated disorders increase the likelihood of developing other forms of anxiety disorders in adulthood. Therefore, it is crucial that anxious adolescents are identified as early as possible and provided with access to effective therapeutic interventions. While self-awareness and metacognitive beliefs have each been studied in relation to anxiety, there is a need for research examining their combined influence, particularly in adolescent girls.

Understanding how these factors interact could lead to more targeted and effective interventions, addressing the complex interplay of cognition and emotion in anxiety management. This research aims to bridge this gap by investigating the simultaneous impact of self-awareness and metacognitive beliefs on anxiety levels in this vulnerable population.

2. Objectives

The present research sought to predict anxiety levels in adolescent girls by examining the predictive capacity of self-awareness and metacognitive beliefs within a multilayer perceptron framework.

3. Methods

The study utilized a descriptive, correlational design focusing on female high school students in Ahvaz during the 2022-2023 academic year. A multi-stage cluster sampling method randomly selected one educational district out of the four in Ahvaz. Three high schools within the chosen district were randomly selected for the study. Following coordination with school principals and teachers, three classes were randomly selected from these schools (totaling nine classes), and 230 questionnaires were distributed among all students in the selected classes. Ultimately, after excluding 15 incomplete questionnaires, data from 215 participants who fully completed the questionnaires were analyzed, representing a response rate of 93.48%. A power analysis, conducted using G*Power software, indicated that a sample size of 215 was sufficient to detect significant correlations with adequate statistical power. Inclusion criteria for the study were: age range between 16 and 18 years, enrollment in secondary school, absence of diagnosed physical or mental illness, and informed consent for participation. The absence of diagnosed physical or mental illness was verified through self-report during the initial survey, where students were asked to indicate any existing diagnoses. This was supplemented by school records, which were consulted for any documented medical or psychological conditions. The exclusion criterion was the submission of an incomplete questionnaire. To ensure adherence to ethical considerations, participants were assured that the data obtained from the research would be used confidentially and anonymously. To protect personal privacy and prevent any intrusion into individuals' private lives, the results would be reported at an aggregate level.

3.1. Instruments

3.1.1. Beck Anxiety Inventory (BAI)

Anxiety symptoms experienced during the past week were measured using the Beck Anxiety Inventory (BAI),²⁰ a 21-item self-report measure. Each item is rated on a four-point Likert scale, ranging from "not at all" (0)

to "severely" (3), resulting in a total possible score between 0 and 63. Higher total scores indicate greater severity of anxiety symptoms. Typically, scores of 0-21 indicate minimal anxiety, 22-35 indicate mild anxiety, 36-50 indicate moderate anxiety, and 51-63 indicate severe anxiety. Previous research has established the BAI's robust internal consistency, with a Cronbach's alpha of 0.82 reported by Hossein Kaviani and Mousavi.²¹ The present study found a Cronbach's alpha of 0.89 for the BAI, indicating excellent internal consistency within this sample.

3.1.2. Five Facet Mindfulness Questionnaire (FFMQ)

Participants' self-awareness was measured using the Five Facet Mindfulness Questionnaire (FFMQ).²² The FFMQ is a 15-item self-report measure that assesses the capacity for non-judgmental attention to present-moment experiences, contrasting with states such as rumination, worry, and automatic pilot. Each item is rated on a six-point Likert scale, resulting in a possible score range of 15 to 90, with higher scores reflecting greater mindfulness. Previous studies have reported robust internal consistency for the FFMQ, with a Cronbach's alpha of 0.86.²³ In the present study, the Cronbach's alpha for the FFMQ was 0.88.

3.1.3. Metacognitions Questionnaire (MCQ-30)

The Metacognitions Questionnaire (MCQ-30) is a 30-item self-report instrument that assesses individuals' metacognitive beliefs relevant to the metacognitive model of psychological disorder.²⁴ Each item is rated on a four-point Likert scale, ranging from 1 ("do not agree") to 4 ("agree very much"), resulting in a total possible score range of 30 to 120. The MCQ-30 comprises five subscales: Positive Beliefs about Worry, Negative Beliefs about Uncontrollability and Danger of Worry, Cognitive Confidence, Need to Control Thoughts, and Cognitive Self-Consciousness. Reported Cronbach's alpha coefficients for these subscales were 0.77, 0.74, 0.84, 0.86, and 0.79, respectively.²⁵

