Id: 1866758

Participatory Educational Research (PER)
Vol.13(3), pp. 183-198, May 2026
Available online at http://www.perjournal.com
ISSN: 2148-6123
http://dx.doi.org/10.17275/per.26.40.13.3

An Investigation of Emotion Regulation and Executive Function Skills of Children Aged 48-72 Months in the Context of Age and Gender

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Article history

Received:
19.01.2026

Received in revised form:
04.03.2026

Accepted:
10.03.2026

Key words:
emotion regulation, executive functions, inhibitory control, working memory, cognitive flexibility

This study aimed to examine the emotion regulation and executive function skills of children aged 48-72 months in the context of age and gender. The study included 200 children aged 48-72 months enrolled in kindergartens with the Ministry of National Education in the Mut district of Mersin province. The 'Child Personal Information Form', 'Emotion Regulation Skills Scale', and 'Touchscreen Executive Function Battery' were utilized as data collection tools. The Bayes Mann-Whitney U Test was employed to determine whether emotion regulation and executive function (inhibitory control, working memory, cognitive flexibility) scores differed according to gender and age. According to the research results, it was found that the relationship between inhibitory control, cognitive flexibility, and emotion regulation differed depending on age and gender in children with high working memory. No significant relationship was found between cognitive flexibility and emotion regulation, or between inhibitory control and emotion regulation, in boys and girls aged 48-72 months with low working memory, nor in boys and girls aged 48-60 months with high working memory. However, a significant relationship was identified between cognitive flexibility and emotion regulation, and between inhibitory control and emotion regulation, in boys and girls aged 61-72 months with high working memory. Ultimately, this study demonstrates that the relationship between cognitive control mechanisms and emotion regulation in children is shaped not only by possessing a high working memory capacity but also by advancing age and developmental maturity.

Introduction

Emotion regulation is the ability to interact with others in a socially acceptable manner, encompassing the capacity and flexibility to adjust intense emotions and their accompanying behavioral responses according to the situation (Hudson & Pulla, 2023). Emotion regulation skills, which encompasses an individual's ability to recognize, understand, and provide appropriate emotional responses, is an essential and necessary skill for daily life. During the preschool period, emotion regulation skills are significantly shaped (Bozkurt

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Yükçü & Demircioğlu, 2017). Emotion regulation involves both intrinsic and extrinsic processes (Thompson, 1994). Throughout the childhood years, emotion regulation undergoes a transition from a structure predominantly based on extrinsic influences to the one based on intrinsic influences, shifting from behavioral regulation patterns toward cognitive regulation patterns (Zeman et al., 2006). During early childhood, the capacity to regulate emotions is transferred from primary caregivers to the children themselves (Hughes et al., 2023). Between the ages of three and five, children begin to establish diverse social bonds beyond their caregivers. Consequently, increased emotional knowledge and the ability to understand emotional expressions enable children to transcend their basic emotional experiences. Children's more comprehensive emotional knowledge, and the subsequent increase in emotion regulation, allows them to be more successful in utilizing emotions within adaptive cognitions and actions (Izard et al., 2011).

Factors affecting emotion regulation are addressed within the framework of the interaction between biological, environmental, and contextual factors. The child's neurological development, immediate environment—particularly the status of secure attachment—socio-economic conditions, family and social support systems, and cultural values are among the significant factors shaping how a child regulates emotions (Hudson & Pulla, 2023). Furthermore, it is emphasized that the development of emotion regulation, especially in early childhood, is shaped by the development of cognitive skills, specifically executive functions (Hong et al., 2025). Executive functions constitute an umbrella term encompassing high-level cognitive abilities required for an individual to analyze and achieve a designated goal. These functions assist us in understanding complex or abstract concepts, solving novel problems, and regulating and maintaining our social relationships. Traditionally, defining executive function has been considerably challenging (Cristofori et al., 2019). Executive functions hold critical importance for numerous skills—such as creativity, cognitive flexibility, self-control, and discipline—on which there is a consensus regarding their significance for academic success in the twenty-first century. Furthermore, executive functions enable us to mentally manipulate ideas, adapt quickly and flexibly to changing circumstances, take time to plan subsequent steps, resist transient distractions, maintain focus, and cope with new, ambiguous challenges. They are essential skills for mental and physical health, academic achievement, and cognitive, social, and psychological development (Diamond, 2013). Individual differences in executive functions predict variations in the success levels of emotion regulation skills (Schmeichel & Tang, 2015). Neuroimaging studies have shown that emotion regulation skills are associated with the activity of various prefrontal brain regions, which mature later in development and play a role in cognitive control and executive functions (Martin & Ochsner, 2016). Relationships identified between behavioral assessments and neuropsychological measurements have further indicated that executive functions and emotion regulation are interconnected (Sudikoff et al., 2015). In ongoing research regarding the measurement of executive functions in early childhood, examining the relationship between the interaction of cognition and emotion appears to be both a valuable and challenging direction for future studies. An increase in studies on executive functions may reveal precious insights to help address and remediate deficits in emotion regulation skills (Blair et al., 2005).

