**Examining the roles of cognitive flexibility, emotion recognition and metacognitions in adult Attention Deficit and Hyperactivity Disorder with predominantly inattentive presentation**

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**Abstract**

The evaluation of cognitive functions in Attention Deficit and Hyperactivity Disorder (ADHD) is fundamental to improve the efficacy of therapeutic interventions. However, the role of specific higher-order cognitive functions in adult ADHD, including cognitive flexibility, emotion recognition, and metacognitions, remain unclear. Therefore, in the current study, we aimed to examine these three distinct higher-order cognitive functions among adult ADHD individuals. Forty patients with ADHD with predominantly inattentive presentation and 42 healthy controls participated in the study.The Adult Attention Deficit and Hyperactivity Disorder Scale (AADHDS), the Wisconsin Card Sorting Test (WCST), the Reading the Mind in the Eyes Test (RMET), and the Metacognitions Questionnaire-30 (MCQ-30) were administered. Results indicated that patients with ADHD had worse metacognitions scores, in specific subdimensions, relative to healthy controls. However, cognitive flexibility and emotion recognition did not differ between the groups. Moreover, the cognitive confidence subdimension of the MCQ-30 was found to be sole significant predictor in the attention deficit subdimension of the AADHDS. Our findings suggest that lack of cognitive confidence may contribute to ADHD symptomatology despite regularly functioning cognitive flexibility and emotion recognition. Therefore, metacognitions could be a suitable target to alleviate the severity of ADHD symptoms.

**Key Practitioner Messages**

* ADHD patients had higher scores on dysfunctional metacognitions compared to healthy controls.
* Cognitive confidence predicted attention deficit symptoms.
* Cognitive flexibility and emotion recognition did not differ between ADHD patients and healthy controls.

**Keywords:** attention deficit; hyperactivity; cognitive flexibility; emotion recognition; metacognitions, symptom severity.

**Introduction**

Attention Deficit and Hyperactivity Disorder (ADHD) is one of the detrimental neurodevelopmental disorders that is often accompanied by impulsiveness, hyperactivity, and inattentiveness which yield significant impairments in maintenance of daily functioning (Ginsberg et al., 2014). Although generally diagnosed throughout childhood, ADHD has increasingly been identified in adults with a prevalence of between 2.5% and 5.0% in the general population (Fayyad et al., 2007; Kessler et al., 2006; Kooij et al., 2010). Adult ADHD frequently manifests in problems related to lack of attentiveness (e.g., disorganization, difficulty in memory tasks, planning) rather than hyperactivity (Kessler et al., 2006). These symptoms have been reported to markedly affect the occupational, interpersonal, and social aspects of individuals’ lives (Das et al., 2012).

**The associations between cognitive flexibility and ADHD**

Cognitive flexibility is defined as individual's attentiveness and awareness of diverse preferences and available discretions in miscellaneous scenarios, and a motivation to become flexible in new situations with self-efficacy (Hampshire & Owen, 2006; Martin & Rubin, 1995). Deficits in cognitive flexibility have been demonstrated in several major mental disorder groups including depression (Fossati et al., 2002), generalized anxiety, obsessive-compulsive disorder (Rosa-Alcázar et al., 2020), schizophrenia (Aydın et al., 2018), bipolar disorder (O’Donnell et al., 2017), and eating disorders (Tchanturia et al., 2012). However, the studies which have examined cognitive flexibility in ADHD have found inconsistent results. There are studies in which individuals with ADHD exhibited poor performance (Gualtieri & Johnson, 2006; Kercood et al., 2017; Roshani et al., 2020) or no significant difference in cognitive flexibility when compared to healthy individuals (Rommelse et al., 2007). Moreover, one previous systematic review which examined the neurological correlates of cognitive flexibility in ADHD patients reported lowered activation in frontal and parietal lobes compared to healthy controls (Bálint et al., 2015) and these regions were shown to be particularly related to cognitive flexibility (Barceló & Knight, 2002; Eisenberg & Berman, 2010; Yates et al., 2013). Therefore it has been acknowledged that neurological deviations may provoke disturbances in cognitive flexibility (problems with switching, decision making and recalling the information) and this may generate attention deficits in ADHD which may decrease daily functioning (Rubia et al., 2010).

