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Behavior Regulation And Attention Problems In Children Between 11 And 18 Years Of Age

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Abstract

Background: Our study aimed to confirm that children who have a higher level of ADHD have higher scores in behavior regulation issues compared to the control group without ADHD.
Methods: This study involved school-based research. There were 1,260 participants, ranging from 11 to 18 years of age. The mean age was 14.23 years (SD = 2.24); there were 46.8% male and 53.2% female participants.
Results: The ADHD group was found to have more significant behavior regulation problems than the control group, t (1258) = - 15.954, p < .001. The results indicated that females with ADHD were more at risk to have higher scores in the behavioral regulation index (BRI) compared to boys with ADHD, but not for the control group. Children from urban parts have presented higher score on BRI compare to rural parts in both groups (ADHD vs control).
Conclusion: Inhibitory control may be a central problem for children with ADHD. Early understanding of gender differences or the effects of demographic variables in relation to the clinical picture of ADHD is of great importance in terms of early and adequate treatments for ADHD.

Keywords: ADHD, children, behavior regulation, executive functions.

Introduction

Over the past decades, studies have changed their trajectory from treating attention deficit hyperactivity disorder (ADHD) as a behavioral illness to a new paradigm that may provide a useful way to integrate many of the unincorporated parts of ADHD's connectivity with executive functions (EFs). This new paradigm provides an integrated understanding of the relationship between brain development and the cognitive functions that underlie ADHD, without regarding it as a simple sequence of behavioral characteristics (Brown, 2013).

EFs are rated the highest in the hierarchy of mental processes; they include working memory, inhibition, cognitive flexibility, planning, verbal fluency as cold EF, and theory of mind as hot EF (Chan et al., 2008). Examination of EFs in adolescents with ADHD is of particular importance; given the fact that the prefrontal cortex is a key part of EF, its development is rapid in adolescence (Sowell et al., 2002). This development is associated with improved cognitive control in adolescents (Blakemore & Choudhury, 2006). These data for adolescents may clarify that if EF deficiency in

ADHD reflects a delayed maturation, where adolescents with ADHD would not manifest persistent weakness or deficiency.

A hybrid model of ADHD introduced by Barkley (1997) sees it primarily as a deficit in executive inhibition. Is believed that children with ADHD, due to poor inhibitory control, cannot delay their behavior long enough to modify their emotional response in a manner appropriate to a given situation. Inhibition control is part of behavior inhibition dimension of executive functions.

Many children with neurodevelopmental disorders (NDDs), such as ADHD, experience difficulties in regulating their behaviors (Posner et al., 2014; Shaw et al., 2014). Additionally, children with ADHD can be sensitive to external affective cues, which makes it hard for them to ignore distractions and follow instructions given by teachers or parents (Blair & Raver, 2015). They may also display frequent and intense shifts in emotions and have trouble recovering from negative events (Rosen et al., 2015).

Behavior regulation involves an adolescent's ability to regulate and monitor behavior effectively. It is composed of inhibition and self-monitoring abilities. Appropriate behavior regulation is likely to be a precursor to appropriate cognitive regulation. It enables the cognitive regulatory processes to successfully guide active, systematic problem-solving and more generally supports appropriate self-regulation. This struggle with behavioral self-regulation (BR) not only impacts children's social relationships and performance at school but also results in better daily life and mental health challenges (Barkley & Fischer, 2010).

The self-monitor scale includes awareness of the impact of one's behavior on other people and outcomes. It captures the degree to which a child or adolescent perceives themselves as aware of the effect that their behavior has on others and how their behavior compares with the standards or expectations for behavior. The sample's score on the self-monitor scale is within normal limits, suggesting that they perceive them self as appropriately aware of their functioning in social settings.

