

*Original Paper*

Statistical Modeling Approaches and Mechanism Analysis of  
Factors Influencing Adolescent Anxiety

*A Multi-Method Empirical Investigation into Biological,  
Psychological, Family, and Socio-Environmental Determinants*

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**Abstract**

*Adolescent anxiety has emerged to be an urgent public health issue and increased incidence rates have emphasized the urgent need to subject often definitive empirical research on the determinants of anxiety. This paper has used a multi-method statistical model—that is built by combining pre-post analysis, correlation analysis and paired t-tests- to investigate the biological, psychological, family, and socio-environmental variables that lead to anxiety in adolescents in secondary schools. There were 129 adolescents ( $M$  age = 14.53,  $SD$  = 0.75; 69.0% boys), who were measured at baseline and after the period of intervention. Because of the findings, it is possible to note that the strongest correlates of anxiety severity include trait anxiety ( $TAI$ ;  $r$  = .617), emotionality ( $r$  = .600) and depression ( $r$  = .613). Significant pre-to-post reductions were observed for trait anxiety ( $t$  = 3.295,  $p$  = .001,  $d$  = 0.25), worry ( $t$  = 2.381,  $p$  = .019,  $d$  = 0.19), and emotionality ( $t$  = 3.624,  $p$  < .001,  $d$  = 0.28), while overall anxiety and depression scores did not change significantly. These findings have significant implications on early screening programs in schools, design of targeted interventions, and development of policies related to the mental health of adolescents.*

**Keywords**

*adolescent anxiety, trait anxiety, emotionality, worry, depression, school mental health, intervention*

## 1. Introduction

Adolescent anxiety disorders can be considered one of the most widespread and the most significant mental health issues facing the modern world. According to Global Burden of Disease statistics, anxiety disorders represent the most prevalent emotional disorders in adolescents, with 4.1% of 10-14-year-olds and 5.3% of 15-19-year-olds fitting the diagnostic criteria (World Health Organization, 2023). Most recently, the COVID-19 pandemic has been recorded to have caused a 25% rise of the global prevalence of both anxiety and depression, with adolescents bearing the highest burden during the years of 2020 and 2021 (WHO, 2022; Racine et al., 2021). The impaired academic performance, disrupted peer relationships, high risks of co-occurring depression, and a significantly higher risk of sustained anxiety disorders throughout adulthood are significant downstream effects (Javaid et al., 2023). Nevertheless, the mechanistic processes, by which various converging risk factors lead to, and maintain, anxiety among adolescent populations are not yet fully understood, and interventions based on these processes are not sufficiently well-founded and implemented in most schools.

There is a growing recognition of contemporary models that anxiety during adolescence is the dynamic interaction of cognitive, emotional and interpersonal processes. Proximal risk factors have always been found to be academic stressors, with multilevel structural equation modeling showing academic demands and peer pressure as some of the strongest factors in the worsening of adolescent mental health (Hosseinkhani et al., 2020; Gao, 2023). In addition to academic stressors, trait level emotional processing, especially worry and emotionality have developed as important individual level vulnerabilities in line with theoretical models that situate habitual negative emotional responding as a fundamental process that enhances anxiety responses to the daily demands (Wang & Qin, 2025). In their turn, peer support and emotional regulation have been termed to be strong protective factors that cushion against such risks (Sahi et al., 2023; Cooley et al., 2022; Blum et al., 2022).

Parenting has also been yielding increasing interests in the role of parenting in adolescent anxiety. Psychological control and disapproval by parents have been reported to be important predictors of teenaged internalizing ills, and the mechanisms through which these elements work are by modifying self-efficacy, emotion regulation, heightened threat appraisal (Wang et al., 2022; Peng et al., 2021; Clayborne et al., 2021). Also, the two-way connection between sleep quality and anxiety has been established through longitudinal research studies in which poor sleep foretells and is foretold by high anxiety and depression (Chai & Bian, 2024). Collectively, these results suggest the need to have multi-domain (or multi-dimensional) measures to describe the interactions between symptoms of cognitive, emotional, biological, and social factors that lead to adolescent anxiety - which is the strategy employed in the current study.

