Research Paper: Predicting Cognitive Emotion Regulation and Academic Achievement Based on Symptoms of Attention-Deficit/Hyperactivity Disorder

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ABSTRACT

Objective: This study aimed to predict cognitive emotion regulation and academic achievement based on symptoms of attention-deficit/hyperactivity disorder.

Methods: The present study has a correlational design. The study population consisted of students at the University of Bojnord, Bojnord City, Iran, in the academic year 2017-18. Of these students, 190 were selected by a convenience sampling method. Adult self-report short-form Conners' scale and cognitive emotion regulation questionnaire were used for data collection. Academic performance was determined by the grade point average. Multivariate regression analysis was used for analysis.

Results: The results showed that hyperactivity and physical problems could predict self-blame, and hyperactivity can predict other blame and rumination. The variables of hyperactivity, impulsivity, and physical problems were also able to predict the catastrophizing strategy. Among the variables studied, only inattention predicted grade point average change.

Conclusion: Thus, the findings of the study suggest that some components of cognitive emotion regulation and academic performance can be predicted based on symptoms of attention-deficit/hyperactivity disorder.

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Highlights

- Inattention can predict grade point average change as an indicator of academic achievement.

- Hyperactivity can predict blame and rumination; hyperactivity and physical problems can predict self-blame.

- Hyperactivity, impulsivity, and physical problems can predict the catastrophizing strategy.

Plain Language Summary

Attention Deficit Hyperactivity Disorder is one of the most common developmental disorders in childhood. The disorder continues until adulthood. Many adults with Attention Deficit Hyperactivity Disorder enter university due to have normal intelligence quotient. However, they may have academic problems because of the symptoms of this disorder and fail good academic achievement. This study investigated the factors related to academic achievement in these children. The results show that some dimensions of cognitive emotion regulation and academic achievement can be predicted based on the symptoms of the disorder.

1. Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) is a childhood-onset disorder that affects cognitive control processes (Chmielewski et al., 2019; Pinzone et al., 2019). This disorder affects about 5% to 8% of children. As a neurodevelopmental disorder, ADHD is characterized by symptoms of inattention and hyperactivity/impulsivity. It is also not diagnosed in most cases alone and is comorbid with other developmental disorders, such as learning disability or coordination disorder (Duda, Casey, O'Brien, Frost, & Phillips, 2019).

ADHD is related to many problems, for example, academic performance deficit (Nugent & Smart, 2014; Langberg et al., 2016; Burr & LeFevre, 2020), grade repetition, school expulsion (Nazari, Nasri, Goodarzi, & Shahrokhi, 2017), poor social and family relationships (Biederman, Mick, & Faraone, 2013; Pollack et al., 2015 quoting Bishop, Mulraney, Rinehart, & Sciberras, 2019), and also other comorbid psychiatric disorders, especially anxiety and mood disorders (Sobanski et al., 2007; Yeom et al., 2020).

Academic performance is one of the most important functions damaged in ADHD persons (Nugent & Smart, 2014; Langberg et al., 2016; Burr & LeFevre, 2020). This disorder can impair academic achievement (Advokat, Lane, & Luo, 2011; Taylor et al., 2019). Academic achievement refers to a portion of an individual's academic status representing the score of a course, the average score for a set of courses in a lesson, or the average score in all courses (Tamannaifar, Salami, & Dashtbanzadeh, 2011).

Another domain of impairment that has recently been considered in ADHD is emotion regulation (Anastopoulos, Smith, Garrett, Morrissey- Kane, & Sommer, 2011; Richards, Deffenbacher, Rosén, Barkley, & Rodricks, 2006; Ghasempour & Ramzani, 2015). Emotion regulation refers to the ability to recognize emotions, modulate the experience, and express emotions (Besharat & Bazzazian, 2014). In other words, emotion regulation is a set of processes that leads to the initiation, maintenance, and modification of emotional situations (Shenaar-Golan, Wald, & Yatzkar, 2017). It is estimated that about 34% to 70% of people with inattention and or hyperactivity/high impulsivity have difficulties in emotion regulation (Shaw, Stringaris, Nigg, & Leibenluft, 2014). Indeed, while executive function deficits are the main focus of cognitive theories in ADHD, recent studies suggest that emotional regulation deficits can play a critical role in understanding the domains affected by this disorder (Graziano & Garcia, 2016).

