Gifted Children with ADHD: How Are They Different from Non-gifted Children with ADHD?

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ORIGINAL ARTICLE

Gifted Children with ADHD: How Are They Different from Non-gifted Children with ADHD?

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Abstract

The present study focused on inattention and hyperactivity/impulsivity differences of gifted children with and without attention deficit-hyperactivity disorder (ADHD). Based on clinical assessment utilizing the Anxiety Disorders Interview Schedule for Children (ADISC-IV) and the Wechsler Intelligence Scale for Children—Fourth Edition, attendees of a public outpatient child service (boys = 359, girls = 148), with mean age 10.60 years (SD = 3.08 years), were allocated into four groups: ADHD ($N = 350$), gifted ($N = 15$), gifted/ADHD ($N = 18$), and clinical controls ($N = 124$). The Strengths and Weaknesses of ADHD-Symptoms and Normal Behavior Scale dimensionally assessed inattention and hyperactivity/impulsivity variations. Compared to the gifted/ADHD group, the ADHD group had higher scores for inattention and comparable scores for hyperactivity/impulsivity. For most symptoms, the ADHD groups (gifted or not) rated higher than the non-ADHD groups (control and gifted without ADHD). Findings appeared to indicate that (i) ADHD is a valid diagnosis among children who are gifted, (ii) gifted children might tend to be less inattentive than non-gifted ADHD children, and (iii) ADHD-gifted children appear to differ from the non-ADHD-gifted children with regard to specific hyperactive and impulsive behaviors. The practical implication of these findings is that clinicians may wish to focus on these symptoms when diagnosing ADHD among children with high intelligence.

Keywords Gifted children · Giftedness · ADHD · Inattention · Hyperactivity · Childhood intelligence

According to the latest (fifth) edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5), attention deficit-hyperactivity disorder (ADHD) is a neurodevelopmental

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disorder observed among children (American Psychiatric Association [APA] 2013). ADHD is characterized by patterns of inattention (IA) and hyperactivity-impulsivity (HI) (APA 2013). A characteristic often defining individuals considered as gifted (at least from an intelligence perspective) is a much higher than average intelligence. A repeatedly highlighted challenge with such individuals is excessive problems with co-existing IA and HI behaviors (Hartnett et al. 2004; Mullet & Rinn, 2015; Rinn and Reynolds 2012; Rommelse et al. 2015; Webb et al. 2005). Although this has historically raised concerns about the validity of ADHD diagnosis among children considered gifted (Lind, 2001), it is now generally accepted that such a diagnosis is valid (Antshel et al. 2007; Minahim and Rohde 2015; Rommelse et al. 2015). However, challenges for the diagnoses of ADHD among gifted individuals are yet to be addressed. More specifically, there is still a dearth of information on the how inattention and/or hyperactivity/impulsivity manifestations in this particular group of children may differ compared to others including (i) non-gifted children with ADHD, (ii) gifted children without ADHD, and (iii) non-gifted and non-ADHD children. The aim of the present study was to bring more clarity to this area, by comparing groups of children differing considering the (co-)presence-absence of giftedness and ADHD, in terms of the overall severity of ADHD behaviors, as well as the specific levels of inattention (IA) and hyperactivity/impulsivity (HI) experienced.

Attention Deficit-Hyperactivity Disorder

The symptoms, subtypes, and diagnosis proposed for ADHD in DSM-IV-TR (American Psychiatric Association 2000) were similar to those in DSM-IV (APA, 1994) and DSM-5 (APA 2013). Overall, eighteen symptoms are enlisted under two separate groups, namely IA and HI, with nine symptoms for each group. The IA symptom group includes behaviors such as distractibility and difficulty focusing on tasks for a sustained period; and the HI symptom group includes behaviors such as fidgeting, excessive talking, and restlessness. DSM-IV and DSM-IV-TR contend that there are three types of ADHD: ADHD predominantly inattentive type (presence of at least six IA symptoms), ADHD predominantly hyperactive/impulsivity type (presence of at least six HI symptoms), and ADHD combined type (presence of at least six IA and six HI symptoms). These types are referred to as presentations in DSM-5 (APA 2013).