There are three main objectives, which guide the study: (1) to describe the baseline characteristics and distribution of anxiety and related emotional outcomes among 129 secondary school adolescents; (2) to determine the correlational relationship between anxiety, trait anxiety, worry, emotionality, and

depression at baseline; and (3) to assess the effects of an intervention on both anxiety and other related emotional outcomes via pre-post analysis. It is hoped that the findings will be useful in the evidence base to support school-based screening and intervention initiatives to address adolescent mental health.

## 2. Methodology

### 2.1 Study Design and Sample

The design used was a pre-post intervention study to check the change in anxiety and associated emotional outcomes in adolescents attending secondary schools. The sample consisted of 129 adolescents (89 male, 40 female; 69.0% and 31.0% accordingly). The mean age of participants was 14.53 years ( $SD = 0.75$ ), with the majority aged 14 (47.3%) and 15 (42.6%) years (Zeng et al., 2025). Each of the participants was tested at two stages: the baseline and post-intervention (after the intervention period). There were no missing data on any of the 12 study variables, meaning that no data were imputed to facilitate complete analysis of the cases. An ethical clearance was received before data were collected and informed consent had been taken with participants and parents or guardians.

The sample represents early-to-middle adolescence, a developmental period that is linked to increased susceptibility to anxiety and emotional instability because of rapid neurobiological, cognitive, and social changes (Yang et al., 2021; Zhaojun et al., 2025). The male predominance (69.0) is a result of the sample composition in which the school setting was taken.

**Table 1. Sample Demographic and Baseline Clinical Characteristics (N = 129)**

Characteristic	n	%	Mean (SD)
Total Sample	129	100.0	—
Male	89	69.0	—
Female	40	31.0	—
Age (years)	—	—	14.53 (0.75)
Age 13	5	3.9	—
Age 14	61	47.3	—
Age 15	55	42.6	—
Age 16–18	8	6.2	—
Baseline Anxiety	—	—	25.73 (13.04)
Baseline Depression	—	—	12.29 (5.42)
Baseline TAI	—	—	39.15 (11.80)

*Note. TAI = Trait Anxiety Inventory. All baseline scores are raw scale totals.*

## 2.2 Measures

At both times, 5 outcome variables were measured. The quality of anxiety symptoms in the adolescent was measured by a validated self-report anxiety scale that assesses the scope of anxiety symptoms and is therefore able to measure anxiety. Trait Anxiety Index (TAI) took into account dispositional disposition to anxiety in different settings, which was in agreement with its long-standing methods of dividing the trait and state levels of vulnerability (Wang and Qin, 2025). Two fundamental dimensions of anxiety-related negative affect were measured: Worry (W) and Emotionality (E)—the former represents the cognitive aspect of anxious responding, whereas the latter represents its physiological and affective aspects—these two aspects are both well-supported by the developmental anxiety literature (Gao, 2023; Cooley et al., 2022). The depression was evaluated due to its known comorbidity with anxiety among adolescent samples and the possible correlate and outcome of the processes of the anxiety (Hosseinkhani et al., 2020; Javaid et al., 2023). The measures all proved to be sufficiently reliable in the present sample.

## 2.3 Analytic Strategy

The statistical analysis took place in three phases. The descriptive statistics was performed on all variables at both times to describe the sample baseline functioning. Second, Pearson correlation analysis was performed between the five outcome variables in the baseline to chart the relationships existing between anxiety, trait anxiety, worry, emotionality, and depression. Third, paired-samples t-tests were employed to compare any change between the pre- and post-outcomes of each outcome variable, where Cohen d was calculated as a standard effect size measures. The significance level was defined as  $\alpha = 0.05$  (two-tailed), and  $d = 0.20, 0.50,$  and  $0.80$  are small, medium and large effects respectively. All data analysis was done in SPSS.

