

Analysis of the Relationship Between Emotion Regulation Difficulties and Impulsivity and Cognitive/Metacognitive Skills in Adolescents Diagnosed with Major Depressive Disorder

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ABSTRACT

Background: Major depressive disorder (MDD) is a significant psychiatric disorder among children and adolescents. It is important that the relationship with depression is analyzed in adolescents in which cognitive and metacognitive processes are different from adult individuals.

Methods: Forty-five patients and 44 healthy controls were included in our study. Participants were administered Difficulties in Emotion Regulation Scale (DERS), Barratt Impulsivity Scale, Behavior Rating Inventory of Executive Function (BRIEF), and Stroop test.

Results: When the DERS total scores were evaluated, a statistically significant difference was found between the 2 groups in terms of DERS scores. In the healthy controls, the emotion regulation skills were significantly higher compared with the MDD group. In the Stroop test, particularly in the fifth section, the control group displayed a statistically significant better performance in both total duration and the number of mistakes made compared with the study group. In the BRIEF test a statistically significant difference was found between the control group and the study group in all 3 areas. In order to determine the efficient factors related to the statistical difference between the BRIEF scores, the multiple linear regression analysis was used.

Conclusion: It was found that depression scores and Stroop performance influence executive functions. Given that Stroop performance can overlap with executive functions, this outcome was expected. However, the impact of depression scores affecting executive functions is also anticipated, considering that these scores particularly affect attention among the cognitive and maladaptive cognitive processes, such as rumination.

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INTRODUCTION

Major depressive disorder (MDD) is a significant psychiatric disorder that can lead to serious psychosocial problems, such as a significant decrease in functionality, increase in suicide risk, and decrease in academic success among children and adolescents.¹ Studies on the prevalence of MDD in adults have shown that about 20% of adults experience an attack at some point in their lives, which fits the MDD diagnosis criteria.² Among adolescents, it has been reported that the prevalence of MDD increases significantly between the ages of 13 and 18, reaching the rates similar to those seen in adults.² Although the rates vary according to the age group, the 12-month prevalence of MDD in adolescents has been determined as 7.5%.³ While similar rates are seen in women and men prior

to adolescence, MDD is seen more in women after the adolescence period (3:1).² An observational study carried out with outpatient adolescents for 8 years revealed that adolescents diagnosed with MDD displayed an improvement rate of 73% within the first 2 years, 91% within 5 years, and 94% during the follow-up period. Additionally, 67% of the adolescents in the study experienced at least 1 relapse during the follow-up period.⁴

During adolescence, the areas of the brain responsible for behavior and mood regulation, including the limbic and prefrontal cortex, undergo structural and functional changes.⁵ As a result of these neurobiological changes, cognitive processes, such as abstract thinking and problem-solving skills, change as well.⁶ Adolescence is a period

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characterized by increased frailty toward internalizing and externalizing psychopathologies related to weak mood regulation.⁷ Therefore, it is normal for adolescents to perceive, in particular, negative events and states in a more problematic manner in the emotional plane, and this can lead to mood regulation problems, maladaptive solution skills, and impulsive behaviors in adolescents. A meta-analysis that analyzed the relationship between depressive and anxiety symptoms and affect regulation strategies/impulsivity in adolescents revealed that inappropriate emotion regulation methods are used more in adolescents with high symptoms; additionally, appropriate emotion regulation skills are not used sufficiently.⁸

Major Depressive Disorder causes insufficiencies in cognitive skills, in addition to symptoms, such as energy loss and low mood. In the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (*DSM-5*), disorders in sub-groups, such as concentration loss, executive functions, decision-making processes, and memory, which are among cognitive skills, are indicated as diagnosis criteria.⁹ The existence of cognitive dysfunction, anhedonia, and depressive mood has been highlighted as critical factors contributing to the loss of functionality associated with depression.⁹ In some studies conducted with adult patients, it has been reported that cognitive deficits are important predictors of impairment severity in functionality.¹⁰ Metacognition, which differs from cognition, pertains to how cognitive situations are perceived rather than how situations are evaluated as they are.¹¹ In a compilation study that analyzed the relationship between metacognitive skills and depression and anxiety, a significant relationship has been found between danger perception and loss of control, which are metacognitive negative beliefs and anxiety and depression severity.¹¹

When reviewing the literature, it can be seen that the relationship between depression and impulsivity and the relationship between cognition and metacognition are analyzed separately. However, there are no studies in which the joint relationship between these concepts is analyzed. Considering the limited number of studies

carried out with adolescents, it is important that the relationship with depression is analyzed in adolescents in which cognitive and metacognitive processes are different from adult individuals. The purpose of this study is to analyze the relationship between cognitive/metacognitive skills, depression, and impulsivity/mood difficulties and to discuss potential underlying reasons for these relationships.

