

The Effectiveness of Emotion Regulation Training on Frustration Tolerance and Executive Functions in Adolescents of Tehran City

Zahra. Etaati¹, Nowzar. Ghorbani², Shahin. Alipanah³, Nazanin. Haghigat Bayan^{4*}, Sara. Rezaei⁵

¹ Department of Industrial and Organizational Psychology, To.C., Islamic Azad University, Tonekabon, Iran

² Department of Clinical Psychology, SR.C., Islamic Azad University, Tehran, Iran

³ Department of Psychology, General Psychology, Allameh Tabatabai University, Tehran, Iran

⁴ Department of Clinical Psychology, Ro.C., Islamic Azad University, Tehran, Iran

⁵ Department of General Psychology, Ayandegan University, Tonekabon, Iran

* Corresponding author email address: nazanin_haghigatbayan@yahoo.com

Article Info

Article type:

Original Research

How to cite this article:

Etaati, Z., Ghorbani, N., Alipanah, S., Haghigat Bayan, N., & Rezaei, S. (2025). The Effectiveness of Emotion Regulation Training on Frustration Tolerance and Executive Functions in Adolescents of Tehran City. *Journal of Adolescent and Youth Psychological Studies*, 6(12), 1-10. <http://dx.doi.org/10.61838/kman.jayps.4727>



© 2025 the authors. Published by KMAN Publication Inc. (KMANPUB), Ontario, Canada. This is an open access article under the terms of the Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) License.

ABSTRACT

Objective: The present study aimed to investigate the effectiveness of emotion regulation training on frustration tolerance and executive functions among adolescents in Tehran City.

Methods and Materials: The research method was quasi-experimental with a pretest-posttest design including a control group. The statistical population comprised all secondary school adolescents in Tehran during 2025, from which 30 participants were selected through convenience sampling and randomly assigned to experimental and control groups. The experimental group participated in ten 90-minute sessions of emotion regulation training, whereas the control group received no intervention. To assess the study variables, the Harrington Frustration Tolerance Questionnaire (2005) and the Barkley Deficits in Executive Functioning Scale (2011) were used.

Findings: Findings indicated that emotion regulation training led to a significant increase in frustration tolerance and improvement in executive functions—including inhibitory control, cognitive flexibility, and self-regulation—in the experimental group ($p < .05$).

Conclusion: These results suggest that emotion regulation training can effectively enhance cognitive and emotional resilience in adolescents by improving self-awareness, emotional management, and flexible thinking skills. Therefore, implementing such training programs in educational and counseling settings is recommended to promote mental health and executive functioning among adolescents.

Keywords: Emotion Regulation Training, Frustration Tolerance, Executive Functions, Adolescents

1. Introduction

Adolescence represents a crucial developmental phase characterized by significant biological, cognitive, and emotional transformations that shape an individual's capacity to manage stress, regulate emotions, and perform complex executive tasks (Ahmed, 2019; Eisenberg, 2010). During this period, heightened emotional reactivity and incomplete maturation of executive brain regions, particularly within the prefrontal cortex, make adolescents especially vulnerable to difficulties in emotion regulation and cognitive control (Barkley & Benton, 2024; Lantrip, 2016). These developmental vulnerabilities often manifest as impulsivity, frustration intolerance, and poor decision-making, which can disrupt academic functioning and social relationships (Giancola, 2008; Perlman, 2014). Understanding the dynamic interplay between emotion regulation and executive functions has therefore become central to developmental and clinical psychology, particularly regarding the design of interventions aimed at fostering emotional resilience and cognitive flexibility in youth (Eisenberg, 2023; Van Meter, 2023).

Emotion regulation (ER) refers to the set of processes through which individuals monitor, evaluate, and modify their emotional experiences to achieve adaptive goals (Eisenberg, 2010). Effective emotion regulation requires both top-down cognitive control and bottom-up emotional awareness, engaging executive processes such as working memory, cognitive flexibility, and inhibitory control (Hong, 2025; Lantrip, 2016). When these processes are underdeveloped, adolescents may resort to maladaptive strategies—such as rumination, suppression, or avoidance—that intensify emotional distress and hinder self-regulation (Keskiner et al., 2024; Mazidi et al., 2025). Research has shown that deficiencies in emotion regulation are closely linked to externalizing problems like aggression and conduct disorder (Frick, 2003; Giancola, 2008) as well as internalizing problems such as anxiety and depression (Cécillon et al., 2024). Conversely, training adolescents in adaptive emotion regulation strategies has been associated with improvements in academic performance, interpersonal competence, and psychological well-being (Eisenberg, 2023; Fombouchet, 2025).