It is important to note that a good proportion of individuals who have ADHD have executive function impairments, but not all individuals who have executive function impairments have ADHD. Weyandt et al. (2014) hypothesize that EF deficits may not be specific to ADHD disorder in its entirety but may be relevant to its subcategories. However, it has been constantly discussed that this inconsistency is related to methodological factors such as sample size, ADHD subtypes, psychometric features of EF tasks, statistical methods, and other factors that may moderate this relationship.

Different studies have found that adolescents with ADHD have manifested deficits in almost all areas of EF (Loo et al., 2007). Lambek et al. (2011) state that 50% of children with ADHD meet the findings-based criteria for executive function deficit (EFD). Castellanos and Tannock (2002) emphasize that ADHD-specific factors have a primary source in EFs in domains that are related to inhibition responses, working memory, or even general weaknesses in executive control. A meta-analysis by Pennington and Ozonoff (1996) showed that problems in one of the EF domains is related to ADHD.

The comparison between different disorders in relation to EFs has shown that individuals with ADHD have greater EFDs and present with major problems, metacognition, and behavioral disorders such as inhibition control and emotion modulation (Gioia et al., 2001). Therefore, Martel et al. (2007) support the idea that cognitive EFs and behavioral control play a key role in understanding ADHD, as they are relevant factors in attention problems.

The aim of this paper is to examine the relation between behavioral regulations measured by BRIEF2-SR with high-risk

children for ADHD compared to the control group. Based on previous studies, we expect to find gender differences on the relationship, but we did not predict which gender has higher scores on behavior regulation according to ADHD symptoms. We also predicted place of living to have an interaction effect on ADHD and behavioral regulation. We did not make any predictions on whether adolescents from rural parts will have higher scores in behavioral regulation according to ADHD symptoms.

Methodology

Participants and Procedures

In this study, 1,260 adolescents participated with ages from 11 to 18. The mean age for all participants was 14.23 years [M_{ADHD} =14.67, SD_{ADHD} = 2.16 vs $M_{Control}$ = 14.21, $SD_{Control}$ =2.24; p>.05]. Further, the study had 46.8% male and 53.2% female participants. There were significant differences between males and females ($\chi 2$ (1) =5.079, p = 0.024) for the whole group, but there were no gender differences (x^2 [1] = .478 p=.533) between the ADHD group and control group. Most of the participants came from middle-income families (86%) (N = 1,084); 1% (N = 13) did not state the category they belonged to, while 1.7% (N = 21) had poor income. Participants reported that only 2.2% (N = 28) had any disease at the time of the interview. Most of them wrote with their right hands, whereas only 8.3% (N = 105) wrote with their left hands.

Prior to collection of the survey data, translation of BRIEF2-SR was performed. An independent translator then back-translated the questionnaire from the Albanian version in English. The original English and the back translation were reviewed by linguists and a team of the researchers. The questionnaire was tested with 10 adolescents for any ambiguous or misleading items. The research study has been approved by the Institutional Review Board of Medical Faculty, which governs the ethics of such research for both the Ministry of Education, Science, and Technology and the Department of Pre-University Education. Oral permission from the children and written informed consent from their parents was obtained before beginning the evaluation.

Instruments

Youth Self Report/YSR. It is a self-administered instrument (Achenbach, 1991; Achenbach & Dumenci, 2001) for 11–18-year-old children and takes 10 to 15 minutes to be filled. There are 112 questions with three-point scale answers: 0 (not true), 1 (sometimes true), and 2 (very true). The questionnaire was standardized in the Albanian culture (Shahini et al., 2011). There are three broadband scales (internalizing, externalizing, and total problems) and eight empirical syndromes (anxious/depressed, withdrawn/depressed, somatic complaints, social problems, thought problems, attention problems, rule-breaking behavior, and aggressive behavior).