3.2. Statistical Analysis

Data analysis for the present study was conducted using SPSS version 27 and MATLAB version 2019. First, descriptive statistics, including means and standard deviations, were calculated to summarize the data. Then, at the inferential level, Pearson's correlation coefficient

was used to examine the relationships between variables. Finally, multiple regression analysis and a multilayer perceptron (MLP) model were employed to examine the predictive power of self-awareness and metacognitive beliefs on anxiety in adolescents. Specifically, the MLP model was designed with two hidden layers. The first hidden layer consisted of 5 neurons, and the second hidden layer consisted of 1 neuron. The activation function used in both hidden layers was the hyperbolic tangent sigmoid function (tansig), and the output layer utilized a linear activation function (purelin). This architecture was chosen after a series of iterative tests to determine the optimal configuration for predicting anxiety based on self-awareness and metacognitive beliefs.

4. Results

Descriptive findings indicated that 64 (29.8%) participants were aged 16, 81 (37.7%) were aged 17, and 70 (32.6%) were aged 18. In terms of academic field, 59 (27.4%) were enrolled in mathematics and physics, 75 (34.9%) were pursuing humanities, and 81 (37.7%) were studying natural sciences.

Table 1 presents the means, standard deviations, and Pearson correlation coefficients for the study variables. The mean scores for anxiety, self-awareness, and metacognitive beliefs were 23.19 ± 5.30 , 50.11 ± 10.58 , and 69.27 ± 15.46 , respectively. A strong and statistically significant negative correlation was found between anxiety and self-awareness ($r = -0.60$, $P < 0.01$), indicating that as self-awareness increases, anxiety tends to decrease. Similarly, a strong and statistically significant negative correlation was observed between anxiety and metacognitive beliefs ($r = -0.53$, $P < 0.01$), suggesting that higher levels of metacognitive beliefs are associated with lower levels of anxiety.

To investigate the relative contribution of self-awareness and metacognitive beliefs in predicting anxiety among adolescent girls, a simultaneous multiple regression analysis was conducted. Self-awareness and metacognitive beliefs were entered as predictor variables, and adolescent girls' anxiety served as the criterion variable. As presented in Table 2, the results revealed a significant multiple correlation between the predictor variables and anxiety ($R = 0.59$, $P < 0.01$). Furthermore, both self-awareness ($\beta = -0.25$, $P < 0.01$) and metacognitive beliefs ($\beta = -0.37$, $P < 0.01$) were significantly and negatively associated with anxiety.

Table 1. Means, Standard Deviations (SD), and Pearson Correlation Coefficients for the Study Variables

Variables	Mean	SD	Pearson correlation coefficients
Anxiety	23.19	5.30	1
Self-awareness	50.11	10.58	-0.60**
Metacognitive beliefs	69.27	15.46	-0.53**

Table 2. Results of Simultaneous Multiple Regression Analysis

Predictor variable	R	R ²	F	P	B	β	P
Self-awareness					-0.01	-0.25	0.001
Metacognitive beliefs	0.59	0.34	37.16	0.001	-0.29	-0.37	0.001
Constant					32.01	-	0.001

Furthermore, an artificial neural network (ANN) was designed and developed using MATLAB software to investigate the predictive power of self-awareness and metacognitive beliefs on anxiety in adolescent girls. The dataset was partitioned into three subsets: 70% for training, 15% for validation, and 15% for testing. Two input variables (self-awareness and metacognitive beliefs) and one output variable (anxiety) were structured in a matrix format within an Excel file and provided as input to the network. The optimal network architecture, which demonstrated the best performance, was determined to be a multilayer perceptron with two hidden layers: the first layer containing 5 neurons and the second layer containing 1 neuron (Figure 1). To mitigate overfitting and determine the optimal training duration, an early

stopping criterion was implemented. During training, validation data were utilized exclusively for performance monitoring, without influencing weight adjustments. Training epochs continued until the improvement in validation error became negligible. The optimal number of epochs was selected based on the minimum sum of squared errors observed in the validation set. The training was terminated at epoch 13, as the validation error remained constant for 7 consecutive epochs, fulfilling the early stopping criterion. Notably, Figure 2 depicts the training process and demonstrates: 1) a low final mean squared error, 2) a similar error trajectory for the testing and validation sets, and 3) the absence of overfitting until epoch 7, where the best validation performance was achieved.