Executive function skills have been the subject of research in the field of education, particularly in the context of their relationship with variables such as emotion regulation, classroom interaction, behavioral problems, and emotional resilience (Brown, 2021; Duval, 2016; Gandotra, 2021; Graziano, 2022; Hughes, 2023; Martins, 2020; Schmidt, 2022). In Türkiye, it is observed that studies focusing on executive function skills within the early

childhood education period remain limited (Ahçı, 2016; Hamamcı, 2020; Öğütcen, 2020; Şahin, 2015). Findings in the literature emphasize that executive function skills must be systematically supported starting from early childhood. Research indicates that these skills influence various developmental domains in preschool children, including behavioral regulation, attentional control, and social adaptation. Furthermore, several studies have demonstrated that children with more advanced executive function skills are more successful in their emotion regulation abilities (Halse, 2024; Hughes, 2023). This highlights a pressing need to expand the scientific body of knowledge regarding the examination of executive function skills in early childhood. Accordingly, it is anticipated that this research; by addressing the executive function skills of preschool children, will both fill a significant gap in the national literature and provide guiding contributions to educational practices and early intervention programs.

Therefore, this study aims to examine the relationship between emotion regulation and executive function skills (working memory, inhibitory control, and cognitive flexibility) of children aged 48-72 months within the context of age and gender variables. By doing so, it is intended to provide a more holistic, comprehensive, and empirically-based understanding of the link between emotion regulation and executive function skills. Clarifying the fundamental mechanisms between these two developmental domains may contribute to the development of effective intervention and supportive programs aimed at preventing potential negative developmental or psychological outcomes that may arise from the interaction between executive functions and emotion regulation. In line with this objective, the following hypotheses were proposed and tested:

H1: The relationship between inhibitory control and emotion regulation skills in children aged 48–72 months differs significantly according to the children's levels of working memory.

H2: The relationship between cognitive flexibility and emotion regulation skills in children aged 48–72 months differs significantly according to the children's levels of working memory.

Method

Research Model

In this study, a correlational survey design, one of the quantitative research methods, was employed to reveal the status of emotion regulation and executive function skills of children aged 48-72 months within the context of age and gender. 'Correlational survey research is conducted to determine the relationships between variables and to predict potential outcomes; they are studies conducted to identify relationships between two or more variables and to analyze these relationships in depth' (Tutar & Erdem, 2022, p. 136).

Study group

The sample of this research, reached through the convenience sampling method, consists of a total of 200 children (95 children aged 48-60 months and 105 children aged 61-72 months) attending a preschool education institution affiliated with the Ministry of National Education in Mersin. Convenience sampling is an approach that includes accessible units in the sample. It relies on elements that are fast and easy to reach. A sufficient number of elements are determined as a sample from currently available units' (Tutar & Erdem, 2022, p. 264). Of the participants, 49% (n = 98) are boys and 51% (n = 102) are girls. When the age

distribution of the children is examined, the proportion of children in the 48-60 month range is 47% (n = 95), while the proportion of children in the 61-72 month range is 53% (n = 105)."

Instruments

Emotion Regulation Checklist (ERC)

The ERC was developed by Shields and Cicchetti (1997) to measure child's emotion regulation skills. It was adapted into Turkish by Batum and Yağmurlu (2007). The scale consists of 24 items in a four-point Likert-type format, with both parent and teacher forms available. The items are rated on a 4-point Likert-type scale: 1 = never; 2 = sometimes; 3 = often; 4 = always. According to the factor analysis by Shields and Cicchetti (1997), the scale consists of two distinct dimensions: Lability-Negativity and Emotion Regulation. The former focuses on behavioral aspects such as emotional instability, lack of cognitive flexibility, and dysregulated anger, whereas the latter is characterized by social-emotional competencies like empathy and the appropriate expression of feelings. The Lability-Negativity subscale contains 15 items (2, 4, 5, 6, 8, 9, 10, 11, 13, 14, 17, 19, 20, 22, 24), and the Emotion Regulation subscale contains 8 items (1, 3, 7, 15, 16, 18, 21, 23); item 12 is not scored for either subscale. The Emotion Regulation subscale consists of 8 items, with total scores ranging from a minimum of 8 to a maximum of 32. The Lability/Negativity subscale comprises 15 items, with total scores ranging from a minimum of 15 to a maximum of 60. High scores on the Lability-Negativity subscale indicate that the child experiences emotional dysregulation, whereas high scores on the Emotion Regulation subscale indicate proficient emotion regulation skills. In the Turkish adaptation by Batum and Yağmurlu (2007), the Cronbach's alpha internal consistency coefficients were .73 for the parent form and .75 for the teacher form. Yağmurlu and Altan (2010) reported internal consistency coefficients of .75 for maternal ratings and .84 for teacher ratings. The validity and reliability of the scale in the national context were further supported by Orta, Aksan, Yağmurlu, and Çorapçı (Orta et al., 2013).