**The associations between emotion recognition and ADHD**

Emotion recognition (a construct closely linked to Theory of Mind-ToM) is an aspect of social cognition and is acknowledged as one of the essential skills for processing other individuals’ mental experiences in order to provide acceptable and functional social interactions (Bora & Pantelis, 2016). This particular social cognition domain was found to be deteriorated in various mental disorders including depression (Anderson et al., 2011), anxiety disorders (Aydın et al., 2019), alcohol/substance use disorder (Ernst et al., 2010; Freeman et al., 2018), schizophrenia (Balikci et al., 2018), autism (Uljarevic & Hamilton, 2013), and Internet Gaming Disorder (Aydın et al., 2020). However, studies which assessed adult ADHD patients for emotion recognition deficits have produced inconsistent results. For example several studies have reported no differences between ADHD patients and healthy controls (Airdrie et al., 2018; Gonzalez-Gadea et al., 2013; Yilmaz et al., 2020), with one study observing lower performance in ADHD patients relative to healthy controls (Ibáñez et al., 2014). Moreover one study demonstrated a weak performance on emotion recognition only when ADHD is accompanied by conduct disorder comorbidity (Airdrie et al., 2018). It is still open to debate whether deficits in emotion recognition develop in childhood and persists through adulthood of ADHD patients or whether these impairments are autonomously derived from intellectual limitations for a specific subgroup of ADHD patients (Bora & Pantelis, 2016; Ibáñez et al., 2011).

**The associations between metacognition and ADHD**

Metacognition refers to how individuals organize, control, monitor and recognize their cognitive experiences (Flavell, 1979). According to Wells’ and Matthews’ metacognitive model of psychopathology, the Self-Regulatory Executive Function (S-REF) model, a cognitive-attentional syndrome (CAS) which involves rumination, worry, elevated threat monitoring and self-focused attention is responsible for the escalation and perpetuation of psychological distress (Wells & Matthews, 1996). The CAS is activated and maintained by metacognitions. Metacognitions are beliefs about the meaning and experience of cognition and how it should be controlled (Wells, 2006). Metacognitions have been separated into two broad categories: positive and negative. Positive metacognitions (e.g., “Worrying helps me to get things sorted out in my mind”) drive the activation of the CAS. Negative metacognitions (e.g., “I cannot stop thinking about my thoughts”) lead to an exacerbation of negative affective responses and the escalation maintenance of the CAS.

Anxiety has been found to feature in up to 25% of children with ADHD (Tannock, 2000) though the proposed pathways for the presence of anxiety in ADHD remain unclear (Nigg et al., 2004). One such pathway posits that that failures in cognitive or regulatory mechanisms lead to insufficient capacity to cope with intrusive thoughts, leading to an escalation in perseverative thinking (such as worry and rumination) and consequently anxiety. The metacognitive model of psychopathology, which was first developed for conceptualizing anxiety disorders, posits metacognitions as central to the activation of the CAS (hence rumination and worry) in the presence of intrusive thoughts. Indeed, there is an extensive research base on the key role of metacognitions across mental disorders including schizophrenia, obsessive compulsive disorder, major depression, eating disorders, substance use disorders, problematic Internet and social networking sites use (Aydın et al., 2019; Balıkçı et al., 2020; Spada et al., 2013; Sun et al., 2017). Research has also shown that negative beliefs about thoughts concerning uncontrollability and danger (e.g., “Thoughts are dangerous if not controlled”), lack of cognitive confidence (e.g. “I do not trust my memory and judgement”), and beliefs about the need to control thoughts (e.g. “Thoughts should be controlled at all times”) are typically higher in individuals with mental disorders (Sun et al., 2017). It would therefore appear plausible to assume that these beliefs should also be present in those diagnosed with ADHD in view of the frequent co-occurrence of psychological distress (be it anxiety, depression, or both) in this condition.

There are also studies on different aspects of metacognition which indicate the value of furthering our understanding of this area in respect to ADHD. For example, different aspects of metacognitive deficits (i.e. self-awareness) among children (Houck et al., 2011) and young adults (Korman et al., 2019) with ADHD have been identified. Additionally, one recent study showed metacognitive awareness deficits particularly in the attention domain of adult ADHD (Butzbach et al., 2021). Moreover, there have been researchers who have recommended Metacognitive Therapy (which is aimed at restructuring metacognitions and interrupting CAS configurations) to alleviate problems related to ADHD because of the frequent presence of anxiety/depression in this condition (Ramos-Quiroga, 2012; Solanto et al., 2010; Wasserstein & Lynn, 2001).

**Aims of the current study**

Adult ADHD is considered to be underdiagnosed (Pitts et al., 2015) and to be less adequately treated (Quintero et al., 2013) compared to childhood ADHD, besides disengagements in the treatment process were also reported during the switch of mental health services from childhood to adulthood (Hall et al., 2013). Despite enhanced coping strategies and cognitive ability arising with age, adult ADHD is still prominent in daily life impairments (Pitts et al., 2015). The above-cited studies have supported the view that different higher-order cognitive functions may be viable targets in ADHD treatment, however, inconsistent results have been reported in regard to deficits in cognitive flexibility, emotion recognition and metacognitions. Therefore, we acknowledge that there is a clear need for research which assesses the relative contribution of these three higher-order cognitive functions in adult ADHD. To our knowledge, there is no study which has evaluated these three constructs concurrently among adult ADHD patients. Accordingly, this study aimed to examine: (1) whether cognitive flexibility, emotion recognition and metacognitions differed between adult ADHD patients and healthy controls; and (2) whether cognitive flexibility, emotion recognition and metacognitions predicted adult ADHD symptoms. Our hypotheses were: (i) ADHD patients may show decreased cognitive flexibility, poor ability in emotion recognition, and higher dysfunctional metacognitions compared to healthy controls; and (ii) Decreased cognitive flexibility, poor ability in emotion recognition, and dysfunctional metacognitions may predict ADHD symptom severity.