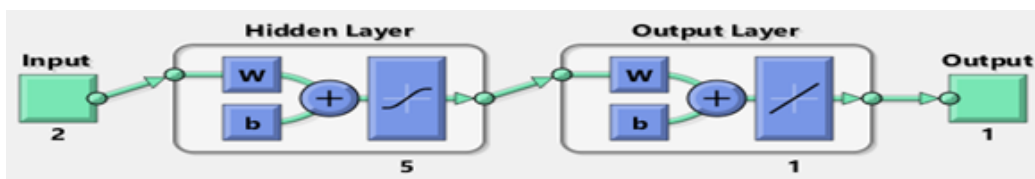


Figure 1. Schematic Representation of the Multilayer Perceptron Model with the Highest Accuracy.

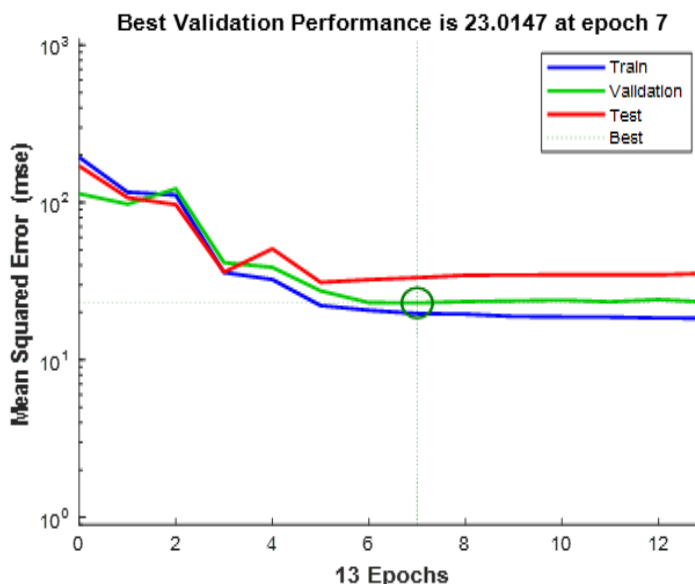


Figure 2. Network Performance Diagram.

Figure 3 shows the analysis results on the importance of self-awareness and metacognitive beliefs in adolescents. The study found that self-awareness and metacognitive

beliefs were the main predictors of anxiety in adolescent girls, with self-awareness being slightly more significant than metacognitive beliefs.

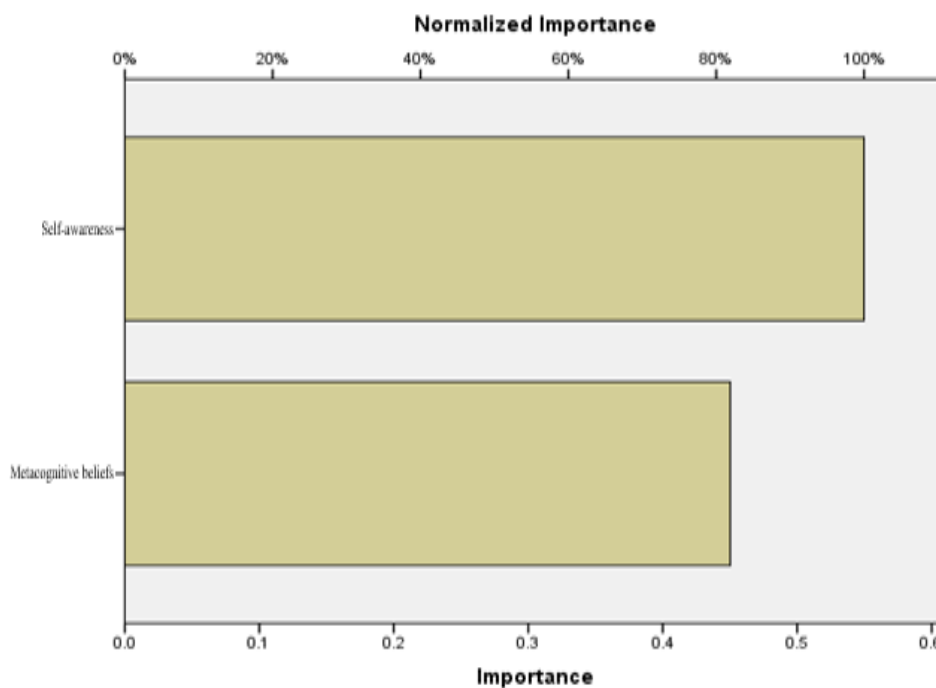


Figure 3. Relative Importance of Predictor Variables.