The neurocognitive mechanisms underlying emotion regulation in adolescence have been increasingly studied using neuroimaging and behavioral paradigms (Ahmed, 2019). The prefrontal cortex, anterior cingulate cortex, and amygdala are among the primary neural systems implicated

in emotion regulation, collectively supporting inhibitory control and reappraisal processes (Barkley & Benton, 2024; Eisenberg, 2023). In adolescents, these regions are still developing, resulting in immature executive regulation of affective responses (Seymour, 2025). Such immaturity may explain why adolescents are prone to emotional instability, frustration, and difficulty tolerating delayed gratification (Deveney, 2020; Perlman, 2014). Neurocognitive studies have confirmed that emotion regulation and executive functioning share overlapping neural circuits, particularly within the dorsolateral and ventromedial prefrontal cortices (Ahmed, 2019; Fombouchet, 2025). Therefore, interventions that target emotional regulation skills may simultaneously strengthen executive control functions such as attention shifting, problem-solving, and self-monitoring (Van Meter, 2023).

Executive functions (EFs) are higher-order cognitive processes that enable goal-directed behavior through the coordination of inhibitory control, working memory, and cognitive flexibility (Barkley & Benton, 2024). These skills are foundational for self-regulation, academic achievement, and social adaptation (Lantrip, 2016). During adolescence, deficits in executive function often co-occur with difficulties in emotion regulation, suggesting a reciprocal relationship between cognitive control and emotional processes (Hong, 2025; Van Meter, 2023). For example, adolescents with poor inhibitory control are more likely to respond impulsively to frustration, while those with low cognitive flexibility may struggle to reappraise stressful situations effectively (Cécillon et al., 2024; Giancola, 2008). Several studies have indicated that interventions enhancing emotion regulation also yield improvements in executive function performance, including planning, inhibition, and attentional control (Eisenberg, 2023; Fombouchet, 2025).

Empirical research has shown that frustration is one of the most emotionally charged states in adolescence, serving as a key context for studying emotion regulation and executive control (Deveney, 2020). When adolescents encounter frustrating situations—such as academic failure, peer rejection, or unmet goals—their ability to tolerate frustration becomes a crucial indicator of emotional maturity (Giancola, 2008; Perlman, 2014). Low frustration tolerance is associated with heightened emotional reactivity, impulsivity, and diminished executive functioning (Frick, 2003; Seymour, 2025). Adolescents who fail to regulate frustration often engage in maladaptive behaviors, including aggression, avoidance, or withdrawal, which further impair psychosocial development (Eisenberg, 2010; Rachma &

Hendrawan, 2025). Therefore, emotion regulation training—designed to increase frustration tolerance and strengthen executive functioning—can serve as an effective tool for fostering emotional and cognitive adaptability during this developmental period (Fombouchet, 2025; Northrup, 2025).

Recent intervention-based studies have emphasized the potential of structured emotion regulation programs to enhance adolescents' cognitive flexibility and inhibitory control (Fombouchet, 2025; Northrup, 2025). For instance, virtual reality (VR)-based interventions have demonstrated promising results in improving executive function and emotion regulation among at-risk adolescents by providing immersive emotional simulations that promote adaptive coping and emotional awareness (Northrup, 2025). Similarly, dialectical behavior therapy (DBT) and mindfulness-based emotion regulation training have been found to significantly improve executive functions such as working memory and attentional shifting, particularly in emotionally dysregulated populations (Ghosh, 2024). These findings underscore the neuroplasticity of executive systems and their responsiveness to interventions targeting emotional regulation (Ahmed, 2019; Eisenberg, 2023).

The theoretical integration of emotion regulation and executive function is further supported by models emphasizing their mutual reinforcement. For example, the dual-systems model proposes that emotion regulation and executive control develop through interacting neural networks—where emotional arousal can either facilitate or impair executive performance depending on context and strategy use (Eisenberg, 2023; Van Meter, 2023). Similarly, Barkley's unified model of executive functioning identifies emotion regulation as a core executive domain essential for planning, self-motivation, and behavioral inhibition (Barkley & Benton, 2024). This conceptualization positions emotion regulation not merely as an emotional skill but as an executive process integrated into higher cognitive control systems. Adolescents who acquire these regulatory capacities are better equipped to manage stress, pursue long-term goals, and maintain adaptive social interactions (Cécillon et al., 2024; Mazidi et al., 2025).