Emotional regulation deficits appear to predict dysfunctions of patients with ADHD in different domains, regardless of the course of the illness (Hirsch, Chavanon, Riechmann, & Christiansen, 2018). Perhaps executive function and emotion regulation deficits can be conceptualized as the general concept of "deficits in self-regulation". Indeed, executive function and emotion regulation both are part of the self-regulatory process. ADHD as a problem of the executive function includes difficulties in behavioral and cognitive self-regulation, such as planning and time management (Barkley, 2011; Knouse, Rawson, & Dunlosky, 2020). On the other hand, in emotion regulation dysfunction, one fails to adjust or regulate the emotional state that can lead to consistent be-

haviors in achieving goals (Graziano & Garcia, 2016). Accordingly, a possible cause of academic problems in students with ADHD is the difficulty of using self-regulatory learning behaviors essential for successful academic performance (Knouse et al., 2020).

ADHD not only affects children's performance in these domains but can also affect adults' academic and occupational function and their personal well-being (Shen et al., 2018; Hirsch et al., 2018; Garcia, Rouchy, Galéra, Tzourio, & Michel, 2020). Studies have shown that the symptoms of ADHD in children often continue into adulthood (Del Ponte, Callo, Cruz, Grellert, & Santos, 2019). In a meta-analysis of follow-up studies on children with ADHD, Faraone, Biederman and Mick (2006) found that about 15% of these children still meet the full diagnostic criteria for ADHD when they reach the age of 25. About 40% to 60% of these children also have residual symptoms under the diagnostic threshold. The sub-threshold symptoms are essential because dysfunction is not only seen in people with the full syndrome but also in people with sub-threshold symptoms. In a follow-up study by Biederman et al. (2000), about 40% of children with ADHD had full diagnostic criteria for ADHD at the ages of 18-20. About 70% of them had sub-threshold criteria. However, 90% of them still had significant dysfunction.

This finding highlights the importance of residual sub-threshold symptoms in ADHD. On the other hand, Agnew-Blais et al. (2016) reported that a significant percentage of adults with ADHD do not have a history of ADHD in childhood, highlighting the need to pay attention to late-onset ADHD in adults. The notable prevalence of adulthood ADHD, on the one hand, and the effects of this disorder on the performance, especially academic performance, on the other hand, highlights to focus on this disorder in university students. McKee (2008) reported that about 7.5% of university students reported a number of symptoms required for ADHD diagnosis. In Shen et al. (2018) study, the prevalence of ADHD in a large sample of university students was 3.5%. Higher Education Research Institute in the USA reported 5% of the prevalence of ADHD among freshmen in 2010 (Higher Education Research Institute, 2011). In Iran, the prevalence of ADHD among students at Ardabil University of Medical Sciences was 8.6% (Sadeghi Movahed, Molavi, Samadzadeh, Shahbazzadegan, & Askari Moghadam, 2013). These statistics indicate that the prevalence of ADHD in university students is notable. However, while many studies have investigated the psychological and functional effects of ADHD in childhood, less information is available on the

effects of ADHD in adulthood. In our search, we did not find any published Iranian studies examining academic performance and emotion regulation (as two critical domains related to self-regulation) in university students with ADHD symptoms. However, given that a significant proportion of students are likely to have symptoms of this disorder, it is necessary to identify its consequences, especially in relation to academic issues, to provide the services that may be needed. Accordingly, the present study aims to examine the role of ADHD symptoms in predicting academic achievement and cognitive emotion regulation in a sample of university students.

2. Methods

Study project and participants

This research is a correlational study. The study population consisted of students at the University of Bojnord, Bojnord City, Iran. The study sample was selected by the available sampling method. The sample size was calculated based on the proposed formula by Tabachnick and Fidell (2013). Accordingly, in multivariate regression, the sample size is determined by $n > 50 + 8m$, where m refers to the number of independent variables. As a result, the minimum sample required for this study should be more than 82 (m=4). In the present study, 190 subjects were enrolled.

The inclusion criteria for students were conscious desire and satisfaction to participate in the research, and the exclusion criteria were major psychological disorders, use of psychiatric drugs, history of seizures, and physical illness.