Raw scores derived from the attention problem section were transformed into T-scores to allow comparison with children from the same gender and age. T-score cut-off points for attention problem scale determined the degree of deviance from normality, categorizing children as clinical, borderline, or non-clinical. In this paper, the group with ADHD is referred to children that showed clinical scores on the attention problem. The clinical category corresponds to high scores for attention problems. T-scores and row scores were assessed using assessment data management (DMA), and all other statistical analyses were performed with Statistical Package for the Social Sciences (SPSS) version 22 for Windows. Cronbach's α coefficient was used as an index of internal consistency. In our study, YSR has shown very good reliability (α = .944).

BRIEF2-SR. It is a self-report questionnaire that takes 10 minutes to be administered with youth responding to items on a four-point scale: 1 (not true), 2 (sometimes true), 3 (often), and 4 (very often). It has three broad scales: behavior regulation index (BRI), emotion regulation index (ERI), cognitive regulation index (CRI), and global executive composite scale (GEC). It is a clinical instrument for assessing abnormalities in executive functioning throughout daily behavior. All alpha values of the self-report coefficient for the index results for BRIEF2 have been reported to be above 0.89 (Gioia et al., 2015). In our study the alpha value for BRIEF2-SR was .944.

For this study, the BRI sub-scale was used, which, in its high scores, shows that adolescents have deficiencies in the ability to regulate and monitor behavior effectively. When adolescents have increased values at the cynical level, they have deficits in the processes that drive problem solving and support emotional self-regulation. The inhibitory rate assesses inhibitory control, which also includes the ability to stop someone's behavior at the right time. High scores on this scale indicate an adolescent's difficulty in resisting impulse action.

Self-Monitor Subscale. It assesses the awareness that a child has on their impact or behavior on outcomes and other people. The higher the scores of this degree, the more difficult it is for an adolescent to understand their strengths and weaknesses, as well as to monitor their influence on others.

T-scores at or above 70 are considered clinically elevated, scores 65–69 are considered potentially elevated clinically, scores 60–64 are considered elevated slightly, and scores less than 60 are in the normal range.

Data Analyses

The Cronbach's alpha (α) coefficient was used as the internal consistency index of the standardized YSR for 11–18-year-old participants and BRIEF-2 self-report. The relationships between the nominal variables were analyzed by the intersections (chi-square statistics), and the Pearson correlation was used for the continuous variables. The differences between the groups were analyzed using T-tests or ANOVA, while a two-way MANOVA was used to determine if there was an interaction effect between two independent variables on two or more dependent variables. SPSS-23 was used for analyzing the data.

Results

Table 1 shows that 71.5% of the participants were from urban areas and 28.5% from rural parts. There were no significant differences between ADHD group and control group for place of living (x^2 [6] = 4.98; p = .546). Most participants had average incomes (77.5%), while 1.7% had poor to very poor incomes (N = 22). Moreover, 2.2% of participants had an illness at the time of the interview. There were 8.3% left-handed and 91.7% right-handed participants.

The prevalence of ADHD was found in 7.5% of our sample, which is comparable with studies on other countries where the worldwide pooled prevalence of ADHD has been estimated at 7.2% (Thomas et al., 2015). As expected, the group with ADHD (M = 32.07, SD = 6.90) was found to have higher means on behavior regulation problems than the control group (M = 21.16, SD = 5.60). The T-test results showed that there were significant differences in the means of the behavioral regulation scale between the two groups t (1258) = - 15.954, p < .001.

Adolescents from the ADHD group (M = 20.25, SD = 4.79) had significantly higher scores in the inhibition scale t (1258) = - 15.758,

p < .001) compared to the control group (M = 13.50, SD = 3.94) as well as in the self-monitoring scale t (1258) = - 15.733, p < .001.