The role of metacognitive awareness in emotion regulation has also gained attention in recent years. Metacognitive beliefs—such as perceptions of emotional controllability and awareness of one's emotional processes—mediate the relationship between emotion regulation and executive functioning (Cécillon et al., 2024). Adolescents with higher metacognitive insight are more

likely to use adaptive regulation strategies, including cognitive reappraisal and problem-solving, which in turn enhance executive efficiency (Mazidi et al., 2025). Conversely, maladaptive metacognitive beliefs (e.g., "emotions are uncontrollable") can perpetuate cycles of frustration and cognitive rigidity (Seymour, 2025). Therefore, emotion regulation training that incorporates metacognitive components can simultaneously strengthen both emotional and executive domains (Fombouchet, 2025; Mazidi et al., 2025).

Cultural and contextual factors also influence the development and application of emotion regulation and executive functioning. For instance, differences in parenting styles, educational environments, and social expectations can modulate the expression of emotional control and cognitive discipline in adolescents (Ahmed, 2019; Keskiner et al., 2024). Cross-cultural findings suggest that adolescents in collectivist societies may emphasize social harmony and suppression of negative emotions, whereas those in individualist cultures may prioritize emotional expression and cognitive autonomy (Cécillon et al., 2024; Fombouchet, 2025). These sociocultural dynamics highlight the need for culturally sensitive intervention programs that address the unique emotional and cognitive challenges faced by adolescents across diverse settings (Ghosh, 2024; Northrup, 2025).

In sum, adolescence is a pivotal stage for the integration of emotion regulation and executive functions—two interdependent constructs that jointly shape adaptive behavior, cognitive flexibility, and psychological well-being (Eisenberg, 2023; Van Meter, 2023). Deficits in these domains can undermine academic performance, interpersonal functioning, and resilience, while targeted interventions that enhance emotional regulation skills hold promise for promoting both emotional stability and executive competence (Fombouchet, 2025; Seymour, 2025). Building upon the theoretical and empirical foundations established by prior research, the present study aims to examine the effectiveness of emotion regulation training on improving frustration tolerance and executive functions among adolescents.

2. Methods and Materials

2.1. Study Design and Participants

This study was conducted using a quasi-experimental method with a pretest–posttest and two-month follow-up design, including a control group. The statistical population

consisted of all adolescents in the city of Tehran who had visited counseling and psychological service centers in 2024. The sample size was determined using Cohen's table with a 95% confidence level, an effect size of 0.30, and a statistical power of 0.83, estimating 12 participants per group. To enhance the generalizability of the results and compensate for possible sample attrition, the sample size for each group was increased to 15 participants. In total, 30 adolescents were selected through convenience sampling and then randomly assigned (via lottery method) to experimental (15 participants) and control (15 participants) groups.

Inclusion criteria consisted of providing informed consent to participate in the training sessions, absence of severe psychological disorders such as depression or bipolar disorder, having at least middle school education, not using psychiatric medications, not receiving psychological services during the past three months, and no prior participation in emotion regulation training programs. Exclusion criteria included absence from more than two sessions, development of new psychological disorders, concurrent participation in other training workshops, or withdrawal from the study.

Ethical principles were fully observed during the study, including obtaining informed consent, providing clear explanations about the research objectives and procedures, ensuring confidentiality and privacy of personal information, and granting participants the right to withdraw from the study at any time. Data were collected using a demographic information form (age, gender, education, and family status) and self-report questionnaires measuring frustration tolerance and executive functions at three stages: pretest (before training), posttest (after completion of training), and two-month follow-up (two months after completion of training).

Sampling took place in May 2025, and the emotion regulation training sessions were conducted from June to the end of September 2025. The follow-up period continued until late October of the same year. The interventions were carried out in group and face-to-face formats by a trained clinical psychologist on Sundays and Tuesdays from 17:00 to 20:00 at the "Roshd va Aramesh" Counseling and Psychological Services Center in Tehran. None of the participants withdrew from the study, and all sessions were conducted free of charge. Participants were also informed that they could discontinue participation at any time and access alternative psychological services. After completion

of the study, the control group was also provided with free emotion regulation training sessions.

2.2. Measures

Frustration Feeling Questionnaire: This instrument was developed by Gilbert and Allan (1998) based on social rank theory. Extensive research using this questionnaire has confirmed its association with hopelessness, depression, suicide, and post-traumatic stress disorder. In most studies, the Frustration Feeling Questionnaire is used alongside the Defeat Feeling Questionnaire. The instrument consists of 16 items and includes two subscales: internal frustration ($\alpha = .89$) and external frustration ($\alpha = .90$). In Iran, the reliability coefficient for the total sample was reported as $\alpha = .93$ in 2015. In the present study, Cronbach's alpha reliability was calculated as $\alpha = .91$.