**Methods**

**Participants**

Fifty participants with ADHD and forty-five healthy participants were recruited for this study. The patient group was randomly selected from the individuals who received regular psychostimulant treatment (methylphenidate) under the control of the psychiatric outpatient unit of Medical Faculty at Near East University in Turkish Republic of Northern Cyprus between August 2019 and June 2020. The patients met DSM-5 criteria for ADHD which were confirmed with a Structured Clinical Interview for DSM-5 (Elbir et al., 2019). Inclusion criteria for the patient group were: (a) to be 18-40 years of age; (b) to have an ADHD diagnosis; (c) to not have had hospital admission in last 6 months; and (d) to not have had treatment changes in last 3 months. The exclusion criteria were: (a) the presence of substance and/or alcohol use disorder; (b) the presence of mental retardation; (c) the presence of a neurocognitive disorder (e.g., Alzheimer's disease, traumatic brain injury); and (d) the presence of comorbid mental disorders (e.g., ADHD with generalized anxiety disorder, ADHD with major depression). After completion of patient recruitment phase, we placed an advertisement on the internet and made an announcement through social media platforms for the healthy control group recruitment. Inclusion criteria for the healthy controls were: (a) to be 18-40 years of age; and (b) to not have any psychiatric diagnosis. The exclusion criteria of the patient group were also set for the healthy controls. Healthy controls’ psychiatric examination were performed using the Structured Clinical Interview for DSM-5 (Elbir et al., 2019). Participants were informed about their right to withdraw from the study at any time without any risk of penalty. The patient group discontinued psychostimulant medications (methylphenidate) for 24 hours prior to participation in order to partially limit the enhancing effects of methylphenidate on performed cognitive tasks (Linssen et al., 2014). Additionally, both groups were notified not to use nicotine and/or alcohol for at least 8 hours before participating in the study to control for its potential effects on focusing on cognitive tasks (Ernst et al., 2001; Kalmijn et al., 2002). The administration of the tests lasted 30 minutes on average. All participants provided written informed consent, however 9 participants from the patient group and 3 participants from the healthy control group did not want to continue the test procedure. Additionally, one patient withdrew the approval of informed consent after participation. The final data was collected from 40 patients with ADHD (who had predominantly inattentive presentation and were in partial remission- age range: 19-37 years) and 42 healthy individuals. The study was approved by the Institutional Review Board of Near East University (Meeting no: 2019/71, Project no:883, Supp. 9S1-2019, 25.07.2019).

**Measures**

***Socio-demographic form***

The socio-demographic form included six questions concerning the gender, age, marital status, education level (in years), duration of disorder (in years), and duration of psychostimulant treatment (in months). These questions were synthesized by the researchers based on the objectives of this study.

***Adult Attention Deficit and Hyperactivity Disorder Scale***

The Adult Attention Deficit and Hyperactivity Disorder Scale (AADHDS) is a self-report scale that has previously been used to assess ADHD symptoms among Turkish samples (Gunay et al., 2006; Turgay, 1995). It consists of three subtests: (1) attention deficit; (2) hyperactivity/impulsivity; and (3) problems regarding ADHD. The first and second subtests are formed based on the attention deficit and hyperactivity/impulsivity symptoms in DSM-IV, and each subscale comprises nine items. However, the third subtest, consisting of 30 items, is created based on clinical experience and observation. Responses are based on a 4-point Likert-style, ranging from 0 (never) to 3 (very often). Higher scores indicate higher symptom severity for the respective subtests. The AADHDS has conclusively been shown to have strong internal consistency (Cronbach’s α = 0.95) and adequate validity (Gunay et al., 2006) in Turkish samples. Cronbach’s α was 0.91 in the current sample.