Table 1. Descriptive Statistics for the ADHD Scale and Behavioral Regulation According to Demographic variables

		ADHD		Inhibit		Self-Monitor		Behavior Regulation Index	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Gender	Male	4.17	3.30	14.11	4.33	8.07	2.70	22.18	6.29
	Female	4.27	3.30	13.92	4.45	7.89	2.71	21.81	6.49
Age group	11–15 years	3.84	3.20	13.63	4.33	7.79	2.78	21.42	6.45
	18–18 years	4.78	3.36	14.56	4.42	8.24	2.58	22.81	6.23
Place of living	Rural	3.68	3.25	13.10	4 9	7.47	2.58	20.56	6.25
	Urban	4.44	3.29	14.38	4.38	7.76	2.63	22.56	6.37
Income	High	3.88	3.13	13.87	4.17	7.99	2.63	22.00	6.08
	Overage	4.25	3.30	14.01	4.39	8.71	2.68	22.43	6.36
	Poor	5.57	3.72	15.71	5.03	7.92	3.54	24.62	7.49
	I don't know	3.31	4.03	12.69	4.59	8.30	4.15	20.63	9.06
Illness	Yes	6.56	3.56	17.75	6.09	9.94	3.92	27.69	8.99
	No	4.19	3.29	13.96	4.35	7.95	2.68	21.91	6.33
ADHD/Control	No	3.63	2.63	13.50	3.94	7.66	2.38	21.17	5.61
	Yes	11.46	1.60	20.25	4.80	11.82	3.42	32.07	6.90

Significant mean differences were found according to the place of living. Children from urban parts had significantly higher scores than the children from rural parts on the BRI t(1258) = - 5.041, p < .001.

Having an illness also significantly influenced the mean scores on the BRI t(1258) = 2.735, p < .001. Children with illness had higher scores than those without an illness. Meantime, there were no interaction effects between ADHD and illness. Incomes were found to have a significant effect on behavioral regulation scores. Children from ADHD group had higher scores compared to the control group.

A two-way ANOVA was used to test if ADHD symptoms and gender (2 x 2) affected BRI variation scores. The presence of symptoms of ADHD showed significant effects on the BRI [F(1) = 311.70, p = 0.001, $\eta 2$ = 0.199] but not on gender [F(1) = 1.43, p= 0.213, $\eta 2$ = 0.001]. An interaction effect between ADHD symptoms and gender was also found [F(3) = 4.93, p = 0.02, $\eta 2$ = 0.004]. The results showed that female participants from the ADHD group had higher scores on BRI compared to male participants from the same group.

This was not the case for the control group, wherein male participants had higher scores than female participants. The interaction effect was explored for the two subscales of BRI. On the inhibition subscale, there were no interaction effects between ADHD symptoms

and gender [F(1) = 3.12,p = 0.07, η2 = 0.002], but the interaction effect was found on the self-monitoring subscale [F(1) = 5.08, p = 0.02, η2 = 0.004]. Female participants in the ADHD group showed significantly higher scores compared to male participants. This indicated that female participants from the ADHD group did not perceive themselves as the male participants from the same group did; they were aware of the effect that their behavior has on others and how these behaviors compare with standards or expectations for the behaviors.