MATERIAL AND METHODS

Sample

Forty-five patients, who have applied to Kars Harakani State Hospital, Children and Adolescent Mental Health Diseases Polyclinic between April 27, 2023, and July 15, 2023, and 44 healthy controls were included in our study. The inclusion criteria for our study were indicated as being in the 12-18 age group, providing consent by the patients and their families to participate in the study, and being literate. The exclusion criteria for our study were indicated as having any additional psychiatric diagnosis (e.g., attention-deficit hyperactivity disorder), which can affect cognitive functions, having mental deficiency or a chronic neurological disease, not giving consent either by the individuals or their families to participate in the study, and having an acute mental condition (e.g., bipolar disorder, manic attack, psychotic depression, acute psychotic relapse), which may affect the perception of tests. Written and verbal consent of all participants was obtained. The ethics committee approval of the study was given by Kars Kafkas University Ethics Deanship Ethics Committee Chairmanship on April 26, 2023 (Approval Number: 80576354-050-99/288). The volunteers' psychiatric examination was carried out by a child-adolescent mental health clinician, an expert in the field, and Schedule for Affective Disorders and Schizophrenia for School-Age Children–Present and Lifetime Version *DSM-5* semi-structured interview was conducted as well in the diagnosis process.

Data Collection Tools

Sociodemographic Data Form: An information form, comprising both closed- and open-ended questions, was prepared to be applied to all volunteers who agreed to participate in our study. The purpose of this form is to gather information regarding their educational status, mother's age and educational background, father's age, employment status of parents, siblings, smoking habits, medical history, and any instances of mental diseases within the immediate family.

Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version–Turkish Version: This scale, developed by Kaufmann et al,¹² is a semi-structured scale that utilizes the *DSM-5* diagnosis criteria. It is used to determine the diagnosis of

MAIN POINTS

- A significant difference was found between adolescents with major depressive disorder (MDD) and healthy adolescents in terms of smoking, alcohol substance use, domestic violence, physical-sexual abuse, and suicide attempts.
- Adolescents with MDD differed from healthy adolescents in terms of emotion regulation difficulties.
- It has been found that healthy adolescents perform better on the Stroop test than adolescents with MDD.
- In the Barratt Impulsivity Scale, Behavior Rating Inventory of Executive Function (BRIEF) test, a statistically significant difference was found between the control group and the study group in all 3 areas.
- Multiple linear regression analysis revealed that executive functions determined by BRIEF were associated with depression severity and Stroop test results.

children and adolescents in the present time and in the past. Diagnoses were made based on the present interviews and the clinician’s views. The Turkish validity and reliability study was conducted by Ünal et al.¹³

Difficulties in Emotion Regulation Scale: This scale was developed by Gratz and Roemer (2004), which serves the purpose of measuring difficulties in emotion regulation.¹⁴ The 5-point Likert-style scale consists of 36 questions and is separated into 6 sub-scales as follows: “purpose, strategy, impulsivity, awareness, clarity, and non-acceptance.” These sub-scales measure emotional clarity, the skill of being aware of and accepting negative emotions, initiation of action in a negative emotion for the purpose of problem-solving, and developing efficient problem-solving skills and impulse control problems. It can be stated that as the scores get higher, the difficulties in emotion regulation also increase. The scale’s Turkish validity and reliability study was carried out by Rugancı et al.¹⁵