Executive Function Touch Battery (EF Touch)

Willoughby et al. (2016) developed a touchscreen computer-assisted version of the Executive Function Battery, titled 'Executive Function Touch'. The scale was adapted into Turkish by Hamamcı (2020). The battery consists of four subdimensions and eight tasks: Working Memory (Houses, Pick-the-Picture, and Farmer tasks), Inhibitory Control (Silly Sounds, Pig, and Arrows tasks), Cognitive Flexibility (Something's the Same task), and Response Time (Bubbles task). The administration of the touchscreen version of the Executive Function Battery requires two screens: a touchscreen for the child to perform the tasks and a second monitor for the evaluator to follow instructions. Upon launching the program, the child's demographic information is entered to initiate the application. The session begins with practice trials, during which executive function skills are not measured. Children who fail the practice items twice are unable to proceed with the respective task. Conversely, children who successfully complete the practice phase perform the actual tasks independently, without any intervention from the evaluator. Performance is assessed at the end of each task, and data are automatically recorded. Correct and incorrect responses (coded as 1 and 0, respectively) and reaction times—measured in milliseconds—are documented. The resulting data file contains detailed performance metrics regarding both the child and the tasks. It is recommended to use the proportion of correct items for each task in the subsequent analyses. Scores range from a minimum of 0 to a maximum of 1. In the test-retest analysis

conducted by Willoughby et al. (2016), the reliability coefficients of the scale were determined to be .99 and .76. The composite reliability coefficient was found to be .804 by Hamamcı et al. (2020). It was established that the Executive Function Battery is a reliable measurement tool, as the composite reliability coefficient calculated for its reliability value was above .60 (Şencan, 2005). A short form of the Executive Function Battery was developed by Willoughby et al. (2013). This short form utilizes the Pig task for inhibitory control (α = .86), the Pick-the-Picture task for working memory (α = .60), and the Something's the Same task for cognitive flexibility (α = .76). Although deriving the three-task short form of the battery resulted in a statistically significant decrease in maximum reliability, it was noted that this relative reduction is acceptable in certain cases, considering time efficiency, reduction of participant burden, and potential administration advantages (Willoughby et al., 2013). In this study, the short form was utilized to prevent undesirable behaviors such as boredom and fatigue during the children's data collection process and to obtain higher quality data.

Data Collection Procedure

The researcher personally visited the classrooms that volunteered to participate in the study, where the objectives and procedures of the research were explained in detail, and the inclusion criteria were clearly stated. Teachers were asked to sign an informed consent document containing the written version of the information provided verbally. The assessment procedures were conducted only with children whose parents provided written informed consent. The children included in the study were informed about the research and they were asked to provide their assent by signing or drawing a picture to indicate their agreement to participate. Participating children provided their assent either in writing or by providing an artistic presentation. They were further informed that if they felt any discomfort during the study, they could withdraw at any time without providing any justification. During the data collection process, the Executive Function Touch Battery was administered to the children. Throughout the process, the children's responses were recorded by the researcher. No child disrupted the data collection process or withdrew prematurely. The administration of the battery took approximately 20 minutes per child. The entire data collection process was completed within an eight-week period. Subsequently, the emotion regulation scales were completed. Participation was entirely voluntary, and informed parental consent was obtained for each child included in the study.

Data Analysis

In accordance with the primary objective of the study, the Bayes Mann-Whitney U Test was employed to determine whether children’s emotion regulation and executive function subscales scores significantly differed based on working memory levels, gender, and age. To categorically examine the children's working memory performance, the continuous scores were divided into two groups: "Low Working Memory" and "High Working Memory." To prevent data loss and maintain the sample size (n=200), the "Median Split" method, which is widely utilized in the literature, was preferred. Descriptive analyses revealed that the median value of working memory scores was 0.7813. Consequently, participants with scores below 0.7813 were assigned to the "Low Working Memory" group, while those with scores at or above the median were included in the "High Working Memory" group. Utilizing the median as a threshold ensured a relatively balanced distribution of data across both groups and minimized the risk of outliers negatively impacting the analysis. Given the data's non-normal distribution and the relatively limited sample size, Kendall's tau-b correlation coefficient was employed for the relational analyses. In Bayesian statistics, the probabilities of supporting the null hypothesis (no difference) and the alternative hypothesis (difference