In this study, two questionnaires were used to collect information. Before presenting the questionnaires to the students, the subjects were given information about the research project. If the subjects agreed, they were first given the attention-deficit/hyperactivity disorder questionnaire. After completing this tool, the next questionnaire, which was cognitive emotion regulation, was given to them.

Students' educational status was determined based on the total grade point average extracted from their transcripts. Students were assured that their information would remain confidential and that the results would be made available to them if they wanted.

Study tools

Conners' Adult ADHD Rating Scale (CAARS)

Conners' Adult ADHD Rating Scale (CAARS) is a diagnostic questionnaire. It is also a valid and reliable

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instrument, consisting of 26 items rated from 0 to 3 and have five subscales (Alizadeh, Birami, & Hashemi, 2013). The subscales include inattention/memory problems, hyperactivity/restlessness, impulsivity, self-concept problems, and hyperactivity/inattention.

In the study of Charles et al. (2006 quoted by Alizadeh et al., 2013), each of these subscales had a good internal consistency coefficient so that the alpha coefficients for each of the scales were 0.87 for inattention/memory problems, 0.74 for hyperactivity/restlessness, 0.81 for, impulsivity, 0.89 for self-concept problems, and 0.85 for hyperactivity/inattention, indicating acceptable reliability coefficients. The hyperactivity subscale is an indicator for the general level of ADHD symptoms which can consider as the best screen to identify people at risk for ADHD. In the study of Arabgol, Hayati and Hadid (2004), the questionnaire was administered to 20 subjects, and its validity was calculated by the Cronbach alpha method, which was 81%. Also, its content validity was evaluated by three psychiatrists and assessed as appropriate.

Cognitive Emotion Regulation Questionnaire (CERQ)

Garnefski et al. developed the Cognitive Emotion Regulation Questionnaire (CERQ) in 2001. The structure of this questionnaire is multidimensional and is used to identify cognitive coping strategies after an unfortunate experience. This questionnaire has 36 items and 9 subscales: self-blame, other blame, rumination, catastrophizing, positive refocusing, positive reappraisal, acceptance, planning, and putting into perspective. The first four subscales assess negative strategies, and the next five subscales assess positive cognitive emotion regulation strategies.

Its internal consistency calculated by the Cronbach alpha was reported as 0.93 for the whole questionnaire, 0.87 for negative strategies, and 0.91 for positive strategies. The Persian version of this questionnaire has been evaluated by Aminabadi, Khodapanahi and Dehghani (2011). Yousefi (cited in Mohammadzade & Rahimi, 2017) calculated the reliability of this tool using the Cronbach alpha coefficient, which were 0.91 and 0.87 for positive and negative strategies, respectively. The validity of this scale was also examined by correlations

between negative strategies with depression and anxiety scale scores in 28 items of the General Health Questionnaire, 0.35 and 0.37. In the research of Mohammadzadeh and Rahimi (2017), the reliability of this tool was calculated using the Cronbach alpha coefficient from 0.54 (for acceptance) to 0.87 (for positive reappraisal).

In this study, the research questionnaires were presented to the subjects with a brief introduction to the research plan, how to publish the research results in line with ethical codes, and how to complete the questionnaires. Descriptive parameters and multivariate regression analysis were used to analyze the data. Analyzes were performed using SPSS V. 22 software.

3. Results

First, we examine the demographic data and the distribution of sample members' scores in the research variables. Table 1 presents the demographic characteristics, and Table 2 presents the distribution of sample members' scores in the research variables.

Then statistical assumptions for multivariate regression were examined. These assumptions are normality, lack of multiple linearities, no outbound data, linearity, residual independence, and dispersion homogeneity (Plant, 2007; Tabachnick & Fidell, 2013). The results of these studies indicate that these assumptions are valid, and the data are suitable for multivariate regression analysis. Table 3 presents the Pearson correlation between the variables. Table 4 presents the results of multivariate regression analysis for predicting cognitive emotion regulation and academic achievement based on the symptoms of hyperactivity-inattention.