5. Discussion

The present research investigated the predictive capacity of a multilayer perceptron model for anxiety in adolescent girls, incorporating self-awareness and metacognitive beliefs as predictor variables. The findings of the study indicated that self-awareness and metacognitive beliefs had a significant correlation with anxiety in adolescent girls. Self-awareness and metacognitive beliefs accounted for 34% of the variance in adolescent anxiety. Furthermore, results from the multilayer perceptron model showed that self-awareness had the strongest relationship with anxiety in adolescent girls. The first finding of this research revealed a significant negative relationship between adolescents' self-awareness and anxiety in adolescent girls in Ahvaz. This finding is consistent with the results of studies by Çalışkan et al.,⁷ Narimani et al.,²⁶ and Brown et al.²⁷ Accordingly, it can be stated that the relationship between self-awareness and adolescent anxiety can have both direct and indirect effects. On the one hand, self-awareness can help adolescents better cope with their anxiety. With self-awareness, adolescents are able to address and understand their feelings and thoughts about anxiety purposefully and without judgment. Awareness of physical and behavioral symptoms of anxiety, such as accelerated heartbeat, sweating, anger, or isolation, may help adolescents gain a more complete and accurate understanding of their own states.²⁸

Self-awareness techniques, such as deep breathing exercises and mindfulness practices, can empower adolescents to proactively and effectively manage their anxiety. Beyond anxiety management, self-awareness can play a preventative role. By cultivating self-awareness,

adolescents can identify and subsequently modify negative and destructive thought and behavioral patterns, fostering healthier and more constructive coping mechanisms.⁷ Moreover, self-awareness practices may enhance cognitive abilities such as focus, creativity, and problem-solving, indirectly contributing to a reduction in anxiety across various life domains. These findings align with previous research. Çalışkan et al.⁷ demonstrated a significant positive correlation between mindfulness and student anxiety, while Brown et al.²⁷ reported a significant negative association between anxiety and mindfulness.

A deeper understanding of how self-awareness reduces anxiety reveals that it operates through several interconnected mechanisms. Firstly, increased self-awareness allows adolescents to recognize the early signs of anxiety, such as physical tension or racing thoughts, before they escalate. This early recognition enables them to implement coping strategies proactively. Secondly, self-awareness facilitates the development of emotional regulation skills. By understanding their emotional triggers and patterns, adolescents can learn to modulate their emotional responses, reducing the intensity and duration of anxiety episodes. Thirdly, self-awareness promotes cognitive restructuring, enabling adolescents to challenge and modify maladaptive thought patterns that contribute to anxiety. For example, they can learn to identify and replace catastrophic thinking with more realistic and balanced perspectives. Finally, self-awareness fosters a greater sense of internal control and agency. By recognizing their ability to manage their thoughts and emotions, adolescents experience a

reduction in perceived helplessness, which in turn diminishes anxiety. This enhanced sense of control empowers them to navigate stressful situations with greater confidence and resilience.

The present study demonstrated a significant negative correlation between metacognitive beliefs and anxiety levels in adolescent girls, aligning with previous research findings.^{29,30} Metacognitive beliefs, broadly defined, encompass an individual's thoughts and assumptions about their own cognitive processes, themselves, others, and the world. These beliefs can exert a significant influence on an individual's emotional and behavioral states, ranging from positive to negative. Adolescent anxiety, a prevalent issue, can arise from various factors, including hormonal fluctuations, peer pressure, concerns about the future, and physical changes.