Wisconsin Card Sorting Test (WCST): This test is a widely recognized instrument for assessing executive functions. Its administration requires several cognitive abilities, including strategic planning, abstract reasoning, cognitive flexibility, goal-directed behavior, organized search, and inhibition of impulsive responses (Zare & Abdollahzadeh, 2014). The test was originally developed by Grant and Berg in 1948, and its reliability was reported as above .86 by Lezak (1995). The Persian software version of this test was designed and validated by Shah-Gholian, Azad-Faleh, Fathi-Ashtiani, and Khodadi (2011), making it applicable for both psychological and clinical research.

2.3. Intervention

The emotion regulation training intervention was conducted over eight 90-minute group sessions designed to enhance adolescents' emotional awareness, cognitive flexibility, and self-regulation. In the first session, participants completed the pretest and were introduced to the concept of emotions, their functions, and the objectives of emotion regulation training. The second session focused on recognizing and recording emotions, emphasizing positive emotions such as joy, interest, and love, and teaching participants how to use these emotions effectively in daily life. The third session addressed awareness of negative emotions—such as anger, sadness, and hatred—highlighting their constructive roles and including imagery and journaling exercises to record major negative emotions. In the fourth session, participants learned to accept positive emotions without judgment, explored the perceptions of parents and peers regarding emotional intensity, and

discussed the consequences of expressing emotions adaptively. The fifth session involved training in the controlled release or redirection of negative emotions, teaching mental inhibition techniques, and the appropriate expression of positive emotions. The sixth session reinforced the integration and cognitive review of positive emotional experiences through practical exercises in real-life situations. The seventh session emphasized reappraisal and appropriate expression of negative emotions, providing opportunities for experiential practice and discussion of maladaptive emotional suppression or overexpression. Finally, the eighth session reviewed all learned skills, consolidated participants' understanding of emotion regulation strategies, and prepared them for the posttest and two-month follow-up assessment.

2.4. Data Analysis

For data analysis, SPSS software version 26 was used. The main statistical method employed for data analysis was two-way repeated measures analysis of variance (ANOVA). Fisher's exact test was used to analyze participants'

demographic data, the Kolmogorov-Smirnov test was used to verify the normality assumption, Mauchly's test was used to assess sphericity, and Levene's test was used to examine the homogeneity of variances. The significance level for all tests was set at $p < .05$.

3. Findings and Results

The mean and standard deviation of age for adolescents in the experimental and control groups were 15.16 ± 1.43 and 15.27 ± 1.52 years, respectively ($P = 0.669$). The results of the independent samples t-test for age and Fisher's exact test for gender, educational level, and family status showed no statistically significant differences between the experimental and control groups in terms of demographic variables ($P > 0.05$).

To analyze and describe the data obtained from the participants, descriptive statistics (mean and standard deviation) for the study variables in the experimental and control groups at the pretest, posttest, and follow-up stages are presented in Table 1.

Table 1

Selected Demographic Characteristics of Participants

Variables	Components	Experimental (n = 15) Frequency (%)	Control (n = 15) Frequency (%)	P-value
Family education level	Diploma	3 (20%)	2 (13.33%)	0.522
	Bachelor's degree	12 (80%)	13 (86.67%)	
School grade	Lower secondary (grades 7–9)	7 (46.7%)	6 (40%)	0.72
	Upper secondary (grades 10–12)	8 (53.3%)	9 (60%)	

As shown in Table 2, the descriptive indices of both groups at the pretest, posttest, and follow-up stages are presented. As the table indicates, the mean scores of the experimental group improved from pretest to follow-up. This improvement in the research variables, reflected by

increases or decreases in the mean scores, demonstrates the effect of emotion regulation training on the studied variables, whereas no significant change occurred in the control group.

Table 2

Descriptive Statistics for Adolescents

Variables	Group	Pretest (Mean \pm SD)	Posttest (Mean \pm SD)	Follow-up (Mean \pm SD)	Minimum	Maximum
Executive Function	Experimental	56.75 ± 3.67	44.40 ± 3.70	44.40 ± 3.70	42	68
	Control	45.80 ± 2.16	46.48 ± 3.38	46.12 ± 3.19	43	70
Frustration Feeling	Experimental	44.56 ± 3.67	40.75 ± 3.70	40.75 ± 3.70	78	97
	Control	45.80 ± 2.16	46.48 ± 3.38	46.12 ± 3.19	84	103

To analyze the data and test the hypotheses related to executive function and frustration feeling, a two-way repeated measures analysis of variance (ANOVA) was conducted. Before performing the repeated measures

ANOVA, its assumptions were examined. The Kolmogorov-Smirnov test indicated that data distributions were normal at a 95% confidence level ($P > 0.05$). The results of Levene's test were greater than 0.05, confirming

the homogeneity of variances between the two groups. Mauchly's test of sphericity indicated that the assumption of sphericity was met for each component: executive function ($\chi^2 = 3.56$, $P = 0.358$) and frustration feeling ($\chi^2 = 16.05$, $P = 0.055$). Therefore, the *sphericity assumed* approach was applied.