According to the results of multivariate regression analysis, the variables associated with hyperactivity/inattention (hyperactivity, impulsivity, physical problems, and inattention) could predict 19% of the variance in the self-blame strategy. According to these findings, only two variables of hyperactivity and physical problems play a significant role in predicting blame strategy. Also, the results for Model 2 show that the variables related to hyperactivity/inattention could predict 15%

Table 1. Demographic characteristics of sample members

Age, Y (Mean±SD)	Sex (%)	
	Male	**Female**
25.21±0.95	2.24	8.75

Table 2. Distribution of scores in variables

Variables	Mean±SD
Hyperactivity	6.81±3.3
Impulsivity	5.5±2.72
Physical problems	5.57±3.14
Inattention	5.04±2.84
Hyperactivity/Impulsivity	28.48±10.55
Self-blame	11.48±2.97
Other blame	9.46±2.93
Rumination	12.31±3.34
Catastrophizing	10.05±3.58
Average	15.45±1.99

of the variance of the other blame strategy. According to these findings, only hyperactivity plays a significant role in predicting the other blame strategy. Based on the results for Model 3, variables related to hyperactivity/inattention could predict 17% of the variance in rumination strategy. According to these findings, only hyperactivity plays a significant role in predicting rumination strategy. The results for Model 4 also show that variables related to hyperactivity/inattention could predict 30% of the variance of catastrophizing strategy. According to these findings, the three variables of hyperactivity, impulsivity, and physical problems play a significant role in predicting catastrophizing strategy. Based on the results for Model 5, the variables related to hyperactivity-inattention could predict 6% of the variance of average. According to these findings, the inattention variable has the only significant role in predicting this variable.

4. Discussion

Attention-deficit/hyperactivity disorder is one of the most common developmental disorders, it changes throughout life, and symptoms of the disorder persist in about 50% of cases until adolescence and adulthood

Table 3. Correlation matrix of study variables

Variables	1	2	3	4	5	6	7	8	9
1. Hyperactivity	1								
2. Impulsivity	0.45**	1							
3. Physical problem	0.37**	0.30**	1						
4. Inattention	0.33**	0.34**	0.53**	1					
5. Self-blame	0.38**	0.20**	0.35**	0.27**	1				
6. Other blame	0.34**	0.25**	0.29**	0.23**	0.23**	1			
7. Rumination	0.37**	0.18**	0.30**	0.16*	0.52**	0.37**	1		
8. Catastrophizing	0.42**	0.39**	0.44**	0.29**	0.36**	0.47**	0.34**	1	
9. Average	-0.01	-0.14	-0.07	-0.21**	-0.17*	-0.05	0.13	-0.03	1

**P≤0.01; *P≤0.05.

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Table 4. Results of multivariate regression analysis to predict cognitive emotion regulation and academic achievement

Predictive Variables	Criterion Variable	F	B	Beta	T	P	R²
Model 1	Self-blame	11.6***					0.19
Hyperactivity			0.25	0.27	3.68	<0.001	
Impulsivity			-0.002	-0.002	-0.003	0.9	
Physical problems			0.20	0.21	2.62	0.009	
Inattention			0.07	0.07	0.87	0.3	
Model 2	Other blame	8.71***					0.15
Hyperactivity			0.20	0.23	2.99	0.003	
Impulsivity			0.11	0.10	1.3	0.19	
Physical problems			0.14	0.15	1.84	0.07	
Inattention			0.04	0.04	0.46	0.64	
Model 3	Rumination	9.76***					0.17
Hyperactivity			0.30	0.30	3.93	<0.001	
Impulsivity			0.02	0.02	0.21	0.8	
Physical problems			0.23	0.22	2.73	0.007	
Inattention			-0.08	-0.06	-0.79	0.4	
Model 4	Catastrophizing	21.11***					0.30
Hyperactivity			0.24	0.22	3.15	0.002	
Impulsivity			0.28	0.21	3.12	0.002	
Physical problems			0.35	0.31	4.14	<0.001	
Inattention			-0.02	-0.02	-0.22	0.8	
Model 5	Average	2.17N.S					0.06
Hyperactivity			-0.02	-0.03	-0.29	0.7	
Impulsivity			-0.06	-0.09	-0.94	0.3	
Physical problems			0.06	0.09	0.93	0.3	
Inattention			-0.16	-0.22	-2.26	0.025	

***$P \leq 0.001$; **$P \leq 0.01$; *$P \leq 0.05$; NS: Non-Significant.

(Parvaresh, Ziaadini, Erfani, & Shokoohi, 2014). This disorder will have a significant impact on people's lives. This disorder can have consequences such as academic failure, job failure, and substance abuse in adults (Lashkaripur, Arabgol, & Bakhshani, 2009). Self-regulation and emotional problems are also associated with ADHD (Anastopoulos et al., 2011). Therefore, this study predicted cognitive emotion regulation and academic performance based on the symptoms of ADHD. The results of this study show that hyperactivity can predict self-blame and other blame. Hyperactivity can also predict rumination. The variables of hyperactivity, impulsivity, and physical problems could also predict the catastrophe strategy. Among the studied variables, only negligence predicted average grade change. The findings of this study are in line with the study results of Birchwood and Daley (2012), Karsazi, Nasiri, Esmaeilpour and Khanjani (2016), and Rosen et al. (2018).