Specifically, metacognitive beliefs influence anxiety through several mechanisms. For instance, negative metacognitive beliefs about worry, such as believing that worrying is uncontrollable and dangerous, can lead to increased anxiety as individuals engage in excessive and unproductive worry. Similarly, positive metacognitive beliefs about worry, such as believing that worrying helps in problem-solving, can paradoxically increase anxiety by perpetuating worry cycles. Furthermore, beliefs about cognitive confidence, or lack thereof, can affect how individuals respond to anxiety-provoking thoughts. If an adolescent believes they cannot control their thoughts or that their thoughts are inherently dangerous, they are more likely to experience heightened anxiety. These beliefs, related to acceptance, self-worth, social relationships, perceived control over life events, and self-efficacy,³⁰ can lead to negative appraisals such as a perceived lack of acceptance or a sense of helplessness, contributing to heightened anxiety levels.

It is important to note that metacognitive beliefs are shaped by a multitude of factors, including past experiences, peer pressure, familial influences, and societal expectations. Consequently, the treatment of adolescent anxiety often involves addressing and modifying maladaptive metacognitive beliefs. Cognitive-behavioral therapies, among other interventions, have demonstrated efficacy in this regard.²⁹

Adolescence is a period of profound physiological and psychological transformation. While a certain degree of anxiety is a normal and even adaptive response during this developmental stage, some adolescents may experience significant and intense emotional fluctuations, potentially leading to panic attacks or anxiety disorders.¹⁹ The manifestation and intensity of anxiety vary considerably among individuals. In certain contexts, anxiety can serve as a motivating force, driving academic achievement, enhancing athletic performance, and increasing vigilance.³¹ However, when anxiety interferes with academic performance, social relationships, or other critical areas

of functioning, it necessitates careful consideration and appropriate interventions.²⁷ Anxiety in adolescents can have detrimental consequences, including poor academic performance, social isolation, and an increased risk of substance abuse.³ Therefore, a comprehensive investigation of the factors influencing anxiety in this population is crucial.

One limitation of the present study is the potential influence of participants' personality traits and individual-familial differences, as well as variations in their levels of attitude and awareness regarding the studied variables, on the research findings. Given that data collection in this study relied on self-report questionnaires, the collected data may be subject to bias. Furthermore, since the sample group in this study consisted of adolescents, this necessitates caution when generalizing the results to other age groups. Additionally, potential confounding variables, such as socioeconomic status, access to mental health resources, and exposure to specific stressors, could have influenced the results.

However, this study also possesses several strengths. It utilized well-validated and reliable measures (BAI, FFMQ, MCQ-30) to assess anxiety, self-awareness, and metacognitive beliefs, ensuring the accuracy of the data. The use of a multilayer perceptron model allowed for a sophisticated analysis of the predictive relationships between variables, providing a more nuanced understanding of their interaction. The relatively large sample size of 215 participants enhances the statistical power of the study. Furthermore, the focus on a specific age range (16-18) in adolescent girls provides valuable insights into this vulnerable population.

6. Conclusion

This study revealed significant negative correlations between self-awareness and metacognitive beliefs and anxiety in adolescent girls, indicating that higher levels of these cognitive factors are associated with lower anxiety. The interconnectedness of these factors was further highlighted by their multiple relationships with anxiety, suggesting they interact to influence anxiety levels. Notably, the multilayer perceptron model identified self-awareness as having the strongest association with anxiety, emphasizing its crucial role in mitigation. These findings suggest that interventions fostering self-awareness, such as mindfulness or emotional regulation training, and those targeting metacognitive beliefs, like cognitive restructuring, hold promise for reducing anxiety in this population. Future research should explore combined interventions, underlying mechanisms, long-term effects, and comparisons with other predictive models. Specifically, future studies could investigate the efficacy of integrated interventions that simultaneously target self-awareness and metacognitive beliefs, such as a combined mindfulness and cognitive restructuring program.

Furthermore, research should delve into the specific neural pathways and cognitive processes mediating the relationship between these factors and anxiety, utilizing neuroimaging and experimental designs.

Research Highlights

What Is Already Known?

Anxiety disorders are prevalent in adolescent girls and negatively impact their well-being. Self-awareness and metacognitive beliefs have been theoretically linked to anxiety.

What Does This Study Add?

This study provides empirical evidence of the negative correlations between self-awareness, metacognitive beliefs, and anxiety in adolescent girls. It further demonstrates the predictive power of these cognitive factors, particularly self-awareness, in explaining variance in anxiety levels.