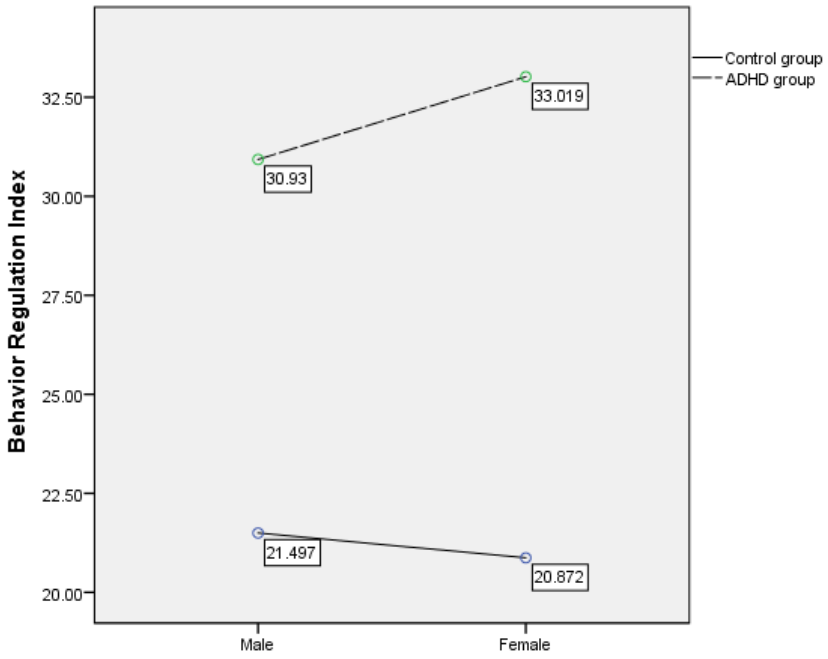

Figure 1. Discription of MANOVA test for Behavior Regulation Index according to gender and ADHD group vs control group

A two-way ANOVA was used to test the interaction effect between ADHD symptoms and group age (2 x 2) on BRI scores. The presence of symptoms of ADHD showed significant effects on the BRI [F(1) = 319.59, p < 0.001, η2 = 0.203] but not on the group age [F(1) = 1.086, p= 0.297, η2 = 0.001]. An interaction effect between ADHD symptoms and group age was found [F(1) = 8.27, p = 0.004, η2 = 0.007]. Adolescents from the ADHD group had higher scores on BRI (M = 33.43, SD = 6.02) compared to the group age of 16–18-year-old (M = 31.03, SD = 7.37) participants from the same group. This tendency was the same for the control group. The results showed participants aged 11–15 from the ADHD group had the highest risk to have behavior deregulation compared to those with ADHD and without ADHD.

Adolescents participating in this study showed a high and significant correlation between behavior regulation problems with other two subscales of BRIEF (r = .758, p < .001) with emotional regulation index and cognitive regulation index (r = .770, p < .001). There were no differences between the ADHD group and control group.

To further investigate the amount of explained variance in the BRI score by the attention problems scale and the relevant control variables—age, gender, and presence of illness—regression analyses were performed.

The results showed that 20.3% of the variance of the BRI was explained by the attention problems scale. Additionally, all variables together explained 22.3% of the variance. For the attention problems scale, the difference of mean scores between females (M = 4.27, SD = 3.30) and males (M = 4.16, SD = 3.29) was not significant t (1258) = - 0.583, p =0.560).

Discussion

The research aimed to reflect the fact that children who present higher level of scores on ADHD will have a higher level of scores on the BRI compared to the control group; this was confirmed. Additionally, in both BRI subscales (inhibition scale and self-monitoring scale) adolescents who were from the group with clinical ADHD level reported higher scores than adolescents from the control group. One of the most commonly known difficulties in children with ADHD is inhibition or restriction of behavior. This is related to deficits in EFs and problems in this discouraging behavioral disruption of people with ADHD (Schoemaker et al., 2012).

Regarding ADHD in adolescents, there are not many studies regarding neurodevelopmental mechanisms, but it has been recently reported that adolescents with ADHD compared to the control group have demonstrated low performance in EF measurements of inhibition and set shifting (Martel et al., 2007). The period of adolescence presents developmental sensitivity, especially to understand the symptomatology of ADHD. In this period, hyperactivity is reported to tend to decline and have improvements in attention span and impulse control (Fischer et al., 2005), but on the other hand, it has been seen that adolescents have an increased demand for autonomy and independence, which increases the worsening of the symptomatology of ADHD (Barkley et al., 2006).

Our findings are supported by the study where the rate of inhibition tended to be higher in children with ADHD compared to the control group (Jacobson et al., 2020). It was also reported that adolescents with ADHD typically manifest difficulties where decision-making is required in a new situation and self-monitoring (Clark et al., 2000).