According to Barkley's model, when people with ADHD are exposed to emotional situations, they exhibit greater emotional responses because of their lack of control. They have difficulty adjusting to emotional regulation compared to normal individuals. This condition results in aggressive behaviors and excessive irritability and may lead to a high degree of comorbidity with oppositional defiant disorder. The high prevalence of emotion regulation problems can lead to difficulty identifying or paying attention to emotional stimuli (Van Stralen, 2016).

Emotions overwhelm logic and reasoning ability in people with inadequate emotional development, difficulty in organizing behavior and emotion, and inadequate negative emotional expression. The persons in a variety of situations only considering the emotional context and environmental factors and make decisions without considering logical solutions. People with ADHD find it difficult to inhibit emotion-related behaviors and to modulate these behaviors (Gross, 2007, quoted in Ghasempour & Ramazani, 2015). Besides, brain magnetic resonance imaging results suggest that limbic system activity, especially the amygdala, is involved in cognitive emotion regulation in people with ADHD, which could explain the greater use of negative emotion regulation in people with ADHD (Brotman et al., 2011 quoted by Ghasempour & Ramazani, 2015).

Emotion regulation is critical for emotional well-being and effective social functioning (Ghasempour & Ramazani, 2015). Emotion regulation ability is one of the prerequisites for healthy psychological functioning, especially during or after exposure to stressors. Deficits in emotion regulation are a risk factor for psychological trauma (Jentsch, Merz, & Wolf, 2019). The individual's ability to cope with stressful situations and regulate emotion plays an essential role in dealing with psychological traumas (Kraaij & Garnefski, 2019). Evidence suggests that impairment in cognitive emotion regulation can be related to the development and persistence of the disorder (Ghasempour & Ramezani, 2015).

This study confirms other studies showing a link between ADHD and academic performance (Biederman et al., 1998; Frazier et al., 2007 quoted by Birchwood & Daley, 2012). Attention problems are significantly correlated with standard reading and mathematics measures (Tamm et al., 2016). Symptoms of ADHD can be good predictors and show that people who report more severe symptoms of ADHD are poorer in education (Birchwood & Daley, 2012). Inattention can make class assignments difficult, lead to failure to follow class instructions, and prevent completing class projects (Marcus & Durkin, 2011).

Students with ADHD are increasingly accepted at universities, and their academic and psychological problems are significantly higher than their normal peers. An essential issue in this regard is identifying the particular services that these students need. While the unique educational and mental health services required by children with ADHD are considered, there is relatively little knowledge about the problems of university students with ADHD and the services they need. However, paying attention to students' special needs with ADHD in the educational and psychological domains will probably increase their success at university (Maxman, 2018). The present study results highlight the need to consider interventions related to improving emotion regulation and cognitive and behavioral regulation skills for university students with ADHD.

5. Conclusion

This study, like other studies, has limitations such as sample size, a specific city, and specific age range and not using diagnostic interviews to assess the symptoms of ADHD. Therefore, caution should be exercised in generalizing research findings. It is suggested that future studies examine the symptoms of ADHD concerning other variables such as work performance, quality of life, and executive functions.

Ethical Considerations

Compliance with ethical guidelines

All the ethical principles related to research are considered in this article. Participants were informed about the reason for conducting the research and its stages. They were assured that their information would be kept completely confidential. They could leave the research whenever they wanted. If they wished, they could be informed of the research results.

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Authors' contributions

Conceptualization, data collection: Roghayeh Asadi Gandomani; Data analysis: Khadije Alavi; Writing original draft: Roghayeh Asadi Gandomani, Narges Moein; Review & editing: All authors.

Conflict of interest

The authors declared no conflict of interest.

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