Author Contributions

MM: Study concept and design, acquisition of data, analysis and interpretation of data, and statistical analysis. BBM: Administrative, technical, and material support, study supervision. MM and BBM: Critical revision of the manuscript for important intellectual content.

Conflict of Interest Disclosures

All authors declared that they have no conflict of interest.

Ethical Approval

The study was approved by the Ethics Committee of Islamic Azad University, Ahvaz branch (code: IR.IAU.AHVAZ.REC.1403.224).

Funding/Support

This research received no external funding.

References

- Cheng TW, Mills KL, Pfeifer JH. Revisiting adolescence as a sensitive period for sociocultural processing. *Neurosci Biobehav Rev.* 2024;164:105820. doi:10.1016/j.neubiorev.2024.105820
- Sisk LM, Gee DG. Stress and adolescence: vulnerability and opportunity during a sensitive window of development. *Curr Opin Psychol.* 2022;44:286-292. doi:10.1016/j.copsyc.2021.10.005
- Rapee RM, Creswell C, Kendall PC, Pine DS, Waters AM. Anxiety disorders in children and adolescents: A summary and overview of the literature. *Behav Res Ther.* 2023;168:104376. doi:10.1016/j.brat.2023.104376
- Teesson M, Newton NC, Slade T, Chapman C, Birrell L, Mewton L, et al. Combined prevention for substance use, depression, and anxiety in adolescence: a cluster-randomised controlled trial of a digital online intervention. *Lancet Digit Health.* 2020;2(2):e74-84. doi:10.1016/s2589-7500(19)30213-4
- Asban F, Bayat F. Effectiveness of Acceptance and Commitment Therapy on Meta-Worry, Irritable Mood, and Emotional Experience Processing in Anxious Female Nurses. *Hosp Pract Res.* 2024;9(1):409-15. doi:10.30491/hpr.2024.458798.1427
- Philippot A, Dubois V, Lambrechts K, Grogna D, Robert A, Jonckheer U, et al. Impact of physical exercise on depression and anxiety in adolescent inpatients: A randomized controlled trial. *J Affect Disord.* 2022;301:145-53. doi:10.1016/j.jad.2022.01.011
- Çalışkan FC, Akmehtmet-Şekerler S, Kızıltepe Z, Aydın Sünbül Z, Börkan B. The mediating role of depression and anxiety on the relationship between mindfulness and college adjustment. *Br J Guid Couns.* 2024;52(4):613-27. doi:10.1080/03069885.2023.2220896
- Bluth K, Eisenlohr-Moul TA. Response to a mindful self-compassion intervention in teens: A within-person association of mindfulness, self-compassion, and emotional well-being outcomes. *J Adolesc.* 2017;57:108-18. doi:10.1016/j.adolescence.2017.04.001
- Creswell JD. Mindfulness Interventions. *Annu Rev Psychol.* 2017;68:491-516. doi:10.1146/annurev-psych-042716-051139
- Badnava S, Pakdaman M, Moshki M, Sahebdel H. Consequences of Spiritual Health Literacy in Students: A Qualitative Study. *Hosp Pract Res.* 2023;8(4):375-80. doi:10.30491/hpr.2024.468634.1440
- Lim HL. Mindfulness and motivation in self-transformation: Thich Nhat Hanh's teachings on the interbeing. *Manusya.* 2022;24(3):334-54. doi:10.1163/26659077-24030004
- Capobianco L, Faija C, Husain Z, Wells A. Metacognitive beliefs and their relationship with anxiety and depression in physical illnesses: A systematic review. *PLoS One.* 2020;15(9):e0238457. doi:10.1371/journal.pone.0238457
- Cortese A. Metacognitive resources for adaptive learning. *Neurosci Res.* 2022;178:10-9. doi:10.1016/j.neures.2021.09.003
- Jia X, Li W, Cao L. The role of metacognitive components in creative thinking. *Front Psychol.* 2019;10:2404. doi:10.3389/fpsyg.2019.02404
- Shekh-Abed A. Metacognitive self-knowledge and cognitive skills in project-based learning of high school electronics students. *Eur J Eng Educ.* 2025;50(1):214-29. doi:10.1080/03043797.2024.2374479
- Rivers ML, Dunlosky J, Persky AM. Measuring Metacognitive Knowledge, Monitoring, and Control in the Pharmacy Classroom and Experiential Settings. *Am J Pharm Educ.* 2020;84(5):7730. doi:10.5688/ajpe7730
- Salek Ebrahimi L, Mousavi SE, Gharraee B, Mohammadi Bytamar J, Saberi Isfeedvajani M. Cognitive errors and psychological resilience in patients with social anxiety and obsessive-compulsive disorder: A cross-sectional study. *Hosp Pract Res.* 2019;4(1):25-30. doi:10.15171/hpr.2019.04
- Allen JL, Sandberg S, Chhoa CY, Fearn T, Rapee RM. Parent-dependent stressors and the onset of anxiety disorders in children: links with parental psychopathology. *Eur Child Adolesc Psychiatry.* 2018;27:221-31. doi:10.1007/s00787-017-1038-3
- Yaffe Y. A narrative review of the relationship between parenting and anxiety disorders in children and adolescents. *Int J Adolesc Youth.* 2021;26(1):449-59. doi:10.1080/02673843.2021.1980067
- Beck AT, Epstein N, Brown G, Steer RA. An inventory for measuring clinical anxiety: psychometric properties. *J Consult Clin Psychol.* 1988;56(6):893-7. doi:10.1037/0022-006X.56.6.893
- Hosseini Kaviani H, Mousavi AS. Psychometric properties of the Persian version of Beck Anxiety Inventory (BAI). *Tehran Univ Med J.* 2008;66(2):136-40.
- Baer RA, Smith GT, Allen KB. Assessment of mindfulness by self-report: The Kentucky Inventory of Mindfulness Skills. *Assessment.* 2004;11(3):191-206. doi:10.1177/1073191104268029