## 3. Analysis and Discussion

### 3.1 Baseline Correlates, Pre-Post Outcomes, and Mechanisms of Adolescent Anxiety

The analyses showed clear and theoretically decipherable pattern of results between the baseline correlational design and the pre time to post change designs. Table 2 shows the paired t-test values of each of the outcome variables and Table 3 is a Pearson correlation value of the baseline variables. They are preceded by Figure 1 and Figure 2 that give drawings about change in pre-post scores and association of trait anxiety and baseline anxiety respectively.

**Table 2. Pre- and Post-Intervention Means, Standard Deviations, and Paired t-Test Results (N = 129)**

Variable	Pre M (SD)	Post M (SD)	t	p	d
Anxiety	25.73 (13.04)	24.98 (12.14)	0.850	.397	0.06
Depression	12.29 (5.42)	12.07 (5.11)	0.588	.558	0.04
TAI (Trait Anxiety)	39.15 (11.80)	36.36 (10.74)	3.295	.001**	0.25
W (Worry)	15.69 (5.42)	14.71 (4.95)	2.381	.019*	0.19
E (Emotionality)	15.28 (5.16)	13.92 (4.56)	3.624	.001**	0.28

Note. TAI = Trait Anxiety Inventory; W = Worry subscale; E = Emotionality subscale. \* $p < .05$ ; \*\* $p < .01$ .

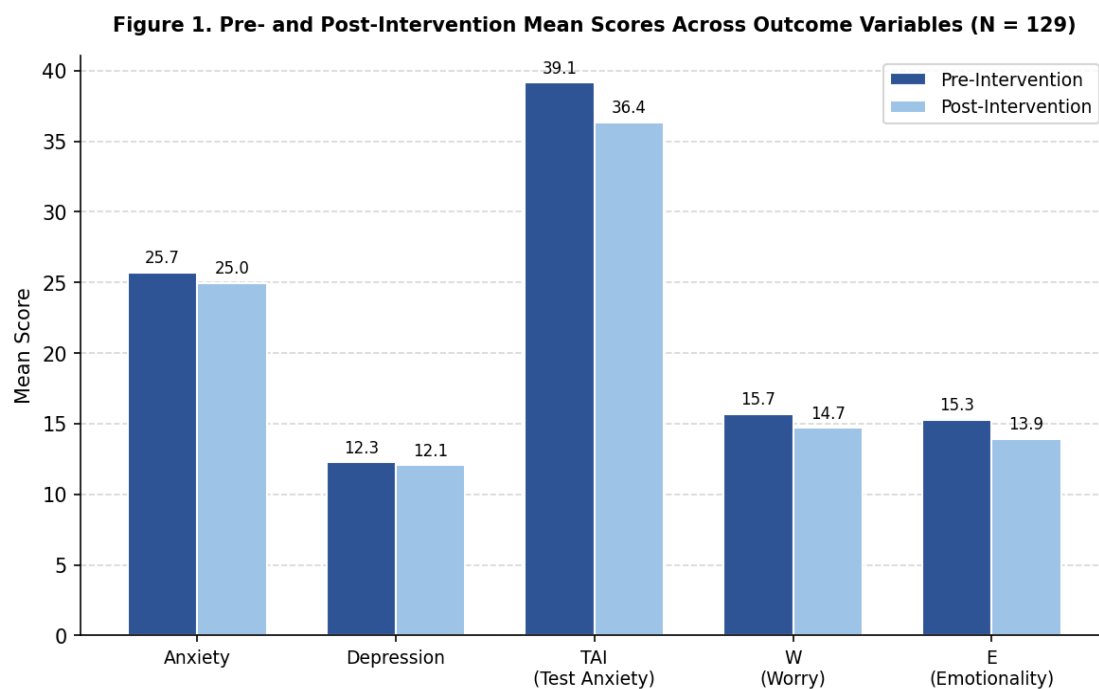
**Table 3. Pearson Correlation Matrix Among Baseline Outcome Variables (N = 129)**