Giftedness

Giftedness in children has been a difficult (and arguably controversial) concept to clearly operationalize (Antshel et al. 2007). It has been defined in terms of high intelligence, creativity, high school performance, leadership, task commitment, and higher likelihood of attaining significant achievements in culturally valued domains (Fernández et al. 2017; Peyre et al. 2016; Pfeiffer 2012; Renzulli 1978). Despite the lack of consensus, most experts generally agree that a hallmark of giftedness is high intelligence (Carman 2013; Marland 1972), Even so, there is no consensus on what level of intelligence constitutes giftedness (Rommelse et al. 2015). Intelligence quotient (IQ), the traditional indicator of an individual's intelligence, is generally established by a well standardized IQ test. In children and adolescents, the most often used IQ test has been the Wechsler Intelligence Scale for Children (the fourth edition was utilized in the present study [Wechsler Intelligence Scale for Children—Fourth Edition, WISC-IV]; Wechsler 2002). Among others, the WISC-IV provides an overall measure of general intelligence or cognitive ability, called Full-Scale IQ (FSIQ). The FSIQ has a mean (standard deviation) of 100 (15). For the WISC-IV, FSIQ cutoff scores of 120, 125, and 130 have been used by various authors to define giftedness (Antshel et al. 2007; Budding and Chidekel 2012; Lovecky and Silverman 1998; Webb et al. 2005).

Giftedness and Attention Deficit-Hyperactivity Disorder

Although giftedness, defined in terms of IQ, is often seen as contributing positively to higher levels of educational and professional achievements (Bergman et al. 2014), some authors have suggested that (under some conditions) it can lead to emotional, behavioral, and social problems (Blaas 2014; Cross and Cross 2015; Guénolé et al. 2015). Generally, such poor outcomes have been explained in terms of overexcitability (Silverman 1993; Karpinski et al. 2018; Piechowski and Colangelo 1984) as described in Dabrowski's theory of positive disintegration (Dąbrowski 1967; Dąbrowski 1972). In this theory, overexcitability refers to the way in which an individual experiences and responds to the world in terms of psychomotor, sensory, intellectual, imaginational, and emotional domains. Dąbrowski (1967), Dąbrowski 1972) proposed that individuals who respond with psychomotor overexcitability will be hyperactive, impulsive, and inattentive, which are the core symptoms of ADHD. Indeed, there is evidence for this association (Hartnett et al. 2004; Rinn and Reynolds (2012). Some researchers have raised the possibility that this association could mean that the hyperactive, impulsive, and inattentive behaviors, shown by gifted individuals, are secondary to psychomotor overexcitability rather than pure indications of ADHD (Silverman 1993; Karpinski et al. 2018; Piechowski and Colangelo 1984). A significant consequence has been the failure to diagnose ADHD (when it is really present) among children who are gifted and/or the incorrect dual diagnosis of ADHD and giftedness (Beljan et al. 2006; Mullet & Rinn, 2015). The validity of the ADHD diagnoses among individuals who are gifted has additionally been questioned. However, a systematic review by Rommelse et al. (2015) concluded that ADHD children with high intelligence (compared to ADHD children with less than high intelligence) do not significantly differ in regard to clinical features (except possibly for hyperactivity), course/outcome, or response to treatment. Based on their findings, they concluded that there was support for the view that ADHD is a valid disorder among individuals with high intelligence (and by extension gifted). Indeed, there is empirical support for this proposition (Antshel et al. 2007, 2008, 2009).

In their first study, Antshel et al. (2007) compared groups of children who were gifted/without ADHD, gifted/with ADHD, and not-gifted/ADHD. They found that children in the gifted/with ADHD group had the following: (i) higher rates of familial ADHD in first-degree relatives, (ii) a need for more academic support, (iii) higher comorbid psychopathology, (iv) poorer performance on the WISC-III Block Design, and (v) more functional impairments. A second study of these groups during adolescence showed the same symptom persistence rates across the gifted/with ADHD and not-gifted/ADHD groups (Antshel et al. 2008). A third study (Antshel et al. 2009) compared groups of adults who were gifted/without ADHD, gifted/with ADHD, and not-gifted/ADHD. The gifted/with ADHD group reported lower quality of life, poorer familial and occupational functioning, more functional impairments, and more comorbidities. Based on the findings across these three studies, the authors concluded that individuals (including children) with a high intelligence concurrently with ADHD showed characteristics consistent with the diagnosis of ADHD among individuals (including children) with average IQ and that the diagnosis of ADHD is valid among high IQ individuals (including children). However, as these studies did not include average IQ and/or ADHD (dimensional) scores, the findings require confirmation and more careful scrutiny by studies involving such measures.