Barratt Impulsivity Scale 11: Barratt Impulsivity Scale 11 (BIS-11) was initially developed in 1959 by Barratt and has undergone changes over the years to its current form.¹⁶ In the 4-point Likert-type scale consisting of 30 items, all the sub-dimensions of the items are added together, and a total score is achieved. The higher the total score, the higher the impulsivity is. The lowest score that can be received from the scale is 30 points, whereas the highest score is 120 points. The scale consists of 3 sub-dimensions: attentional impulsiveness, nonplanning impulsiveness, and motor impulsiveness. The sub-scale related to attentional impulsiveness consists of 8 items and evaluates particular areas, such as concentration and flight of ideas. The motor impulsiveness sub-scale, meanwhile, consists of 11 items and evaluates moving fast and giving fast reactions. The nonplanning impulsiveness sub-scale consists of 11 items and evaluates lack of plans and tendencies about the future. The scale’s Turkish validity and reliability study was carried out by Güleç et al.¹⁷

Behavior Rating Inventory of Executive Function: Behavior Rating Inventory of Executive Function (BRIEF), developed by Gioia et al.,¹⁸ primarily evaluates the executive functions’ adaptive skills and problem-solving behaviors in daily life and consists of a total of 86 items. The scale has 2 separate forms for parents and teachers. The higher the score received from the scale, the more impaired the executive functions. The scale was adapted to Turkish by Batan et al.¹⁹ The BRIEF sub-scales are presented in Table 1. Among these sub-scales, inhibit, shift, and emotional control scores are added to calculate the “Behavior Regulation Index.” Similarly, the initiate, working memory, plan/organize, organization of materials, and monitor scores are added to determine the “Metacognition Index.” By adding these 2 indexes, the “Global Executive Composite” is calculated.

Diagnostic and Statistical Manual of Mental Disorders Fifth Edition Level 2 Depression Scale—Child Form: Diagnostic and Statistical Manual of Mental Disorders Fifth Edition Level 2 Depression Scale—Child Form (DEP) was developed with the purpose of questioning depression in children and adolescents. The scale consists of 2 forms to be filled out by parents and children-adolescents. The form for parents consists of 11 items, and the form for children and adolescents consists of 14 items. Each item questions depression symptoms experienced within the past 7 days. The total score in DEP, which is a 5-point Likert-type scale, is achieved with the addition of the 14 items. Higher scores indicate more severe depression symptoms. In our study, we utilized the adolescent self-report form. The scale was adapted to Turkish in 2017 by Yalın Sapmaz et al.²⁰

Stroop Test—Basic Sciences Research Group Form: The Stroop Test—Basic Sciences Research Group Form (ST-TBAG) is the evolved version of the Stroop test, which was first developed in 1935, and adapted to the present time. Its validity and reliability study in children and adolescents was carried out by Kılıç et al.²¹ The Stroop test consists of 5 sections, where mistakes made and the durations are recorded and compared as each section is completed. The main point of evaluation in Stroop tests emerges while saying the colors in the second card indicated in the fifth step. The other sections consist of control cards to determine the basic level with the purpose of comparison. In the validity and reliability study, it was found that the durations achieved in each section and the durations in the fifth section displayed high correlation. It was also emphasized that only the durations of the second and fifth sections can be used in the comparison. Stroop measures channeling the attention, conceptual flexibility, and operational speed.

Table 1. Barratt Impulsivity Scale, Behavior Rating Inventory of Executive Function Sub-scales

Emotional control	Regulating emotional behavior appropriately
Shift	The ability to move freely from one situation or activity or one aspect of a problem to another, in line with demands
Inhibit	Ability to control impulses and stop behavior when necessary
Plan/organize	Ability to anticipate future events, set goals, anticipate required steps, systematically perform tasks, understand and communicate key ideas
Working memory	Simultaneous holding and processing information in short-term memory.
Initiate	Ability to start a task or activity.
Organization of materials	Ability to keep in mind the relevant parts of the environment in a systematic manner.
Monitor	Supervising work performed, evaluating performance, monitoring/recording one’s and others’ efforts.