***Wisconsin Card Sorting Test***

Traditionally, the Wisconsin Card Sorting Test (WCST) has been one of the main methods for assessing the cognitive flexibility aspect of executive function, and many researchers have utilized it up to the present (Aydın et al., 2018; Kado et al., 2020; Ohyama et al., 2017; Scheres et al., 2004; Seidman et al., 2004). Developed by Heaton (Heaton et al., 1993), the WCST is applied by using four stimulus cards and 64 response cards in two separate packs of cards. Each card has different shapes with varying numbers. The participants are asked to sort each response card in the pack with a stimulus card that they think is matching. The test yields results in: (1) categories achieved (WCST-CA); and (2) perseverative errors (WCST-PE). The first result refers to correct answers given by participants 10 times in a row; the second result refers to answers that are not consecutively correct. The WCST has been adapted into Turkish, and it was found to be valid and reliable (Karakaş, S., Irak, M., & Ersezgin, 1998). The computerized version of the WCST was used in this study.

***Reading the Mind in the Eyes Test***

The Reading the Mind in the Eyes Test (RMET), developed and revised by Baron-Cohen et al. (Baron-Cohen et al., 2001), comprises 36 photographs showing the eye region of face, of which the participants are asked to find the word among four options that best represents the complex emotional and cognitive state of the person in the photograph. The test includes photographs with positive, negative, and neutral emotions and the score is calculated for overall achievement (Harkness et al., 2005). The test has been acknowledged to be effective in identifying specific Theory of Mind impairments in populations who obtain worse scores on other Theory of Mind tests (Broicher & Jokeit, 2011). The adaptation of RMET into Turkish was conducted in 2011, and it was found valid and reliable (Yildirim et al., 2011).

***Metacognitions Questionnaire 30***

The Metacognitions Questionnaire-30 (MCQ-30), developed by Wells and Cartwright-Hatton (2004), assesses different metacognitions. The MCQ-30 is a self-report questionnaire with 30 items that are rated on a 4-point Likert scale, ranging from 1 (do not agree) to 4 (agree very much). The questionnaire includes five factors: positive beliefs about worry (MCQ-30-PBW), negative beliefs about thoughts concerning uncontrollability and danger (MCQ-30-NBT), cognitive confidence (MCQ-30-CC), beliefs about the need to control thoughts (MCQ-30-NCT), and cognitive self-consciousness (MCQ-30-CSC). Higher scores indicate higher levels of dysfunctional metacognitions. The validity and reliability study on the MCQ-30 has been established in community samples (Spada, Mohiyedinni & Wells, 2008) and in a Turkish sample (Tosun & Irak, 2008), in which strong internal consistency (Cronbach’s α = 0.86) and adequate test–retest reliability (r from 0.40 to 0.94) were demonstrated. Cronbach’s α was 0.87 in the current sample.

**Statistical analyses**

The assumptions of normality were met according to the Shapiro-Wilk test. Chi-square and independent-samples’ t-test were conducted to explore differences in the socio-demographic variables between the patient and healthy control groups. An ANCOVA analysis was conducted to compare the WCST, RMET, and MCQ-30 subtests between patients and healthy groups, controlling for the possible effect of confounding variable/s. Since ageing negatively affects cognitive flexibility (Taconnat et al., 2009), emotion recognition (Sullivan et al., 2007), and metacognition (Palmer et al., 2014) and taking into account the potential relationship between higher education level, cognitive flexibility (Taconnat et al., 2009), emotion recognition (Denervaud et al., 2020), and metacognition (Mahdavi, 2014); we decided to control for these variables. Pearson Product moment correlations and multiple linear regression analyses were performed to explore the relationships between WCST, RMET, MCQ-30 and AADHDS subtests in the patient group. Cohen's *f* 2 which is appropriate for calculating the effect size within a regression model was computed, and according to Cohen's guidelines, *f* 2 ≥ 0.02, *f* 2 ≥ 0.15, and *f* 2 ≥ 0.35 represent small, medium, and large effect sizes, respectively (Cohen, 1988). The statistical significance (*p*) value was adjusted as 0.05, and all analyses were estimated with statistical analysis software (IBM Corp., Armonk, NY. SPSS Statistics 22.0.).

**Results**

**Group differences in socio-demographic variables**

Table 1 presents an overview of the descriptive statistics for all study measures. Differences in gender (*χ2*(1) = 0.21, *p* = 0.64) and marital status (*χ2*(2) = 2.27, *p* = 0.24) were not statistically significant between the patient and control groups. However, both groups differed significantly in regards to age (*t*(80) = 2.14, *p* = 0.03) and education level (*t*(80) = 3.59, *p* < 0.01). The patient group was older and had higher levels of education compared to the health control group.