The Present Study

Although it could be argued that there is now some support for the validity of ADHD classification among children who are gifted, there are particular weaknesses in the extant literature. First, to date, no study has ever compared ADHD symptom characteristics among individuals with high intelligence (and therefore gifted from that perspective). Consequently, it is still not robustly demonstrated whether (and to what extent) children who (i) are gifted and (ii) show ADHD symptoms present differences in their IA and HI behaviors compared to non-gifted children with ADHD. Such data could contribute to better diagnosis of ADHD among gifted children and provide clearer insights into the differential interference of higher intelligence with the manifestation of the specific ADHD aspects of IA and HI. For example, at a more general level, if high intelligent (gifted) ADHD children/individuals are (i) comparable considering their (exhibited) level of ADHD symptoms with average intelligent (non-gifted) children with ADHD and (ii) also more deviant (based on their levels of IA and HI) than children who are gifted (without ADHD) and children with ADHD (not gifted), then it could be assumed that high intelligence does not significantly differentially interfere with the IA and HI symptoms exhibited. On the other hand, if individuals with ADHD (not gifted) and gifted (without ADHD) are more deviant (based on their levels of IA and HI) than individuals with average intelligence (without ADHD) and ADHD (with average intelligence), then it could be assumed that in the presence of ADHD, gifted children present at greater risk for more severe IA and HI symptoms (i.e., consistent with the twice-exceptional concept; Budding and Chidekel 2012). In contrast, if individuals who are gifted and have ADHD are less deviant (based on their levels of IA and HI) than individuals with average intelligence and ADHD, then it could be assumed that in the presence of ADHD, high intelligence could moderate the severity of the ADHD symptoms, or expressed differently, giftedness might buffer the severity of ADHD symptoms (i.e., consistent with the cognitive reserve concept; Minahim and Rohde 2015).

In that context, and although researchers have suggested that for understanding ADHD among gifted individuals, it would be necessary to compare ADHD/gifted individuals with gifted/non-ADHD individuals (Moon et al. 2008; Yewchuck and Lupart 2000), the present study argues that a much better understanding of ADHD among gifted individuals can be obtained by concurrently comparing gifted/ADHD, ADHD/not gifted, gifted/non-ADHD, and non-gifted/non-ADHD groups. Based on a review of the literature, no study to date has ever addressed this aim.

Given existing limitations and omissions in this area, the major aim of the present study was to examine the characteristics (in particular, severity) of the 18 DSM-IV ADHD symptoms (comparable to DSM-5) of gifted and average intelligence children with and without ADHD. Related to this, the study also examined the severity of the IA and HI dimensions along with the total ADHD scores across these groups. To achieve these goals, the following groups were compared: children with average intelligence (IQ 80 to 119) with an ADHD diagnosis (ADHD group), children with gifted intelligence (IQ $\geq$ 120) with an ADHD diagnosis (gifted/ADHD group), children with average intelligence (IQ 80 to 119) without ADHD (clinical control group), and children with gifted intelligence (IQ $\geq$ 120) without ADHD (gifted group). The operationalization of gifted in terms of IQ $\geq$ 120 is consistent with past literature (e.g., Antshel et al. 2007, 2008; Lovecky and Silverman 1998). Based on existing data, it was hypothesized that there would be no (or little) difference in the mean scores across the two ADHD groups (ADHD, and gifted/ADHD) for most of the separate ADHD symptoms, as well as for IA, HY, and total ADHD scores. Furthermore, it was hypothesized that these groups would have higher scores for these variables compared to the control and gifted groups. Based on the conclusions made in the systematic review by Rommelse et al. (2015), it was predicted that such differences would be more evident for the IA dimension than the HI dimension.