Statistical Analysis

The analysis of the study was carried out using Statistical Package for the Social Sciences (SPSS) version 24.0 (IBM SPSS Corp.; Armonk, NY, USA). The suitability of continuous variables to normal distribution was investigated using normality tests (Kolmogorov-Smirnov/Shapiro-Wilk tests). Descriptive statistics of the data are presented with n (%), for non-normalized variables, and are shown as “median (min-max),” and for normalized variables, are shown as “mean \pm SD.” Chi-square test was used in the study to show whether there was a difference between categorical variables. If the proportion of cells with expected values less than 5 in the chi-square table was below 20%, the *P*-value obtained from the Pearson chi-Square test was used, and if it was above 20%, the *P*-value obtained from the Fisher exact or Fisher-Freeman-Halton exact test was used. Mann-Whitney *U*-test was used to compare continuous variables without parametric properties in independent groups. Multiple linear regression analysis was used when the dependent variable was numerical and this result was desired to be predicted based on the values of 1 or more known variables. In multiple regression analysis, the model was created with BRIEF global executive score as the dependent variable, and DEP score, Stroop performance, and DERS total score as independent variables. A significance level of *P* < .05 was accepted. The reliability of the scales was evaluated with Cronbach’s alpha value. Cronbach’s alpha value of the Turkish versions of the scales used in the studies was examined. DERS was 0.94;¹⁵ Barratt 0.78;¹⁷ It was determined as between 0.60 and 0.94 for BRIEF¹⁹ and 0.81 for Stroop.²¹ Cronbach’s alpha value calculated in this study is 0.873 for DERS; 0.971 for BRIEF; 0.764 for Barratt. For Stroop, it was calculated as 0.807.

RESULTS

Our study included 45 female adolescents diagnosed with MDD and 44 healthy female control group (CG) adolescents without any psychiatric diseases, aged 12-18. The mean value age of the participating adolescents was found to be 15.22 ± 1.64 . Sociodemographic and clinical characteristics were compared between MDD and CG groups. The median age value was found to be 16.00 (12.00-18.00) years in the MDD group and 15.00 (12.00-18.00) years in the CG group, and there was no statistically significant difference between the 2 groups (*P* = .428, Table 2). The median value of maternal age was found to be 40.00 (32.00-51.00) years in the MDD group and 39.50 (32.00-50.00) years in the CG group, and no statistically significant difference was found between the 2 groups (*P* = .953, Table 2). Suicide attempts were found in 22.22% (*n* = 10, Table 2) of the patients in the MDD group and 0.00% (*n* = 0, Table 2) of the patients in the CG group, and were found to be statistically significantly higher in the patients in the MDD

Table 2. Sociodemographic and Clinical Characteristics of Major Depressive Disorder and Control Group

	MDD (n=45) Median (Minimum- Maximum)/n (%)	CG (n=44) Median (Minimum- Maximum)/n (%)	<i>P</i>
Age	16.00 (12.00-18.00)	15.00 (12.00-18.00)	.428
Maternal age	40.00 (32.00-51.00)	39.50 (32.00-50.00)	.953
Attempted suicide			
Yes	10 (22.22)	0 (0.00)	<.001
No	35 (77.78)	44 (100.00)	
Smoking			
Never tried smoking	27 (60.00)	41 (93.18)	<.001
Tried but not smoking	16 (35.56)	3 (6.82)	
Currently smokers	2 (4.44)	0 (0.0)	
Alcohol use			
Yes	15 (33.33)	4 (9.09)	.005
No	30 (66.67)	40 (90.91)	
Sexual abuse history			
Yes	9 (20.00)	0 (0.00)	.003
No	36 (80.00)	44 (100.00)	
Physical abuse history			
Yes	10 (22.72)	1 (2.27)	.004
No	34 (77.28)	43 (97.73)	
Judicial incident history			
Yes	6 (13.33)	1 (2.27)	.110
No	39 (86.67)	43 (97.73)	

Values in bold indicate statistical significance.
CG, control group; MDD, major depressive disorder.