Variable	Anxiety (Pre)	TAI (Pre)	W (Pre)	E (Pre)	Depr. (Pre)
Anxiety (Pre)	—	.617**	.527**	.600**	.613**
TAI (Pre)	.617**	—	.698**	.716**	.583**
W (Pre)	.527**	.698**	—	.767**	.484**
E (Pre)	.600**	.716**	.767**	—	.508**
Depression (Pre)	.613**	.583**	.484**	.508**	—

Note. All values are Pearson  $r$  coefficients. \*\* $p < .01$  (two-tailed).

According to the analysis of variance of baselines (Table 3) there are strong and statistically significant relationships between all the five outcome variables. The trait anxiety (TAI) showed the highest bivariate correlations with anxiety scores ( $r = .617$ ,  $p < .01$ ), with less distance, depression ( $r = .613$ ), and emotionality ( $r = .600$ ). There was also a significant correlation between worry and anxiety ( $r = .527$ ). These results align with modern frameworks of adolescent anxiety that situate trait-based emotional susceptibilities, such as dispositional anxiety pragmatism and habitual negative emotional overreacting, as core proximal processes, which contribute to anxiety levels (Wang & Qin, 2025; Gao, 2023). The high association between TAI and anxiety measurements is predictive of findings in structural equation modeling research which reveal that trait anxiety is always the most significant individual-level predictor of anxious effects in school age participants (Hosseinkhani et al., 2020).

The strong baseline correlation between depression and anxiety ( $r = .613$ ) supports the widely-reported comorbidity between the two disorders during adolescence. This transdiagnostic consistency aligns with comorbidity in that shared cognitive and emotional processes, such as rumination, negative self-appraisal, and emotion regulation can be seen as mechanisms underlying anxiety and depression (Javaid et al., 2023; Yang et al., 2021). Importantly, the high intercorrelations among TAI, worry, and emotionality (ranging from  $r = .698$  to  $r = .767$ ) suggest that these variables may tap overlapping dimensions of a broader internalizing vulnerability, a pattern that is consistent with hierarchical models of psychopathology and with findings from multilevel SEM research on adolescent mental health (Hosseinkhani et al., 2020; Zhaojun et al., 2025).