**Group comparison of WCST, RMET, and MCQ-30 subtests**

An ANCOVA analysis was run to compare the WCST, RMET and MCQ-30 subtest scores on both samples after controlling for age and education. There were no significant effects for age (Wilks’ Lambda; *F*(8,71) = 0.73; *p* = 0.65; ηp2 = 0.07) and education (Wilks’ Lambda; *F*(8,71) = 0.82; *p* = 0.58; ηp2 = 0.08) between the groups. Additionally, the group effect was significant for the following subtests: MCQ-30-NBT, MCQ-30-CC, MCQ-30-NCT, but not for MCQ-30-PBW, MCQ-30-CSC, RMET score, WCST-CA, and WCST-PE. The patient group had higher scores on MCQ-30-NBT, MCQ-30-CC, and MCQ-30-NCT which indicates the importance of maladaptive metacognitions when compared to controls. All results are presented in Table 2.

**Bivariate correlations between AADHDS, WCST, RMET, and MCQ-30 subtests in the patient group**

The attention deficit subtest was found to be positively and significantly correlated with hyperactivity/impulsivity, problems subtests, MCQ-30-NBT, MCQ-30-CC, and MCQ-30-NCT. The hyperactivity/impulsivity subtest was found to have a positive and significant correlation with the problems subtest, MCQ-30-NBT, MCQ-30-CC, and MCQ-30-NCT. Lastly, positive and significant correlations were present between the problems subtest, MCQ-30-NBT, MCQ-30-CC, and MCQ-30-NCT. Although no significant correlation was found between AADHDS, RMET, and WCST subtests, there was a negative and significant correlation between WCST-PE and RMET score, and a positive and significant correlation between WCST-CA, and RMET score. All correlation coefficients are presented in Table 3.

**The multiple linear regression results**

Only significant variables associated with three AADHDS subtests in the correlation analysis were included in the models. MCQ-30-NBT, MCQ-30-CC and MCQ-30-NCT were entered into the equation as independent predictors whereas attention deficit, hyperactivity/impulsivity, and problems subdimensions were entered as the outcome variables, separately. MCQ-30-CC was found to be the sole significant predictor of the attention deficit subdimension of AADHDS. No significant predictors were found for hyperactivity/impulsivity and problems subdimensions. Table 4 presents the result from the liner regression. The linear regression results indicated a large effect size (*f* 2=0.45) according to Cohen’s guidelines (Cohen, 1988).

**Discussion**

This study set out to compare cognitive flexibility, emotion recognition and metacognitions between adult ADHD patients and healthy controls and to examine the associations between these higher-order cognitive functions and ADHD symptomatology. Contrary to our presumptions, cognitive flexibility and emotion recognition did not differ between the groups. Furthermore, one specific subdomain of dysfunctional metacognitions, cognitive confidence, was found to be associated with attention deficit in ADHD, although neither cognitive flexibility nor emotion recognition was correlated with symptomatology in ADHD group.

**Cognitive flexibility**

Cognitive flexibility is one of the well-studied areas in ADHD and the majority of previous findings have observed substantial impairments in this higher-order cognitive function relative to healthy controls (Antshel et al., 2010; Brown et al., 2009; Milioni et al., 2017) yet there are also non-significant findings (Rommelse et al., 2007). Our findings did not identify differences in cognitive flexibility between groups nor in correlations with symptoms of ADHD. There are several possible explanations for this result. First, the IQ of the participants might have affected the WCST performance. Milioni and colleagues (2017) have suggested that ADHD adults with higher IQ may find a broad range of intellectual strategies to overcome cognitive flexibility deficits relative to individuals with standard IQ. However, we did not measure the IQ of the participants due to lack of availability of valid and reliable adult intelligence for our sample. Furthermore, the ADHD group held a higher educational level (ranked by total years) compared to the healthy control group which may have impacted on the capability of completing the tests. A further explanation for our findings is that the psychostimulant treatment may have improved cognitive flexibility. There are studies which have provided evidence in regard to the positive effects of long-term psychostimulant treatment on cognitive flexibility (Barnett et al., 2001; Berridge & Devilbiss, 2011; Shaw et al., 2009; Vance et al., 2003). However, we did prevent the instant positive effects of psychostimulant treatment on cognitive task performance by discontinuing medication for 24 hours prior to the study. It is possible to conclude that the ADHD group in our sample may have effectively tackled their deficits in cognitive flexibility with the aid of long-term psychostimulant treatment.