group (*P* < .001, Table 2). When smoking was evaluated, it was seen that 60.00% (*n* = 27, Table 2) of the patients in the MDD group and 93.18% (*n* = 41, Table 2) of the patients in the CG group had never tried smoking. It was observed that 35.56% (*n* = 16, Table 2) of the patients in the MDD group and 6.82% (*n* = 3, Table 2) of the patients in the CG group tried smoking but did not start smoking. Those who never tried smoking were found to be statistically significantly higher in the CG group, and those who tried but did not start smoking were found to be statistically significantly higher in the MDD group (*P* < .001, Table 2). Alcohol use was detected in 33.33% (*n* = 15, Table 2) of the patients in the MDD group and in 9.09% (*n* = 4, Table 2) of the patients in the CG group, and it was observed that patients in the MDD group used it at a statistically significantly higher rate (*P* = .005, Table 2). A history of sexual abuse was found to be present in 20.00% (*n* = 9, Table 2) of the patients in the MDD group and in 0.00% (*n* = 0, Table 2) of the patients in the CG group, and it was found to be statistically significantly higher in the patients

Table 3. Comparison of Difficulties in Emotion Regulation Scale and Barratt Impulsivity Scale 11 Scores Between Groups

	MDD (n=45) Median (Maximum- Minimum)	CG (n=44) Median (Maximum- Minimum)	P
DERS			
Purpose	18.00 (9.00-25.00)	13.50 (8.00-22.00)	<.001
Strategy	26.00 (12.00-36.00)	13.00 (10.00-29.00)	<.001
Impulsivity	14.00 (5.00-22.00)	9.00 (7.00-15.00)	<.001
Awareness	13.00 (7.00-22.00)	18.00 (9.00-25.00)	<.001
Clarity	15.00 (7.00-20.00)	13.00 (8.00-17.00)	.001
Non-acceptance	16.00 (6.00-29.00)	9.00 (6.00-23.00)	<.001
DERS total	102.00 (57.00-131.00)	79.00 (53.00-111.00)	<.001
BIS-11			
Attentional impulsiveness	17.00 (11.00-23.00)	16.00 (10.00-24.00)	.045
Motor impulsiveness	21.50 (14.00-35.00)	18.00 (12.00-23.00)	<.001
Nonplanning impulsiveness	25.00 (19.00-37.00)	28.00 (19.00-38.00)	.001
BIS-11 Total	61.00 (48.00-81.00)	62.00 (42.00-77.00)	.648

BIS-11: Barratt Impulsivity Scale 11; CG, control group; DERS, Difficulties in Emotion Regulation Scale; MDD, major depressive disorder.

in the MDD group ($P=.003$, Table 2). A history of physical abuse was found to be present in 22.72% ($n=10$, Table 2) of the patients in the MDD group and in 2.27% ($n=1$, Table 2) of the patients in the CG group, and it was found to be statistically significantly higher in the MDD group ($P=.004$, Table 2). Additionally, 7.86% of the participants ($n=7$, Table 2) have been involved in a judicial incident, and 8 of the participants (8.98%) have a domestic violence story. The sociodemographic data are summarized in Table 2. The groups were compared in terms of emotion regulation skills and impulsivity. Purpose, strategy, impulsivity, clarity, non-acceptance, DERS total scores were found to be statistically significantly higher in the MDD group, and awareness score was found to be statistically significantly higher in the CG group (purpose $P < .001$; strategy $P < .001$; impulsivity $P < .001$; awareness $P < .001$; clarity $P = .001$; non-acceptance $P < .001$; DERS total $P < .001$, Table 3). Attentional impulsiveness and motor impulsiveness scores were found to be statistically significantly higher in the MDD group, and Nonplanning Impulsiveness Score was found to be statistically significantly higher in the CG group (attentional impulsiveness $P = .045$; motor impulsiveness $P < .001$, nonplanning impulsiveness $P = .001$, Table 3). There was no statistically significant difference between the 2 groups in terms of BIS-11 total score ($P = 0.648$, Table 3). The comparison of DERS and Barratt scores is given in Table 3. In the Stroop test, the groups were

Table 4. Comparison of Stroop Test Performance Between Major Depressive Disorder and Control Group Groups

	MDD (n=45) Median (Maximum- Minimum)	CG (n=44) Median (Maximum- Minimum)	P
Duration (seconds)			
Stroop section 1	9.90 (7.05-20.59)	8.48 (6.28-13.57)	.011
Stroop section 2	10.09 (6.36-17.39)	8.96 (6.56-13.62)	.011
Stroop section 3	12.26 (9.09-21.18)	10.89 (8.16-16.48)	.004
Stroop section 4	15.73 (9.72-29.87)	13.30 (10.96-20.27)	.002
Stroop section 5	22.57 (14.03-45.81)	19.66 (13.50-29.80)	.009

CG, control group; MDD, major depressive disorder.

compared in terms of the total duration and number of mistakes made. Particularly in the fifth section, which is the main evaluator of the test, the control group displayed a statistically significant better performance in both total duration compared with the study group (total duration, $P = .009$, Table 4). The Stroop test performance comparison is presented in Table 4.