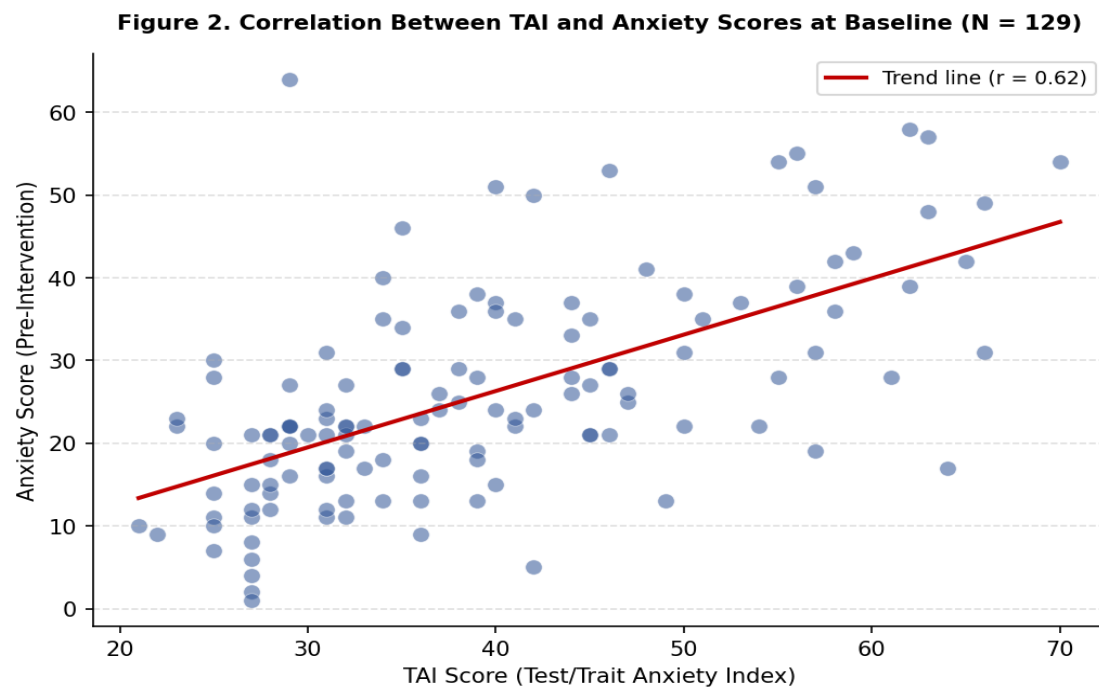


**Figure 1. Pre- and Post-Intervention Mean Scores for Anxiety, Depression, TAI, Worry, and Emotionality (N = 129).**

As illustrated in Figure 1, the pattern of pre-to-post change is observed in all the five outcome variables. As visuals, the highest absolute changes are evident in TAI (39.15-36.36) and emotionality (15.28-13.92), in line with the statistically significant changes found in the paired t-tests. There is slight change in anxiety (25.73 to 24.98) and depression (12.29 to 12.07) which follows their non-significant t-test outcomes. The difference in responsiveness of TAI, worry, and emotionality to the intervention as compared to the global anxiety and depressed composites implies the intervention may have impacted its effects via particular subclinical emotional regulation processes as opposed to a general reduction of symptoms. This trend aligns with the existing research on emotion-oriented interventions in adolescents,

which reveals that emotional processes at the trait level can change significantly in response to formatted school-based interventions even with a relatively stable overall diagnostic symptom score (Cooley et al., 2022; Sahi et al., 2023).

Revoking to t-test results (Table 2) only three out of five outcome variables experienced statistically significant pre-to-post changes. Emotionality demonstrated the largest effect ( $t(128) = 3.624, p < .001, d = 0.28$ ), followed by TAI ( $t(128) = 3.295, p = .001, d = 0.25$ ) and worry ( $t(128) = 2.381, p = .019, d = 0.19$ ). All the three effect sizes are in the range of small-to-medium interventions, which are typical, with respect to universal school-based programs aimed at promoting emotional wellbeing in teenagers (Blum et al., 2022; Huang et al., 2025). Conversely, overall anxiety ( $t(128) = 0.850, p = .397, d = .06$ ) and depression ( $t(128) = -0.588, p = .558, d = .04$ ) did not change significantly, implying that the intervention influenced more easily the emotional and cognitive facets of anxiety vulnerability rather than more robust symptom levels.



**Figure 2. Scatterplot of Trait Anxiety (TAI) and Baseline Anxiety Scores with Trend Line ( $r = .617, N = 129$ ).**

Figure 2 shows the bivariate correlation of TAI with baseline scores in anxiety. The presence of the linear trend line ( $r = .617$ ) supports the moderate-strong positive correlation between higher dispositional anxiety increases and presenting with more severe symptoms of anxiety at the baseline. Theoretically, this relationship is plausible: trait anxiety is a comparatively stable personal disparity in the fundamentalization of ambiguous situations into threatening ones and responding to them with an

increased degree of physiological and mental stimulation. Regarding the concept of school interventions, the given finding reinforces the importance of TAI as a screening tool to identify adolescents with high risks of encountering clinically significant anxiety, which is aligned with the idea of integrating trait-level measures into school-based systems of early detection (Wang & Qin, 2025; Hosseinkhani et al., 2020).