exists) are expressed proportionally (Dienes, 2014; Han et al., 2018). Interpretations were based on the calculation of the Bayes Factor (BF_{10}). Accordingly, BF_{10} values were calculated and interpreted throughout the study. The BF_{10} value ranges from 0 to ∞, where a value of 1 indicates that the data do not support one theory over the other (Dienes, 2014). JASP (version 0.19) software was utilized for Bayesian analysis and Mann-Whitney U visualizations, while Tableau was used to visualize the relationships between variables.

Results

A summary of the descriptive statistics pertaining to all examined variables is provided in Table 1.

Table 1. Summary of Descriptive Characteristics for Study Measures

Variables	n	Mean (*M*)	Standard Deviation (*SD*)	Minimum	Maximum
Inhibitory Control	200	0.952	0.958	0.725	1.000
Working Memory	200	0.760	0.101	0.375	0.969
Cognitive Flexibility	200	0.796	0.116	0.433	0.967
Emotion Regulation	200	52.410	6.574	39.000	74.000

Descriptive parameters, including means, standard deviations, and extreme values for all analyzed variables, are summarized in Table 1.

The mean score for Inhibitory Control was found to be 0.952, with a standard deviation of 0.958. Scores ranged from 0.725 to 1.000, indicating that the children's inhibitory control skills were generally high and showed low variability. For Working Memory, the mean score was 0.760, with a standard deviation of 0.101, and scores were distributed between 0.375 and 0.969. The mean score for Cognitive Flexibility was 0.796, with a standard deviation of 0.116, ranging from 0.433 to 0.967. Finally, the mean total score for Emotion Regulation was calculated as 52.410, with a standard deviation of 6.574, within a range of 39.000 to 74.000.

Table 2. The Correlational Links Between Emotion Regulation and Cognitive Flexibility Based on Independent Variables

Working Memory	Gender	Correlation	48-60 Months	61-72 Months	All Ages
High	**Boy**	**Kendall'stau**	-0.215	-0.237	-0.193
		BF_{10}	0.788	1.518	1.787
	Girl	**Kendall'stau**	-0.119	-0.281	-0.192
		BF_{10}	0.355	1.638	1.328
	Total	**Kendall'stau**	-0.138	-0.246	-0.198
		BF_{10}	0.512	7.414	15.644
Low	**Boy**	**Kendall'stau**	0.031	-0.167	-0.123
		BF_{10}	0.365	0.480	0.370
	Girl	**Kendall'stau**	-0.121	-0.111	-0.104
		BF_{10}	0.406	0.356	0.319
	Total	**Kendall'stau**	-0.014	-0.148	-0.090
		BF_{10}	0.258	0.446	0.277
Total		**Kendall'stau**	-0.154		
		BF_{10}	7.955		

Table 2 illustrates the correlational links between emotion regulation and cognitive flexibility,

taking into account the varying levels of working memory, gender, and age among the participants. The strength of the evidence regarding the existence of a relationship was determined based on the Bayes Factor (BF_{10}) values.

As a result of the analyses, the correlational links between the cognitive flexibility subdimension and emotion regulation scores with high working memory differs depending on age and gender. In the 48-60 month age group, no significant relationship was identified for boys (τ= -0.215, BF_{10} = 0.788), girls (τ= -0.119, BF_{10} = 0.355), or the combined gender group (τ= -0.138, BF_{10} = 0.512). In the 61-72 month age group, a low-level negative relationship was found between cognitive flexibility and emotion regulation scores in both boys (τ= -0.237, BF_{10} = 1.518) and girls (τ= -0.281, BF_{10} = 1.638). When the combined gender group was examined, a moderate negative relationship was identified (τ= -0.246, BF_{10} = 7.414). In other words, in these groups, as cognitive flexibility skills increase, emotion regulation difficulty scores also increase. Similarly, when all gender and age groups of children with high working memory were combined, a high-level negative relationship was identified between cognitive flexibility and emotion regulation scores (τ= -0.198, BF_{10} = 15.644). This suggests that as cognitive flexibility skills increase, children with high working memory exhibit an increase in their emotion regulation abilities.