To assess the equality of covariance matrices, Box's M test was used. According to the results, the assumption was met for the variables of internalized shame (Box's M = 3.051, F = 1.572, P = 0.514) and frustration feeling (Box's M = 4.179, F = 3.260, P = 0.508). The between-group test results indicated a significant difference between the experimental and control groups in terms of mean internalized shame ($P = 0.008$) and frustration feeling ($P = 0.024$). The within-group (time) test results also revealed significant differences in mean internalized shame ($P < 0.001$) and frustration feeling ($P < 0.001$). In other words, the differences in mean scores of internalized shame and frustration feeling across the three stages—pretest, posttest,

and follow-up—were 67% and 78%, respectively, and both were statistically significant.

Furthermore, as shown in Table 3, the interaction effect of group and time on the variables of executive function and frustration feeling was statistically significant ($P < 0.001$), indicating that the intervention led to an increase in mean scores of executive function and frustration tolerance in the posttest and follow-up stages for the experimental group compared to the control group.

The effect size, representing the proportion of explained variance due to between-group, within-group (time), and interaction effects, was 77% for executive function, meaning that 77% of the changes in executive function scores were explained by these effects. Similarly, the effect size for the frustration tolerance variable was 71%, indicating that 71% of the variance in frustration tolerance scores could be explained by between-group, within-group, and interaction effects.

Table 3

Results of Two-Way Repeated Measures ANOVA for the Effect of the Independent Variable on Executive Function and Frustration Feeling

Variable	Source of Variation	Sum of Squares	df	Mean Square	F	P	Effect Size
Executive Function	Group	205.589	1	205.589	4.688	0.033	0.27
	Time	96.572	2	48.286	24.416	< 0.001	0.67
	Group × Time	120.001	2	60.000	30.888	< 0.001	0.71
Frustration Feeling	Group	98.822	1	98.822	15.703	0.024	0.20
	Time	92.822	2	46.411	36.997	< 0.001	0.79
	Group × Time	132.022	2	66.011	18.206	< 0.001	0.65

4. Discussion and Conclusion

The present study investigated the effectiveness of emotion regulation training on frustration tolerance and executive functions among adolescents in Tehran City. The results revealed that the participants who received emotion regulation training demonstrated a significant improvement in frustration tolerance and executive functioning—including inhibitory control, cognitive flexibility, and self-regulation—compared to the control group. These findings provide empirical evidence supporting the view that targeted interventions focused on emotional regulation can enhance cognitive control and adaptability in adolescents, thereby promoting greater emotional resilience and behavioral stability. The observed effects remained consistent at the two-month follow-up stage, indicating the durability of the training outcomes and the long-term benefits of structured emotion regulation programs for adolescents.

The enhancement in executive function observed in the experimental group aligns with a growing body of literature emphasizing the reciprocal relationship between emotion regulation and executive processes (Barkley & Benton, 2024; Eisenberg, 2023). Emotion regulation involves monitoring and modifying emotional reactions, which requires executive capacities such as working memory and inhibitory control (Ahmed, 2019; Fombouche, 2025). Adolescents who develop these skills become better able to manage impulsive responses and maintain goal-directed behavior even in emotionally charged situations. The findings of this study are consistent with (Van Meter, 2023), who reported that emotion regulation interventions significantly improved cognitive flexibility and planning abilities in adolescents, and with (Lantrip, 2016), who demonstrated that adolescents' emotion regulation strategies are closely tied to their executive control efficiency. Moreover, (Hong, 2025) found that children and adolescents with higher executive functioning tend to prefer adaptive

emotion regulation strategies such as cognitive reappraisal over maladaptive ones like suppression or avoidance. This suggests that the current intervention may have strengthened both top-down and bottom-up regulatory processes, thereby facilitating a more integrated form of emotional and cognitive regulation.

Improvement in frustration tolerance is another significant finding of this study. Frustration tolerance reflects an individual's capacity to endure distress or obstacles without resorting to impulsive or maladaptive reactions (Deveney, 2020; Perlman, 2014). The results indicate that adolescents who participated in emotion regulation training were better able to cope with frustration and delay gratification, a finding that corroborates prior research on the role of cognitive control in managing frustration (Giancola, 2008; Seymour, 2025). Emotion regulation training likely enhanced participants' awareness of emotional triggers and provided them with strategies to reinterpret and manage frustration constructively. (Eisenberg, 2010) emphasized that emotion-related self-regulation is vital for reducing maladjustment, particularly in adolescents who experience frequent emotional fluctuations. Similarly, (Fombouchet, 2025) demonstrated that adaptive regulation strategies such as reappraisal are positively associated with greater inhibitory control and frustration tolerance. The current study's findings reinforce the view that structured training in emotion regulation can foster more effective coping responses to challenging or emotionally demanding situations.