The cognitive performance scores of the study and control groups were evaluated using the BRIEF test. All BRIEF total and sub-scores were found to be statistically significantly higher in the MDD group than in the CG group. Behavior index regulation score, Metacognitive index score, global executive score, median values are 66.00 (39.00-99.00), 90.00 (54.00-130.00), 154.00 (94.00-229.00) in the MDD group, 51.00 (38.00-68.00), 69.50 (52.00-102.00), 122.50 (93.00-168.00) in the CG group and were found to be statistically significantly higher in the MDD group than in the CG group ($P < .001$). The summary of BRIEF scores is presented in Table 5. In order to determine the efficient factors related to the statistical difference between the BRIEF scores, the multiple linear regression analysis was used. The analysis revealed that emotion regulation scores are not effective on the BRIEF but are related to depression severity and Stroop performance (DERS, $P = .247$, $B = 0.317$ [95% CI (-0.226)-0.859]); Stroop fifth section performance, $P = .008$, $B = 1.581$ (95% CI 0.423-2.738); DEP total score, $P = .043$, $B = 0.572$ (95% CI 0.018-1.125); total explained variance R square = 0.359; $P < .001$, Table 6). The result of the regression analysis is shown in Table 6.

DISCUSSION

In our study, female adolescents diagnosed with MDD and healthy controls were compared in terms of sociodemographic and clinical data (Table 2). The comparison revealed a significant difference between the 2 groups concerning alcohol-substance use, smoking, domestic violence, physical-sexual abuse, and suicide attempt (Table 2). When the literature was analyzed, it was seen that psychiatric diseases, such as depressive and anxiety disorders, are more prevalent in adolescents who

Table 5. Comparison of Barratt Impulsivity Scale, Behavior Rating Inventory of Executive Function Scores Between Major Depressive Disorder and Control Group Groups

	MDD (n=45)	CG (n=44)	P
	Median (Maximum-Minimum)	Median (Maximum-Minimum)	
Inhibit	22.00 (15.00-41.00)	17.00 (15.00-26.00)	.001
Shift	20.00 (11.00-31.00)	18.00 (11.00-23.00)	<.001
Emotional control	22.00 (12.00-29.00)	17.00 (11.00-25.00)	<.001
Behavior regulation index	66.00 (39.00-99.00)	51.00 (38.00-68.00)	<.001
Initiate	16.00 (8.00-22.00)	12.00 (8.00-19.00)	<.001
Working memory	20.00 (12.00-33.00)	15.00 (12.00-24.00)	<.001
Plan/organize	24.00 (16.00-40.00)	20.00 (15.00-31.00)	<.001
Organization of materials	15.00 (8.00-21.00)	10.00 (8.00-19.00)	<.001
Monitor scores	15.00 (8.00-22.00)	11.00 (8.00-21.00)	<.001
Metacognitive index	90.00 (54.00-130.00)	69.50 (52.00-102.00)	<.001
Global executive score	154.00 (94.00-229.00)	122.50 (93.00-168.00)	<.001

CG,: control group; MDD, major depressive disorder.

use alcohol and substances and can be triggers for each other.²² In another study, which analyzed the frequency of depression and substance use in adolescents, it has been shown that smoking, alcohol, and substance use increase with depression and that smoking and alcohol use can predict marijuana and cocaine use.²³ It has been found that smoking and alcohol and substance use can increase impulsivity control problems besides problems related to depression. In another study carried out with adolescents over the sample of society, it has been determined that smoking increases self-harming behavior by 2 to 3 times.²⁴ The relationship between suicide thoughts and attempts and its prevalence in adolescent groups have been discussed frequently in the literature, and the findings of our study are in line with the literature data. Despite an overall

increase in suicide attempts among adolescents in recent years, the literature indicates that those experiencing depressive disorders are more prone to attempting suicide compared with their peers. Furthermore, the number of their repeated attempts are higher.²⁵ Another study revealed that risky behaviors and behavioral problems increase suicide attempts, depression, and thoughts of suicide. Notably, women appear to be more vulnerable to depression compared with men.²⁶