In contrast, no significant relationship was found between the cognitive flexibility subdimension and emotion regulation scores with low working memory. The analysis revealed that for the 48-60 month age group with low working memory, no relationship was identified for boys (τ= 0.031, BF_{10} = 0.365), girls (τ= -0.121, BF_{10} = 0.406), or the combined gender group (τ= -0.014, BF_{10} = 0.258). Similarly, in the 61-72 month age group, no significant relationship was found for boys (τ= -0.167, BF_{10} = 0.480), girls (τ= -0.111, BF_{10} = 0.356), or the combined gender group (τ= -0.148, BF_{10} = 0.446). When examined across age groups, no significant relationship was detected between the cognitive flexibility subdimension and emotion regulation scores for boys (τ= -0.123, BF_{10} = 0.370), girls (τ= -0.104, BF_{10} = 0.319), or the combined gender group (τ= -0.090, BF_{10} = 0.277) among children with low working memory.

In conclusion, the analysis conducted for all participants revealed a moderate negative relationship between cognitive flexibility and emotion regulation scores in children within the high working memory group (τ= -0.154, BF_{10} = 7.955). In other words, as the cognitive flexibility skills of children in the high working memory group increase, their emotion regulation abilities also demonstrate an increase.

Table 3. The Correlational Links Between Emotion Regulation and Inhibitory Control Based on Independent Variables

Working Memory	Gender	Correlation	48-60 Months	61-72 Months	All Ages
High	Boy	Kendall'stau	0.121	-0.318	-0.105
		BF_{10}	0.287	1.113	0.219
	Girl	Kendall'stau	0.102	-0.636	-0.272
		BF_{10}	0.267	61.794	1.131
	Total	Kendall'stau	0.116	-0.272	-0.082
		BF_{10}	0.373	17.330	0.280
Low	Boy	Kendall'stau	0.363	-0.169	0.203
		BF_{10}	0.651	0.482	0.388
	Girl	Kendall'stau	0.119	-0.175	-0.130

	Total	**BF_{10}**	0.404	0.494	0.388
		Kendall'stau	-0.127	0.043	-0.049
		BF_{10}	0.375	0.268	0.201
Total		**Kendall'stau**	-0.072		
		BF_{10}	0.264		

In Table 3, the correlational links between the participants' inhibitory control subdimension and their emotion regulation difficulty scores was examined in detail according to age, gender, and working memory levels. The strength of the evidence regarding the existence of a relationship was determined based on the Bayes Factor (BF_{10}) values.

As a result of the analyses, the correlational links between the inhibitory control subdimension and emotion regulation scores with high working memory differs depending on age and gender. In the 48-60 month age group, no significant relationship was identified for boys (τ= 0.121, BF_{10} = 0.287), girls (τ= 0.102, BF_{10} = 0.267), or the combined gender group (τ= 0.116, BF_{10} = 0.373). Conversely, in the 61-72 month age group, a very high-level negative relationship was identified between the inhibitory control subdimension and emotion regulation in girls with high working memory (τ= -0.636, BF_{10} = 61.794), while a weak negative relationship was found for boys (τ= -0.318, BF_{10} = 1.113). When the combined gender group was examined, a high-level negative relationship was detected (τ= -0.272, BF_{10} = 17.330). In other words, for all children in this age group, as inhibitory control skills increase, emotion regulation difficulty scores decrease. According to this result, as inhibitory control skills increase in children with high working memory, their emotion regulation abilities demonstrate an increase.

In contrast, no significant relationship was identified between the inhibitory control subdimension and emotion regulation difficulty in children with low working memory. For the 48-60 month age group with low working memory, no relationship was found between the inhibitory control subdimension and emotion regulation for boys (τ= 0.363, BF_{10} = 0.651), girls (τ= 0.119, BF_{10} = 0.404), or the combined gender group (τ= -0.127, BF_{10} = 0.375). Similarly, in the 61-72 month age group, no relationship was observed between the inhibitory control subdimension and emotion regulation for boys (τ= -0.169, BF_{10} = 0.482), girls (τ= -0.175, BF_{10} = 0.494), or the combined gender group (τ= 0.043, BF_{10} = 0.268). When examined across age groups, no significant relationship was detected between inhibitory control and emotion regulation for boys (τ= 0.203, BF_{10} = 0.388), girls (τ= -0.130, BF_{10} = 0.388), or the combined gender group (τ= -0.049, BF_{10} = 0.201). These results indicate that inhibitory control skills do not have a significant effect on emotion regulation difficulty with low working memory.

Finally, in the analysis conducted for all participants, no significant relationship was identified between the inhibitory control subdimension and emotion regulation scores (τ= -0.072, BF_{10} = 0.264).