The persistence of these effects in the follow-up stage underscores the stability of the acquired skills. Long-term retention of emotion regulation skills is critical in adolescence, as this developmental stage is often marked by heightened emotional reactivity and underdeveloped self-regulatory systems (Ahmed, 2019; Barkley & Benton, 2024). By strengthening prefrontal executive networks, emotion regulation training may contribute to more sustainable changes in behavior and cognition. (Seymour, 2025) reported that emotion regulation abilities in adolescents extend beyond basic executive dysfunction and involve broader metacognitive and motivational processes that evolve with practice. The present study's follow-up data suggest that once adolescents internalize emotion regulation strategies, they continue to apply them autonomously, supporting lasting behavioral adaptation.

Furthermore, the study's results are consistent with (Northrup, 2025), who found that immersive virtual reality emotion regulation programs enhanced both executive

functioning and emotional control in at-risk adolescents. Similarly, (Ghosh, 2024) demonstrated that mindfulness and emotion regulation training derived from dialectical behavior therapy improved executive functions in patients with emotional dysregulation, indicating that these interventions can generalize across clinical and nonclinical populations. The improvements observed in this study suggest that emotion regulation training may promote neural integration between affective and cognitive systems, allowing adolescents to respond to stressors with greater flexibility and self-control.

In interpreting the findings, it is also essential to consider the theoretical frameworks underlying the observed outcomes. The dual-systems model posits that emotion regulation and executive function develop through the interaction of socio-emotional and cognitive control networks, with emotion regulation mediating the effects of executive maturation on behavioral adaptation (Eisenberg, 2023; Van Meter, 2023). The results of the present study align with this model by demonstrating that interventions designed to enhance emotion regulation simultaneously improve executive functioning. According to (Barkley & Benton, 2024), emotion regulation is an essential aspect of executive functioning itself, underpinning planning, problem-solving, and self-motivation. Thus, improvements in executive function following emotion regulation training may reflect enhancements in metacognitive self-regulation processes that govern both emotional and cognitive domains (Mazidi et al., 2025).

From a developmental perspective, adolescence is a period during which both emotional reactivity and executive functioning undergo significant transformation (Ahmed, 2019; Lantrip, 2016). The prefrontal cortex, which governs inhibitory control and cognitive flexibility, continues to mature during this stage, while the limbic system responsible for emotional responses remains highly active (Eisenberg, 2010). This neurobiological imbalance often leads to impulsivity, mood instability, and poor frustration tolerance (Deveney, 2020; Giancola, 2008). By teaching adolescents structured emotion regulation strategies, this study may have effectively strengthened prefrontal-limbic connectivity, promoting a more balanced regulation of affective and cognitive processes. In this respect, the current findings extend the results of (Cécillon et al., 2024), who demonstrated that emotion regulation and metacognitive beliefs jointly predict executive performance and academic achievement in youth.

Metacognitive awareness plays a vital role in sustaining these effects. Emotion regulation training helps adolescents become more conscious of their thought-emotion interactions and encourages adaptive beliefs about emotions (Cécillon et al., 2024; Mazidi et al., 2025). This self-awareness facilitates the implementation of cognitive reappraisal and attentional control strategies, enhancing the efficiency of executive functioning. (Seymour, 2025) similarly emphasized that metacognitive and motivational components of regulation contribute significantly to adolescents' emotional adjustment beyond cognitive skills alone. The results of this study demonstrate that participants not only improved their behavioral control but also developed greater self-reflective awareness of their emotional processes, indicating metacognitive growth.

The positive outcomes of emotion regulation training in this study also align with previous research that linked adaptive emotion regulation with reductions in both internalizing and externalizing symptoms (Eisenberg, 2023; Frick, 2003; Giancola, 2008). Emotion regulation supports behavioral inhibition, empathy, and social understanding—all critical components for adolescent adjustment. (Fombouche, 2025) found that emotion regulation strategies such as problem-solving and acceptance were positively correlated with executive functioning indices, supporting the interdependence of these constructs. The improvements in frustration tolerance observed in this study suggest that adolescents learned to redirect emotional energy into problem-focused coping rather than impulsive behavior. Such shifts in coping patterns can have far-reaching implications for mental health, academic success, and interpersonal functioning during adolescence.