Children with ADHD consistently have displayed impulsivity across a variety of measures (Pennington & Ozonoff, 1996; Quay, 1997). However, despite the results in many studies, it has not yet been specified how ADHD symptoms predict deficit in inhibitory control based on variables such as gender, age, or place of living. However, it is important to note that the reasons why children have problems with inhibition control may also be reflected in the lack of motivation to focus on the self-assessment scale or problems adjusting to different instructions rather than because of poor inhibitory control per se. In addition to a diagnosis of ADHD, other factors, such as gender, age, place of living, and incomes, were investigated as possible contributors to inhibitory control.

Adolescents from ages 11–15 years old had higher score on BRI compare to 16–18 years' old participants form the same group. According to the literature, children who are older show more inhibitory control regardless of whether they did or did not have a diagnosis with ADHD (Stevens et al., 2002). Even in the research of Toplak et al. (2009), ADHDs show clinically significant results in the BRIEF scales. Although childhood EF performance improves in boys and girls with ADHD, EF appears to remain impaired in further adolescence and adulthood (Skogli et al., 2014).

In terms of gender only, it was seen that the female participants from ADHD group have higher score of BRI compare to male participants from the same group. This results are consistent with Abikoff et al. (2002) and

Hinshaw (2002), as they found that girls diagnosed with ADHD expressed significantly higher levels of relational aggression than their non-diagnosed female peers. The non-gender differences in externalizing problems was reported by Shahini et al., 2015). We assume that girls who exhibit ADHD behaviors are more at risk to be bulled due to the expectation that our society has according to girls.

In terms of residence, children living in urban areas showed a high score on the BRI compared to children living in rural areas. Further, the research found evidence that supports the fact that children in rural areas tend to have higher levels of ADHD compared to children in urban areas; this is based on demographic factors and family organization systems such as low levels of education, economic conditions, and mental health impairments (Anderson et al., 2013), and not having easy access to health care (Knopf et al., 2012). We assume that our findings are related to the fact that society in Kosovo has a large movement from rural to urban areas, bringing into question the effect of sub-urbanism, which is generally related to the dynamics previously identified in rural areas. This is an area that requires a wider exploration due to the many dynamics that are related to suburbanization and are not explored. Also, in a study in Germany, it was seen that the prevalence of ADHD has increased with increasing level of urbanization (Knopf et al., 2012).

If before, outdoor exposure throughout a child lifetime has been seen as a powerful factors to reduce risk of ADHD (Donovan et al., 2019), children living in urban areas have less opportunities for such activities, as suburbanization has created overcrowding, loss of green space, and, at the same time, loss of space for such activities.

Concerning illness, children who claimed to have an illness showed high scores on the BRI than those without an illness. It is important that the children with chronic illness may suffer silently. Children with medical co-morbidity pretend to have increase at higher rate the emotional/behavior problems compare with children without illness (Wilcox et al., 2016). Numerous studies has found that children with chronic illness are at increased risk of behavioral and emotional problems (Hysing et al., 2007).

Conclusion

The study supports the association between ADHD and behavioral regulation problems by confirming the hypothesis that inhibitory control may be a central problem for children with ADHD. Early understanding of gender differences or the effects of demographic variables in relation to the clinical picture of ADHD is of great importance in terms of early and adequate treatments for ADHD, where it contributes to the improvement of public and scientific health.

Limitations

Some limitations should be noted in the current study. The fact that these analyzes were based on data obtained from a community sample can be considered as a force but also a limitation at the same time.

Regarding the evaluation of children, it would be very dimensional to receive information if parents and teachers were also interviewed. Based on the fact that the use of self-report questionnaires, which are validated in our culture (Shahini et al., 2015), in this study, we did not confirm the symptomatology through clinical evaluation. We also did not exclude from the study children who might be being treated at the time of the research. What is worth mentioning is that in Kosovo, no psychostimulants are used in the treatment of ADHD.

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Conflicts of Interest: None.

Ethical standards: The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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