23. Heydarinasab L. An investigation of the validity and reliability of psychometric characteristics of five facet mindfulness questionnaire in Iranian non-clinical samples. *Int J Behav Sci.* 2013;7(3):229-237.
24. Wells A, Cartwright-Hatton S. A short form of the metacognitions questionnaire: properties of the MCQ-30. *Behav Res Ther.* 2004;42(4):385-396. doi:10.1016/S0005-7967(03)00147-5
25. Shirinzadeh Dastgiri S, Goudarzi MA, Rahimi C, Naziri GH. Study of factor structure, validity and reliability of metacognition questionnaire-30. *J Psychol.* 2009;12:445-61.
26. Narimani M, Jani S, Rezaei R. The role of alexithymia and mindfulness in predicting depression and anxiety in women with cancer. *Shenakht J Psychol Psychiatry.* 2020;7(1):78-89. doi:10.52547/shenakht.7.1.78
27. Brown MM, Arigo D, Wolever RQ, Smoski MJ, Hall MH, Brantley JG, et al. Do gender, anxiety, or sleep quality predict mindfulness-based stress reduction outcomes?. *J Health Psychol.* 2021;26(13):2656-62. doi:10.1177/1359105320931186
28. Zeqeibi Ghannad S, Allipour S, Shehni Yailagh M, Hajiyakhchali A. Evaluation of the causal relationship model of mindfulness with anxiety and depression by mediating unintentional mind wandering. *J Fundam Mental Health.* 2019;21(4):241-8. doi:10.22038/jfmh.2019.14657
29. Eslamiyan S, Noury Ghasemabadi R, Hasani J. The mediating role of maladaptive cognitive emotion regulation strategies in the relationship between metacognitive beliefs and test anxiety. *Appl Psychol.* 2022;16(4):111-32. doi:10.52547/apsy.2022.225586.1251
30. Moeenizadeh M, Molavi E, Asghari Ebrahimabad MJ. Investigating the relationship between metacognitive beliefs and cognitive-attentional syndrome with social anxiety of female students: the mediating role of uncertainty intolerance and ambiguity tolerance. *Res Clin Psychol Couns.* 2021;10(2):5-24. doi:10.22067/tpccp.2021.36722.0
31. Strack J, Lopes P, Esteves F, Fernandez-Berrocá P. Must We Suffer to Succeed? *Journal of Individual Differences.* 2017;38(2):113-24. doi:10.1027/1614-0001/a000228