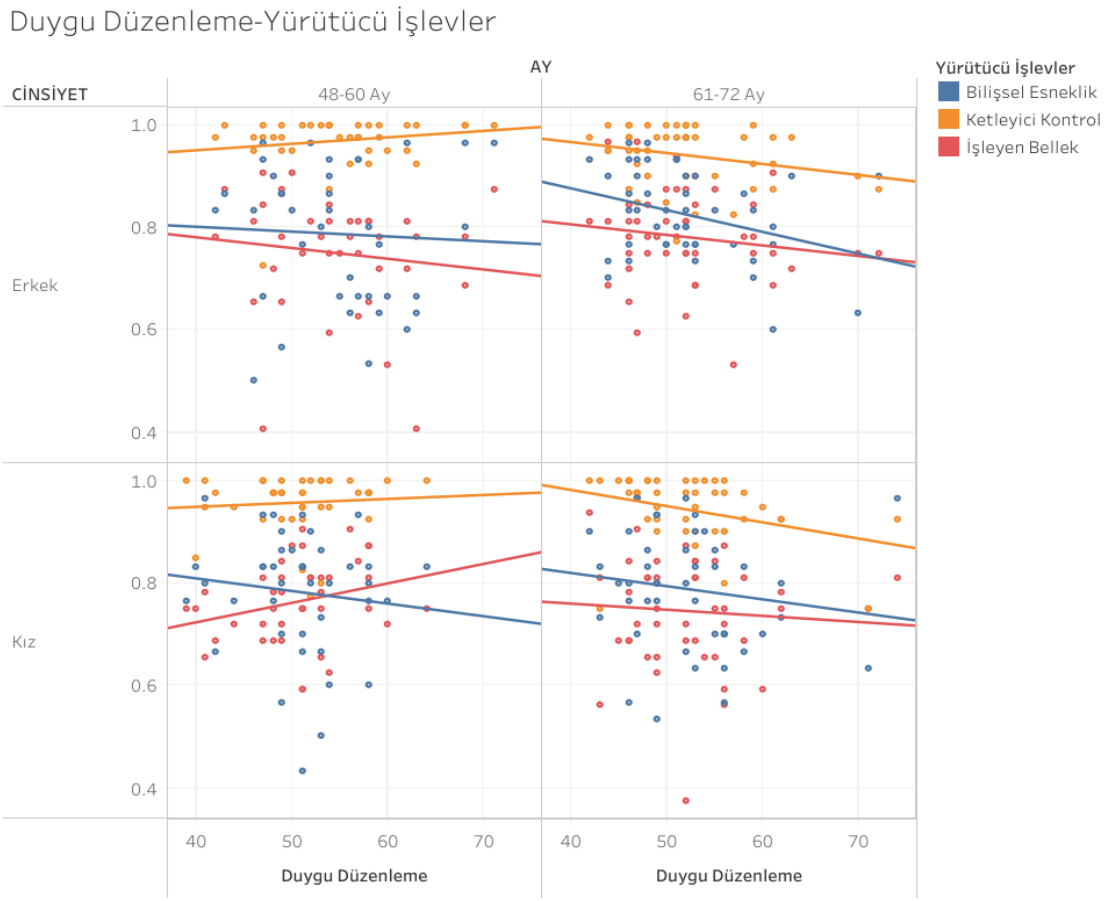

Figure 1. Scatter plot of the distribution of emotion regulation and executive functions by age and gender

The correlational patterns between executive function subscales and emotion regulation are depicted in Figure 1, where the results are segmented by age (in months) and gender to highlight group-specific differences.

In boys aged 48-60 months, a positive relationship is observed between Emotion Regulation and Inhibitory Control, whereas a negative relationship is seen between Emotion Regulation and both Cognitive Flexibility and Working Memory. While the trend lines for Cognitive Flexibility and Working Memory are downward-sloping, trend lines for Inhibitory Control exhibit an upward trajectory. This indicates that as emotion regulation difficulty increases, cognitive flexibility and working memory skills decrease, whereas inhibitory control skills appear to increase. In contrast, for boys aged 61-72 months, a negative relationship is observed between Emotion Regulation and all executive functions subscales. All trend lines in this group are downward-sloping. This situation suggests that as emotion regulation difficulty increases in boys within this age group, there is a corresponding decline across all executive function skills.

In girls aged 48-60 months, a positive relationship is observed between Emotion Regulation and both Inhibitory Control and Working Memory, while a negative relationship is seen between Emotion Regulation and Cognitive Flexibility. This indicates that as emotion regulation difficulty increases, inhibitory control and working memory skills decrease,

whereas cognitive flexibility skills appear to increase.

In girls aged 61-72 months, a negative relationship is observed between Emotion Regulation and all executive functions subscales. This demonstrates that as emotion regulation difficulty increases, there is a decline across all executive function skills in girls aged 61-72 months.