Another noteworthy aspect of this study is its contribution to culturally relevant applications of emotion regulation research. Most existing studies have been conducted in Western contexts, yet emotion regulation and executive function development are influenced by sociocultural factors (Keskiner et al., 2024). Cultural norms regarding emotional expression and control may shape adolescents' regulation strategies and their interpretation of frustration. The present findings contribute to the understanding of emotion regulation interventions in non-Western populations, such as Iranian adolescents, demonstrating that structured emotional training can be effective across cultural contexts. These results echo the findings of (Keskiner et al., 2024), who showed that behavioral emotion regulation strategies predicted lower psychological distress among Turkish

university students, underscoring the cross-cultural relevance of emotional skills training.

Collectively, the findings of this study support the growing consensus that emotion regulation training represents an effective, evidence-based approach for enhancing adolescents' cognitive and emotional competencies (Eisenberg, 2023; Mazidi et al., 2025; Northrup, 2025). By targeting both emotional awareness and cognitive flexibility, such interventions can mitigate frustration intolerance, strengthen self-regulation, and improve overall mental health. The improvements in executive function and frustration tolerance observed here may also act as protective factors against future maladaptive behaviors, consistent with (Rachma & Hendrawan, 2025), who found that emotion dysregulation mediates the relationship between executive dysfunction and self-injurious behaviors. This finding suggests that bolstering emotion regulation during adolescence can serve as a preventative measure against more severe forms of psychological distress in later life.

In summary, this study provides empirical validation for the theoretical proposition that emotion regulation and executive functioning are integrally connected and mutually reinforcing processes in adolescent development (Eisenberg, 2023; Fombouche, 2025; Van Meter, 2023). The evidence indicates that structured emotion regulation training not only improves frustration tolerance but also enhances higher-order cognitive control. The consistency of these findings with prior studies and theoretical models strengthens the argument for implementing emotion regulation interventions in educational and clinical settings to support adolescents' emotional and cognitive growth.

5. Limitations & Suggestions

Despite its meaningful findings, this study has several limitations that warrant consideration. First, the sample size was relatively small, which may limit the generalizability of the results to broader adolescent populations. Second, participants were selected using convenience sampling, potentially introducing selection bias and limiting the representativeness of the sample. Third, the reliance on self-report measures for assessing frustration tolerance and executive function might have introduced response biases, as participants may have provided socially desirable answers rather than accurate self-assessments. Additionally, the study focused exclusively on adolescents from Tehran City, which may restrict the applicability of the results to other

cultural or socioeconomic contexts. The absence of a long-term follow-up beyond two months also limits the ability to determine the sustainability of the observed improvements over extended periods. Finally, the study did not include neurophysiological or behavioral performance measures of executive functioning, which could have provided more objective evidence of cognitive changes.

Future studies should consider employing larger and more diverse samples to enhance the generalizability of findings across different cultural and developmental contexts. Researchers are encouraged to utilize longitudinal designs with extended follow-up periods to evaluate the long-term effects and maintenance of emotion regulation training outcomes. Incorporating neurocognitive assessments, such as functional brain imaging or behavioral tasks, could offer a more comprehensive understanding of the neural mechanisms underlying emotion regulation and executive function improvements. It would also be beneficial to compare different intervention modalities—such as mindfulness-based, cognitive-behavioral, or virtual reality-based emotion regulation programs—to identify the most effective approaches for adolescent populations. Finally, examining potential moderating factors such as gender, socioeconomic status, and baseline emotional reactivity could provide valuable insights into which adolescents benefit most from these interventions.

From a practical standpoint, integrating emotion regulation training into school curricula and counseling programs can provide adolescents with essential tools for managing emotions and enhancing cognitive control. Educators and school psychologists can use structured group sessions to teach emotion identification, cognitive reappraisal, and adaptive coping strategies, thereby improving students' resilience and frustration tolerance. Clinicians working with adolescents may also consider incorporating emotion regulation components into therapy to enhance executive functioning and reduce maladaptive behaviors. Furthermore, parental involvement in these interventions could strengthen the transfer of learned skills to everyday life, fostering a supportive environment for emotional growth. Finally, policymakers should prioritize emotional education as a preventive strategy to promote adolescents' mental health, academic engagement, and long-term psychological well-being.

Acknowledgments

We would like to express our appreciation and gratitude to all those who cooperated in carrying out this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

Funding

This research was carried out independently with personal funding and without the financial support of any governmental or private institution or organization.

Authors' Contributions

All authors equally contributed to this article.