**Emotion recognition**

Emotion recognition, an important aspect of social cognition, is a fundamental aptitude in preservation of social interactions (Mennin et al., 2005). In our study we applied the RMET which is commonly utilized as a ToM task in various mental disorders to examine emotion recognition ability (Domes et al., 2007; Fertuck et al., 2009; Guastella et al., 2010). The findings in this study indicated that the ADHD group displayed no significant differences in emotion recognition ability when compared to the healthy control group. As is the case with cognitive flexibility, several studies which assessed adult ADHD patients with the RMET have indicated inconsistent results. For example two studies reported no difference in overall score on the RMET between ADHD and controls (Gonzalez-Gadea et al., 2013; Yilmaz et al., 2020). However, another study showed a lower performance in ADHD patients relative to controls (Agustín Ibáñez et al., 2014). It should be noted that previous studies generally tend to exhibit a decline in ToM capacity in ADHD (Ibanez et al., 2014; Ibáñez et al., 2011; Markovska-Simoska & Pop-Jordanova, 2010), with a recent meta-analysis revealing a heterogeneous distribution of effect sizes particularly for the RMET and concluding that deficits in emotion recognition may recover due to maturation and neuronal development (Bora & Pantelis, 2016). Additionally, a few studies have showed that individuals with higher education levels perform better on different emotion recognition tasks (Mill et al., 2009; Trauffer et al., 2013). Thus, the relatively higher education levels may have contributed to optimum emotion recognition ability of the patient sample. Another factor which could explain the lack of difference across the two groups in our study may is the intertwined structure of emotion recognition and cognitive flexibility. Several studies have demonstrated overlapping neural circuits and significant associations between these two cognitive constructs. Moreover, they acknowledged that the impairments in one may lead to disturbances in the other or improvements may appear simultaneously across both domains (Frye et al., 1998; Gonzalez-Gadea et al., 2013; Pineda-Alhucema et al., 2018; Tatar & Cansız, 2020). Therefore, taking into account the significant association between emotion recognition and cognitive flexibility in our sample, we can interpret that these two higher-order cognitive functions may compensate the deficits of each other during the developmental process among our sample. Another potential cause may be attributed to the emotion categories assessed in RMET task. We estimated emotion recognition capacity for positive, negative, and neutral emotions together, however, it was previously reported that ADHD patients have significant recognition difficulties particularly for negative emotions (such as fear and anger) rather than positive ones (Bora & Pantelis, 2016). Therefore, impaired performance may be possible on different emotion recognition tasks which evaluate emotions separately.

**Metacognitions**

The evidence from our research showed that metacognitions (i.e., negative beliefs about thoughts concerning uncontrollability and danger, lack of cognitive confidence, and beliefs about the need to control thoughts) were higher in the ADHD group relative to the healthy controls group. It is therefore plausible to assume that dysfunctional metacognitions which are an established transdiagnostic precipitant of distress in mental disorders (Sun et al., 2017) are also present in adult ADHD. Additionally, lack of cognitive confidence was found to be sole predictor of attention problems in ADHD.

Negative beliefs about thoughts concerning uncontrollability and danger (e.g., “I cannot control my thinking”) are acknowledged to play a role in the perpetuation of repetitive negative thinking patterns (e.g., rumination and worry) as a means of coping. These beliefs have been found to be strong predictors of generalized anxiety disorder for example (Wells, 1995; Wells & Carter, 2001). However, we excluded comorbid disorders in our sample owing to the high presence of anxiety disorders in ADHD. It is therefore plausible to assume that individuals with ADHD may show higher levels of worry (and rumination) which may be, at least in part, driven by negative beliefs about thoughts concerning uncontrollability and danger.

Cognitive confidence (e.g., “I do not trust my memory”) refers to beliefs about personal cognitive resources and capabilities (e.g. attention, memory, judgement) (Wells, 2008). Lack of cognitive confidence has been found to be present in schizophrenia and other mental disorders (Bora et al., 2010; Sun et al., 2017). Considering the potential common neurodevelopmental background of ADHD and schizophrenia (Marwaha et al., 2015), it is unsurprising that we found this particular metacognition to be a differentiator between the groups and the only predictor of symptoms severity in the ADHD group. Lack of cognitive confidence can be seen as a marker for diminished confidence in coping (Wells, 2000). In other words, metacognitive knowledge about the ineffectiveness of the ‘cognitive system’. This lack of cognitive confidence may lead to the need to anticipate problems (through worry for example) and ‘control’ cognition in order to function.

Beliefs about the need to control thoughts refer to judgements about the importance of controlling thoughts arising from consciousness which may lead to worrying and ruminating (e.g., “If I did not control a worrying thought, and then it happened, it would be my fault”) (Wells, 2008). The activation of thought suppression, rumination and worry as form of coping are associated to such beliefs (Wells & Carter, 2009). A possible explanation of the relevance of such beliefs in ADHD is that those presenting with this disorder may be monitoring internal states and wanting to exert control over signals of potential cognitive dysfunction. However, employing thought suppression as a means of coping may have a paradoxical effect which may cause intensification of the suppressed cognitive experience (Wenzlaff & Wegner, 2000).