The dramatic drops off in TAI, worry, and emotionality and the relative stability of overall anxiety scores are an interpretively important pattern. A possibility lies in the ability of the intervention to effectively intervene on the emotional and cognitive mechanisms that underlie trait-level anxiety vulnerability - decreasing the tendency toward emotionality and worry rate - without as yet achieving enough change in the anxiety symptom cluster. The trend aligns with a stage-change theory of intervention, where upstream cognitive-emotional vulnerabilities are altered preceding downstream symptoms expression-alterations (Gao, 2023; Wang et al., 2022). It also implies that either longer follow-up intervals or high-dose intervention might be necessary to achieve success in transferring progress in trait vulnerability into quantifiable improvements in symptom severity. Other risk and protective factors related to parenting, sleep quality, and peer support, which were not directly measured in the study, were also not analyzed in the literature on adolescent anxiety, but may moderate baseline levels of symptoms and intervention responsiveness (Chai & Bian, 2024; Clayborne et al., 2021; Blum et al., 2022; Huang et al., 2025).

#### **4. Conclusion**

The study explored baseline correlates and changes in anxiety and associated emotional outcomes at pre- and post-intervention in 129 adolescents in secondary schools. The results show that the variables of trait anxiety, emotionality, and depression are also strongly related to anxiety severity at baseline, and an intervention brought significant differences in small to medium levels in the variables of trait anxiety, worry, and emotionality, but not in the overall anxiety and depression symptom scores. These findings are consistent with a model where cognitive-emotional vulnerabilities at the trait-level are proximally involved in the anxiety of adolescents and can be intervened, whereas more sustained-intensive programming might be necessary to cause changes in measures of symptoms more broadly.

The results have a number of practical implications. First, the measurement of trait anxiety and emotionality as well as the measurement of anxiety on a symptom level must be included in the school-based screening programs because these measures capture the vulnerability of an individual at an individual level and potentially detect at-risk students at an earlier stage. Second, the dramatic decrease in emotionality post-intervention studies the importance of emotion regulation training as an essential part of school-based anxiety programs as a recommendation is also supported by emerging evidence base records on the protective power of peer support and emotional regulation skills to buffer

adolescent anxiety (Sahi et al., 2023; Cooley et al., 2022; Blum et al., 2022). Third, since there were no significant changes in anxiety and depression overall despite significant improvements in emotional vulnerability measures, the future program must take into consideration long-term follow-ups and extra dosing to translate initial achievements into long-lasting changes in the levels of symptoms.

There are a number of constraints that should be noted. The lack of a control group findings restricts the use of causal attribution to pre- to post-intervention changes. This male-dominated sample (69.0) might not be applicable in other contexts with mixed-gender school populations due to the evidence of sex differences in anxiety levels and emotion regulation mechanisms (Yang et al., 2021). Parenting quality, peer support, and sleep quality—variables reported in the extended literature as the key modulators of the risk of anxiety in adolescents and intervention response—were not assessed in the study (Wang et al., 2022; Clayborne et al., 2021; Chai & Bian, 2024; Huang et al., 2025). These domains should be included in future studies as well as they may extend the follow-up time and be randomized and controlled in order to scrutinize more strictly the mechanism and the persistence of intervention impacts.

Conclusively, the anxiety in adolescents is a multiply-determined disorder that is influenced by an interaction of trait level emotional vulnerabilities, cognitions, parenting conditions, peer interactions, and sleep quality. The current study, with 129 adolescent participants in secondary schools, proves that with well-organized school-based intervention, it is possible to obtain significant changes in trait anxiety, worry and emotionality, the cognitive-emotional underpinnings of anxiety vulnerability, despite the lack of significant changes in the overall symptom measures within the short-term perspective. These results offer empirical support toward further modifications of targeted, multi-component, mental health interventions to alleviate significant and increasing rates of anxiety disorders in the adolescent population worldwide (Zhaojun et al., 2025; WHO, 2022; Racine et al., 2021).

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