Discussion

This study examines the emotion regulation and executive function skills of children aged 48-72 months within the context of age and gender. The primary finding of the study is that the relationship between inhibitory control and emotion regulation in children with high working memory differs depending on age and gender. While no significant relationship was found for either boys or girls in the 48-60 month age group, a significant relationship was identified between inhibitory control and emotion regulation in both boys and girls in the 61-72 month age group. According to this result, it was determined that as inhibitory control skills increase, emotion regulation abilities also increase in 61-72-month-old children with high working memory. Conversely, no significant relationship was found between inhibitory control and emotion regulation in children with low working memory. These results demonstrate that there is no relationship between inhibitory control and emotion regulation in 48-72-month-old children with low working memory, nor in 48-60-month-old children with high working memory; however, a relationship exists specifically for 61-72-month-old boys and girls. Xie et al. (2021) concluded that executive function training improves children's working memory and inhibitory control; however, only the increase in inhibitory control skills mediated the effects on maladaptive emotion regulation strategies. This finding emphasizes that cognitive training aimed at increasing working memory alone may be insufficient for improving the use of emotion regulation strategies, highlighting the importance of inhibitory control in cognitive training designed to enhance these strategies. In a study examining individual differences in the relationship between inhibitory control and emotion regulation, Carlson and Wang (2007) found that individual differences in inhibitory control among children aged 4-6 were significantly related to their ability to regulate emotions. Furthermore, Alamos et al. (2022) found that inhibitory control was related to emotion regulation through positive interactions with peers and negative interactions with teachers and peers. Children who began the preschool period with weaker inhibitory control skills were observed to have more conflict-ridden interactions with teachers and peers throughout the year. It was noted that these interactions, characterized by tension and negative emotions, were evaluated by teachers as low levels of emotion regulation skills. In a study examining how executive function training can improve emotional competencies, Li et al. (2020) found that children who received executive function training achieved significantly higher emotional competence scores compared to the control group. Changes in inhibitory control and working memory significantly predicted differences in emotional competencies. Specifically, it was emphasized that children's inhibitory control and working memory can make changes in emotion regulation and emotional understanding skills more effective. Additionally, Hudson and Jacques (2014) found that inhibitory control was positively correlated with emotion regulation. These research results, which reveal the relationships between inhibitory control and emotion regulation skills in young children, partially support our finding that emotion regulation skills increase as inhibitory control increases, specifically in 61-72-month-old boys and girls with high working memory levels. Current research results confirm the relationship between inhibitory control and emotion regulation skills in children aged 61-72 months.

The second finding of the study is that the relationship between cognitive flexibility and emotion regulation in children with high working memory differs depending on age and gender. While no significant relationship was observed for both boys and girls in the 48-60 month age group, a significant relationship was identified between cognitive flexibility and emotion regulation in both boys and girls in the 61-72 month age group. According to this result, it was determined that as cognitive flexibility skills increase, emotion regulation abilities also increase in 61-72-month-old children with high working memory. Conversely, no significant relationship was found between cognitive flexibility and emotion regulation in children with low working memory. These results reveal that there is no relationship between cognitive flexibility and emotion regulation in 48-72-month-old children with low working memory, nor in 48-60-month-old children with high working memory; however, a relationship exists specifically for 61-72-month-old boys and girls. Numerous studies in the literature have established a positive relationship between cognitive flexibility and emotion regulation (Liebermann et al., 2007; Şahin, 2015; Tümtürk, 2025). In a study examining the relationships between control and understanding processes in the domains of emotion and cognition in 3-4-year-old children, Blankson et al. (2013) found reciprocal relationships between these two domains, noting that emotional control is a significant predictor of the development of both cognitive control and cognitive understanding skills during the preschool period. Similarly, in a longitudinal study conducted with 4- and 5-year-old children, Wang (2021) identified that early cognitive flexibility significantly predicts the later development of emotional understanding. Mengxia (2024) found that cognitive flexibility significantly predicts emotional understanding in children aged 3-6, even when age and gender variables are controlled. These results indicate that cognitive flexibility serves as an essential cognitive foundation for emotional understanding skills in early childhood. Furthermore, Hedier (2025) aimed to examine the roles of both family interactions and cognitive flexibility on different components of emotional knowledge during the preschool period. It was found that a child's cognitive flexibility provides a significant contribution, particularly to the expressive components of emotional knowledge. These research findings, which highlight the relationships between cognitive flexibility levels and emotion regulation skills in young children, support our finding that as cognitive flexibility increases, emotion regulation abilities also increase, specifically in 61-72-month-old boys and girls with high working memory levels.