References

Ahmed, S. P. (2019). Neurocognitive bases of emotion regulation development in adolescence. *Developmental Cognitive Neuroscience*, 15, 11-25. <https://doi.org/10.1016/j.dcn.2015.07.006>

Barkley, R. A., & Benton, C. M. (2024). Focus on Executive Functions. Part 3: Emotion Regulation, Self-Motivation, and Planning/Problem-Solving. *The ADHD Resource Hub*, 2(6), 90-99. <https://doi.org/10.1521/adhdhub.2024.2.6.1>

Cécillon, F. X., Mermilliod, M., Leyls, C., Lachaux, J. P., Le Vigouroux, S., & Shankland, R. (2024). Trait Anxiety, Emotion Regulation, and Metacognitive Beliefs: An Observational Study Incorporating Separate Network and Correlation Analyses to Examine Associations with Executive Functions and Academic Achievement. *Children*, 11(1), 123. <https://doi.org/10.3390/children11010123>

Deveney, C. M. (2020). Frustration Paradigm and Cognitive Control in Children. *Journal of Child Psychology and Psychiatry*, 61(9), 987-995. <https://pubmed.ncbi.nlm.nih.gov/PMC7523008>

Eisenberg, N. (2010). Emotion-Related Self-Regulation and Children's Maladjustment. *Annual Review of Clinical Psychology*, 7, 495-525. <https://doi.org/10.1146/annurev.clinpsy.121208.131208>

Eisenberg, N. (2023). Emotion Regulation and Executive Functioning in Intervention Outcomes. *Children*, 10(1), 139. <https://doi.org/10.3390/children10010139>

Fombouchet, A. (2025). Relationships between emotion regulation strategies and executive functions in adolescence. *Developmental science*, 28(2), e13567. <https://doi.org/10.1111/desc.13567>

Frick, P. J. (2003). Callous-unemotional traits and developmental pathways to severe conduct problems. *Journal of Clinical Child and Adolescent Psychology*, 32(4), 537–548. https://doi.org/10.1207/S15374424JCCP3204_07

Ghosh, R. (2024). *Effect of Mindfulness and Emotion Regulation Skills of Dialectical Behaviour Therapy on Executive Functions in Patients With Bipolar Affective Disorder, Current Episode Manic* Master's thesis, Central Institute of Psychiatry [India]. <https://search.proquest.com/openview/bb2fcc1012ba1095e325e986ba024ffa/1?pq-origsite=gscholar&cbl=2026366&diss=y>

Giancola, P. R. (2008). Executive functioning and aggression in adolescents. *Aggression and Violent Behavior*, 13(5), 357–368. <https://doi.org/10.1016/j.avb.2008.06.001>

Hong, Y. (2025). Children's executive functions predict emotion regulation preferences. *Cognition and Emotion*, 39(6), 1312–1328. <https://doi.org/10.1080/0269931.2024.2438078>

Keskiner, E. S., Şahin, E., Topkaya, N., & Yiğit, Z. (2024). Behavioral Emotion Regulation Strategies and Symptoms of Psychological Distress Among Turkish University Students. *Behavioral sciences (Basel, Switzerland)*, 15(1), 6. <https://doi.org/10.3390/bs15010006>

Lantrip, C. (2016). Executive Function and Emotion Regulation Strategy Use in Adolescents. *Applied Neuropsychology: Child*, 5(1), 50–55. <https://doi.org/10.1080/21622965.2014.960567>

Mazidi, M., Preece, D. A., Becerra, R., Gross, J. J., & MacLeod, C. (2025). Beliefs About Emotions in Self and Others: Links With Emotion Regulation and Psychological Distress. https://doi.org/10.31219/osf.io/es6ac_v1

Northrup, J. B. (2025). Improving Emotion Regulation and Executive Function in At-Risk Adolescents via VR. *Applied Sciences*, 15(3), 1223. <https://doi.org/10.3390/app15031223>

Perlman, S. B. (2014). Developmental differences in frustration on working memory tasks. *Child development*, 85(3), 1139–1152. <https://doi.org/10.1111/cdev.12189>

Rachma, A., & Hendrawan, D. (2025). Pathway Linking Executive Function Problems and Non-Suicidal Self-Injury Among Adolescents: The Mediating Role of Emotion Dysregulation. *Psikohumaniora Jurnal Penelitian Psikologi*, 10(1), 43-58. <https://doi.org/10.21580/pjpp.v10i1.23353>

Seymour, K. E. (2025). Emotion regulation beyond executive dysfunction in adolescents. *Child and adolescent psychiatry and mental health*, 19, 12. <https://doi.org/10.1186/s13034-025-00898-1>

Van Meter, A. (2023). The Effect of Emotion Regulation on Executive Function. *Journal of Child and Adolescent Psychopharmacology*, 33(8), 312–320. <https://pubmed.ncbi.nlm.nih.gov/PMC10544783>