The relationship between domestic violence among parents or toward children and depression in children and adolescents is known. Studies have shown that both physical violence toward children and violence between parents increase depression, externalization problems, and thoughts of suicide in children and adolescents.²⁷ According to the literature, maladaptive findings, such as grandiosity, aggressive attitude toward others, and rationalization of violence, are more prevalent in adolescents who witness domestic violence or are directly subjected to physical abuse. Additionally, women have been found to be at a higher risk of developing aggressive attitudes compared with the men.²⁸

Sexual abuse is known to have a significant impact on the internalization and externalization problems in children and adolescents. A large-scale study has revealed that, in addition to an increase in depressive symptoms, the rate of medication use and suicide thoughts also increases in adolescents with a sexual abuse history.²⁹ In a study conducted in Turkey, it has been observed that post-traumatic stress disorder developed in 36.9% of abused children and adolescents, and 14% of the participants attempted suicide after the abuse.³⁰ It can be stated that all the differences between the sociodemographic and clinical data of the groups in our study align with the literature.

In our study, a significant difference was found between the group with depressive disorder and the control group regarding emotion regulation skills (Table 3). In addition, no significant difference was found between BIS-11 total scores (Table 3) In the literature, it is reported that although impulse control problems in adolescents are due to undeveloped neural pathways, these problems can increase depending on the change in the neural cycle between the amygdala and the prefrontal cortex in

Table 6. Multiple Regression Analysis Examining Barratt Impulsivity Scale, Behavior Rating Inventory of Executive Function Global Executive Score in Relation to Diagnostic and Statistical Manual of Mental Disorders Fifth Edition Level 2 Depression Scale-Child Form Score, Stroop Performance and Difficulties in Emotion Regulation Scale Total Score

Dependent Variable	Independent Variables	B	95% CI	P	VIF	P
BRIEF global executive score	DEP score	0.572	0.018-1.125	.043	2.258	<.001
	Stroop performance	1.581	0.423-2.738	.008	1.090	
	DEP total score	0.317	-0.226-0.859	.247	2.131	

The value in bold indicates statistical significance.

DEP, DSM-5 Level 2 Depression Scale-Child Form; DERS, Difficulties in Emotion Regulation Scale.

*Adjusted $R^2 = 0.359$.

situations, such as depression and anxiety disorder.³¹ In a study on temperament traits, parental attitudes, and mood regulation skills, it has been found that all 3 variables influenced the severity of depression as a moderator.³² In a meta-analysis on the effects of mood regulation strategies (cognitive restructuring, problem-solving, and acceptance) on depression, the severity of depression has been found significantly lower in individuals who display suitable skills. While acceptance has been found as the most effective mood regulation strategy, avoidance and rumination were reported as thought patterns, which display the strongest positive correlation with depression severity.⁸ The serotonergic changes in depressive adolescents can increase mood monitoring difficulties and trigger some mood disorders. It is known that serotonergic dysregulation and serotonergic agents lead to impulsivity, manic attacks, or hypomania.³³

There are numerous studies in the literature that analyze the relationship between impulse control skills and MDD. In a study carried out in an inpatient unit, it has been determined that experiencing intense negative emotions significantly increases suicide thoughts; the feeling of being triggered is closely related to carrying out a suicide attempt, and that both are higher in adolescents whose impulsivity scores are higher.³⁴ A neuroanatomic study reported that impulsivity can emerge all of a sudden with depression as a result of certain common brain areas being affected. Particularly, the lateral areas of the prefrontal cortex and decreased cortical thickness seen in depression can be important in the emergence of impulsivity.³⁵ However, the relationship between depression and impulsivity in the literature is disputable. In a study conducted in France on the relationship between the impulsivity levels and depression in 2 age groups, 13-16 and 15-19, only a relationship between impulsivity and depression has been found in the 15-19 age group.³⁶ In our study, the finding that there was no significant relationship between the impulsivity scores might be related to the group choice. Based on the literature, both the age group's characteristics and the existence of numerous factors, other than depression, that affect impulsivity might have caused this result. In our study, since adolescents who had a comorbid diagnosis other than depression have been excluded, the lack of certain conditions, which can cause impulsivity and are seen frequently with depression (attention-deficit hyperactivity disorder, behavior disorder, etc.), might have led to such a result.