Furthermore, the finding that a relationship exists between emotion regulation and both inhibitory control and cognitive flexibility in 61-72-month-old children with high working memory—whereas this relationship is absent in those with low working memory—suggests that as children age, they can utilize their own cognitive processes to regulate emotions. However, it indicates that to do so, they must be able to effectively use all subdimensions of executive functions (working memory, inhibitory control, and cognitive flexibility) in an integrated manner. While this result supports numerous studies demonstrating the relationship between cognitive flexibility, inhibitory control, and emotion regulation, it further reveals that working memory must also be strengthened for cognitive flexibility and inhibitory control to be utilized effectively in emotion regulation skills. According to this conclusion, it can be argued that all subdimensions of executive function skills must be supported to enable 61-72-month-old children to reduce their reliance on adult support and utilize their own cognitive processes while regulating their emotions.

The finding that no relationship exists between emotion regulation and either inhibitory control or cognitive flexibility in younger children (48-60 months), regardless of their working memory levels, suggests that at these younger ages, children are not yet able to

utilize their own internal cognitive processes to regulate emotions. This result is consistent with research indicating that children require more intensive adult support for emotion regulation during early childhood. The development of emotion regulation begins in infancy and, during this early period, is largely managed through caregivers. In infancy and early childhood, emotion regulation is shaped by sensitive caregiver interactions rather than the child's own internal cognitive processes. Inadequate caregiver support during this period can seriously jeopardize the development of emotion regulation and lead to long-term adverse effects on the child (Cole et al., 1994). Lin (2023), using longitudinal data from children aged 14–60 months, examined the relationship between parental supportiveness and emotion regulation skills. The results revealed a reciprocal and ongoing transactional relationship over time between parental supportive behaviors and the emotion regulation abilities. Both parental supportiveness and the development of emotion regulation skills significantly predicted each other over time. These findings indicate that the interaction between parental support and emotion regulation in early childhood is not a unidirectional process but rather a dynamic and bidirectional developmental journey. Furthermore, Ellis (2014) identified that increased family risk in children aged 46–58 months reduced their emotion regulation skills. The study also determined that maternal emotion coaching played a partial mediating role in the relationship between family risk and emotion regulation, particularly regarding the emotional lability.

In summary, the research results reveal that while 60-72-month-old children with high working memory can regulate their emotions by utilizing their own cognitive processes (inhibitory control and cognitive flexibility), 48-60-month-old children are not yet able to utilize these internal processes. Indeed, Landry et al. (2000) found that maternal direction is crucial for the development of cognitive and reactive skills until the age of 4; however, this effect reverses after the age of 4 in relation to the decrease in children's need for structural support.

Conclusion and Recommendations

The study results indicate that the development of inhibitory control, cognitive flexibility, and emotion regulation skills are interrelated in children with high working memory, and that executive function skills collectively play a significant role in supporting emotion regulation abilities. For cognitive flexibility and inhibitory control to be utilized effectively in emotion regulation, working memory must also be strengthened. In light of these findings, it is recommended that family- and school-based educational programs aimed at supporting the development of emotion regulation skills specifically include games and activities that enhance working memory.

Furthermore, in children aged 48-60 months, an increase in inhibitory control and cognitive flexibility skills was not found to be associated with an increase in emotion regulation abilities, regardless of their working memory levels. Therefore, it is recommended that parents and teachers of 48-60-month-old children utilize methods that provide adult-led support to foster emotion regulation skills, rather than focusing solely on supporting executive function skills.

There are several limitations to be considered regarding the results of this study, which also offer suggestions for future research. First, the participants in the current study were limited to children attending preschool education institutions in a single district. The generalizability of the tested model and hypotheses depends on replication studies with samples selected from

various cultural contexts across multiple provinces and districts. Furthermore, intervention-based and longitudinal research studies are necessary to more clearly establish the causal relationships between the variables addressed.

Declarations

Funding: *This study received no specific grant from any funding agency, commercial, or not-for-profit sectors.*

Ethics Statements:

This study was approved by the the Necmettin Erbakan University Educational Sciences Research Ethics Committee. The decision number is 2024/891. In the informed consent, parents and children were informed about the purpose, procedures, potential risks and benefits of the study and were informed that they could withdraw from the study. To protect confidentiality, codes were used instead of names.

Conflict of Interest: *The authors have no conflicts of interest to disclose.*

Informed Consent: *Participants in the study were fully informed about the nature and procedures of the research, and written and verbal consent was obtained from all participants*

Data availability: *The data that support the findings of this study are available from the corresponding author upon reasonable request, provided that the data are de-identified*

Note: *This article is derived from "Examination of Emotion Regulation And Executive Function Skills Of 48-72 Months Old Children In The Context Of Age And Gender", a master's thesis prepared by first author in Necmettin Erbakan University Graduate School of Education.*

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