**Limitations**

The generalizability of these results is subject to certain limitations. For instance, the relatively small sample size and correlational nature of the study precludes causal interpretation. Our patient sample consisted predominantly of individuals with inattentive presentation of ADHD who were under regular psychostimulant treatment. Perhaps, research with hyperactivity/impulsivity groups and treatment naïve patients may have yielded different results. The non-significant associations with ADHD symptoms were only reported for the cognitive flexibility aspect of executive functions and the emotion recognition facet of ToM. Therefore, various cognitive tasks indicating different aspects of executive functions (e.g., inhibitory control, working memory, etc.) and ToM (e.g., false belief, perspective thinking) may reveal different results. Owning to the associations between neurodevelopmental processes and higher-order cognitive functions, longitudinal studies could present very interesting data.

**Conclusions**

One of the strengths of this study is that it examines, simultaneously, three related but distinct higher-order cognitive functions (Roebers, 2017; Tatar & Cansız, 2020). This research partially confirms previous findings and provides additional evidence that suggests metacognitions may be an important predictor in ADHD with inattentive presentation despite the presence of relatively functioning cognitive flexibility and emotion recognition. Previous studies have suggested that different therapy methods (e.g. metacognitive executive function training, cognitive-behavioral group therapy, metacognitive therapy, dialectical behavior therapy, cognitive remediation) may generate promising outcomes in ADHD treatment (Ramos-Quiroga, 2012; Solanto et al., 2010; Tamm et al., 2014; Wasserstein & Lynn, 2001). However, researchers have also highlighted that to meticulously ascertain the cognitive deficits in ADHD is vital to enhance the efficacy of the applied treatment (Vidal-Estrada et al., 2012). Therefore, we may suggest that clinicians could consider integrating interventions that target metacognitions (e.g., attention training technique, detached mindfulness, re-appraisal of metacognitions) in the form of metacognitive therapy (Fisher & Wells, 2008; Wells, 2011; Wells and Fisher, 2011) in predominantly inattentive presentation ADHD to obtain more encouraging results in this debilitating disorder.

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**Table 1**

Sociodemographic characteristics of the study groups

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | ADHD Group (*n* = 40) |  | Control Group (*n* = 42) |  | Stats. |
|  | Mean | S.D. | Count (%) |  | Mean | S.D. | Count (%) |  |  |
| *Gender* |  |  |  |  |  |  |  |  |  |
| Male |  |  | 23 (57%) |  |  |  | 22 (52%) |  | χ2(1) = 0.21, p = .64 |
| Female |  |  | 17 (43%) |  |  |  | 20 (48%) |  |  |
| *Age* | 23.1 | 3.5 |  |  | 21.7 | 2.2 |  |  | t(80) = 2.14, **p = .03** |
| *Marital Status* |  |  |  |  |  |  |  |  |  |
| Married |  |  | 2 (5%) |  |  |  | 0 (0%) |  | χ2(2) = 2.27, p = .24 |
| Not married- in a relationship |  |  | 15 (38%) |  |  |  | 13 (31%) |  |  |
| Not married- single |  |  | 23 (57%) |  |  |  | 29 (69%) |  |  |
| *Education level (in years)* | 15.8 | 1.5 |  |  | 14.6 | 1.5 |  |  | t(80) = 3.59, **p < .01** |
| *Disease duration (in years)* | 6.5 | 5.1 |  |  |  |  |  |  |  |
| *Duration of psychostimulant (in years)* | 2.3 | 2.5 |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| *AADHDS Attention deficit* | 16.4 | 4.0 |  |  |  |  |  |  |  |
| *AADHDS Hyperactivity/Impulsivity* | 15.2 | 5.5 |  |  |  |  |  |  |  |
| *AADHDS Problems* | 43.4 | 12.8 |  |  |  |  |  |  |  |

Note. The Adult Attention Deficit and Hyperactivity Disorder Scale.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | ADHD Group (*n* = 40) |  |  Control Group (*n* = 42) |  | Stats. |  |  |
|  | Mean | *SE* |  | Mean | *SE* |  | *F* | *p* |  ηp2  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| WCST-PE | 19.20 | 1.85 |  | 19.44 | 1.80 |  | .01 | .93 | .01 |
| WCST-CA | 5.91 | .43 |  | 5.94 | .41 |  | .01 | .95 | .01 |
| RMET | 23.57 | 2.94 |  | 24.54 | 3.59 |  | 2.36 | .12 | .01 |
| MCQ-30-PBW | 12.94 | .76 |  | 11.66 | .74 |  | 1.33 | .25 | .01 |
| MCQ-30-NBT | 15.35 | .59 |  | 13.28 | .57 |  | 5.81 | **.01** | .06 |
| MCQ-30-CC | 13.90 | .77 |  | 10.97 | .75 |  | 6.80 | **.01** | .08 |
| MCQ-30-NCT | 16.41 | .79 |  | 12.79 | .77 |  | 9.84 | **<.01** | .11 |
| MCQ-30-CSC | 17.18 | .52 |  | 16.40 | .51 |  | 1.04 | .31 | .01 |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |

**Table 2**

 *Group comparison of WCST, RMET and MCQ-30 subtests showing means and the results from the ANCOVA analysis.*

Note. SE: Standard Error, WCST-PE: Wisconsin Card Sorting Task Perseverative Error; WCST-CA: Wisconsin Card Sorting Task Categories Achieved; RMET: Reading the Mind in the Eyes Test Total Score; MCQ-30-PBW: Positive beliefs about worry; MCQ-30-NBT: Negative beliefs about thoughts concerning uncontrollability and danger; MCQ-30-CC: Cognitive confidence; MCQ-30-NCT: Beliefs about the need to control thoughts; MCQ-30-CSC: Cognitive Self-consciousness.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6  | 7 | 8 | 9  | 10 | 11 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 1.Attention deficit | - | **.509\*\*** | **.547\*\*** | -.269 | .087 | .189 | .057 | **.333\*\*** | **.563\*\*** | **.322\*** | -.108 |
| 2.Hyperactivity/Impulsivity |  | - | **.491\*\*** | -.237 | .162 | .033 | .192 | **.342\*** | **.343\*** | **.440\*\*** | -.008 |
| 3.Problems |  |  | - | -.147 | .012 | .148 | .130 | **.546\*** | **.429\*\*** | **.556\*\*** | .097 |
| 4.WCST-PE |  |  |  | - | **-.694\*\*** | **-.401\*** | -.130 | -.281 | -.244 | -.091 | -.153 |
| 5.WCST-CA |  |  |  |  | - | **.408\*** | .279 | .212 | .181 | .128 | .108 |
| 6.RMET |  |  |  |  |  | - | .156 | .082 | .278 | .032 | .268 |
| 7.MCQ-30-PBW |  |  |  |  |  |  | - | .311 | .112 | .103 | .224 |
| 8.MCQ-30-NBT |  |  |  |  |  |  |  | - | **.513\*\*** | **.651\*\*** | **.494\*\*** |
| 9.MCQ-30-CC |  |  |  |  |  |  |  |  | - | **.392\*** | .003 |
| 10.MCQ-30-NCT |  |  |  |  |  |  |  |  |  | - | .194 |
| 11.MCQ-30-CSC |  |  |  |  |  |  |  |  |  |  | - |

**Table 3**

*Bivariate correlations between AADHDS, WCST, RMET and MCQ-30 subtests in the adult ADHD group*

Note. WCST-PE: Wisconsin Card Sorting Task Perseverative Error; WCST-CA: Wisconsin Card Sorting Task Categories Achieved; RMET: Reading the Mind in the Eyes Test Total Score; MCQ-30-PBW: Positive beliefs about worry; MCQ-30-NBT: Negative beliefs about thoughts concerning uncontrollability and danger; MCQ-30-CC: Cognitive confidence; MCQ-30-NCT: Beliefs about the need to control thoughts; MCQ-30-CSC: Cognitive Self-consciousness; \**p*<0.05, \*\**p*<0.01.

**Table 4**.

*Multiple linear regression results for the ADHD group*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Dependent variable | Independent variable | Standardized Beta | t | *p* | R2 | Adjusted R2 | *95% CI* [LL, UL] |
|  |  |  |  |  |  |  |  |
| Attention deficit | MCQ-30-NBT | -0.02 | -0.10 | .92 | .32 | .27 | [-.48, -.44] |
|  | MCQ-30-CC | 0.52 | 3.27 | **<.01** |  |  | [.17, .75] |
|  | MCQ-30-NCT | 0.13 | 0.72 | .47 |  |  | [-.19, .40] |
|  |  |  |  |  |  |  |  |
| Hyperactivity/Impulsivity | MCQ-30-NBT | 0.01 | 0.03 | .97 | .22 | .16 | [-.66, .69] |
|  | MCQ-30-CC | 0.20 | 1.16 | .25 |  |  | [-.18, .66] |
|  | MCQ-30-NCT | 0.35 | 1.84 | .07 |  |  | [-.03, .82] |
|  |  |  |  |  |  |  |  |
| Problems | MCQ-30-NBT | 0.24 | 1.30 | .20 | .39 | .34 | [-.50, 2.32] |
|  | MCQ-30-CC | 0.17 | 1.15 | .25 |  |  | [-.48, -.44] |
|  | MCQ-30-NCT | 0.33 | 1.91 | .06 |  |  | [-.04, 1.75] |

Note. *95% CI* [LL, UL]: 95% Confidence intervals [Lower Level, Upper Level], MCQ-30-NBT: Negative beliefs about thoughts concerning uncontrollability and danger; MCQ-30-CC: Cognitive confidence; MCQ-30-NCT: Beliefs about the need to control thoughts; MCQ-30-CSC: Cognitive Self-consciousness.