In our study, a significant difference was found between the 2 groups' Stroop and BRIEF scores (Table 4, Table 5). Similarly, all of the BRIEF sub-scores have been found statistically significantly worse compared with the control group (Table 5). It is known that depression affects cognitive skills and attentional skills. Findings related to attention are diagnosis criteria in DSM-5. In a meta-analysis carried out on Stroop scores in depression, it has been shown that

depression significantly spoils Stroop performance (Hedges g , 0.98), and it has been highlighted that as depression severity increases, this impairment increases even more.³⁷ Stroop can be impaired in high impulsivity and is related to impulsivity. However, the finding that there is no difference between the groups' impulsivity scores in our study leads to the thought that this difference is due to Stroop's cognitive components (e.g., working memory) and not impulsivity.

While the BRIEF scale is a practical tool for assessing executive functions, it has not been studied in adolescents in terms of depression. Especially in studies on adolescents who have diseases, which are known to impair executive functions, such as attention deficit and hyperactivity disorder or playing games on the internet disorder, it has been determined that there are significant differences compared with healthy controls, and the scale has displayed a high validity and reliability success.^{38,39} The relationship between synaptic plasticity and executive functions is known, and problems such as alcohol and substance use or long-term depression can temporarily or permanently impair executive functions over glutamatergic pathways. Additionally, due to the ongoing neuroplastic processes, adolescents are more sensitive to these effects.⁴⁰

However, there are conflicting publications in the literature about the relationship between depression and the sub-dimensions of executive functions. In a large-scale systematic compilation, while a direct relationship has been found between depression and executive functions in some studies, a difference has not been found in parameters, which actively and directly measure executive functions in particular, such as spatial memory, attention maintenance, planning, and negative attention bias in some other studies.⁴¹

In our study, it was found that depression scores and Stroop performance influence executive functions, but they have no relationship with mood skills (Table 6). Given that Stroop performance can overlap with executive functions, this outcome was expected. However, the impact of depression scores affecting executive functions is also anticipated, considering that these scores particularly affect attention among the cognitive and maladaptive cognitive processes, such as rumination.

Our study has certain limitations. First, it is a cross-sectional case-control study. Therefore, due to the nature of the study, it gives limited information about the causality of the problem. Another limitation is that, although the intelligence level of the participants in the study was found as being within normal limits during the clinical examination, the participants were not given any intelligence tests. The differences in intelligence test scores can affect executive function performance and metacognitive performance. In our study, the patients who were being followed-up due to their MDD diagnosis were using medication as a part of their treatment. Although it

is known that these medications have limited effects on cognitive skills in these patients who were mostly using serotonin uptake inhibitors, executive functions might have been affected. Some studies in the literature state that there might be differences between female and male adolescents in terms of executive functions.⁴² Therefore, only female adolescents were included in our study. However, in order to be able to achieve closer results to the world sample and the general population, there is a need for larger scale studies with homogeneous groups, including both female and male adolescents. Executive functions are made up of numerous subheadings. Although the measurement power of the scales used in the study is good, it would be more suitable to apply different tests to evaluate different dimensions.

As a result, cognitive and metacognitive skills were found to be worse in the group diagnosed with depression compared with the healthy control group. Although it has been shown that depression has an impact on mood regulation disorders and executive functions, the causality remains unclear. Adolescents with psychosocial risk factors might be more prone to conditions like depression, anxiety disorders, or mood regulation problems. Larger scale observational studies are necessary to determine the role of executive functions or mood regulation difficulties in the etiology of depression.

Ethics Committee Approval: This study was approved by the Ethics Committee of Kars Kafkas University (Approval Number: 233; Date: April 26, 2023).

Informed Consent: Informed consent was obtained from the patients who agreed to take part in the study.

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