Method

Participants

The data for all participants were collected archivally from the Academic Child Psychiatry Unit (ACPU) of the Royal Children's Hospital, Melbourne, Australia. The ACPU is an out-patient psychiatric unit that provides services for children and adolescents. Referrals are generally from other medical services, schools, and social and welfare organizations. All parents and children were informed that the clinic would provide diagnosis and appropriate treatment and that assessment would be over 2 days, covering a range of tests involving the parents, children/adolescents, and their teachers. They were also informed that all data collected would be kept in an unidentifiable form in a secure database and would be used to support future research (following their written consent).

The records of children and adolescents, aged 6 to 17 years, referred between 2004 and 2017 ($N = 2457$), who had been clinically assessed, were screened to inform the groups of interest for the present study. In total, there were 507 participants in the study (boys = 359, girls = 148), with mean age 10.60 years ($SD = 3.08$). The maximum estimated sampling error for a number of 507 participants was -/+ 4%, which is within the recommended limits (Sanchez 2016). Participants were allocated into four groups: children with average intelligence ($n = 350$; IQ 80 to 119) with an ADHD diagnosis (ADHD group), children with gifted intelligence ($n = 18$; IQ > 120) with an ADHD diagnosis (gifted/ADHD group), children with average intelligence ($n = 124$; IQ 80 to 119) without ADHD (control group), and children with gifted intelligence ($n = 15$; IQ > 120) without ADHD (gifted group).

Table 1 shows the mean (and standard deviation) scores for age and IQ for the participants in the different groups and the results of the relevant group comparisons. As shown, the groups differed considering IQ. The two gifted groups (gifted/ADHD and gifted) had comparable scores, and their scores were higher than the scores for the control and ADHD groups. The control and ADHD groups had comparable scores, and the groups did not differ regarding their mean age. In terms of gender distribution across the groups (see Table 2), there were significant group differences (χ^2 ($df = 3$) = 10.17, $p < .05$). There were relatively more males in the ADHD (non-gifted-ADHD and gifted with ADHD) and gifted groups compared to the control group. However, the gender distribution was comparable across the ADHD and gifted groups.

Table 1 Mean (and standard deviation) scores for IQ and age in the different groups and results of group comparisons

Dependent variables	Group				Group Comparison		
	ADHD (1)	Gifted/ADHD (2)	Control (3)	Gifted (4)	F (df = 3)	p	η_p^2
IQ	93.93 (9.37)	124.00 (4.46)	97.01 (9.52)	123.33 (5.32)	105.48***	<.001	.621
Age	10.48 (3.05)	10.00 (3.77)	10.85 (3.03)	12.13 (3.11)	1.94	.122	.011

For the Levene's test of homogeneity of variance, the values for all dependent variables were not significant. Bonferroni correction was applied for group comparisons

η_p^2 partial eta squared

***=> p<.001

Table 2 provides additional information considering the fathers' education and employment as well as the annual family income (of the families that the participants came from). Briefly, in terms of the socio-economic background, most parents completed secondary school and were employed. Also, the average family annual income was AUS $50,000 or more. The four groups of interest did not differ for father's employment categories (χ^2 [df = 3] = 1.73, p = ns; Cramer's V = .071), or annual family income (χ^2 [df = 3] = 5.79, p = .001, Cramer's V = .108). However, they differed regarding fathers' education levels (χ^2 [df = 6] = 17.1, p < .01, Cramer's V = .144). More specifically, there were relatively fewer fathers in the gifted groups in the secondary education category and relatively more children in the gifted groups for tertiary education. Therefore, overall, the groups were matched in terms of (i) age, (ii) fathers' employment, and (iii) annual family income, but not for (i) gender distribution and (ii) fathers' education level.

Measures

The measures (retrieved from archival data) and included in the present study were the parent version of the Anxiety Disorders Interview Schedule for Children (ADISC-IV) (ADISC-IV-P; Silverman and Albano 1996), WISC-IV (Wechsler 2002), and the Strengths and Weaknesses of ADHD-Symptoms and Normal Behavior Scale (SWAN; Swanson et al. 2006). Additionally, a number of variables related to socio-economic background of the families were collected (father's education levels, father's employment categories, annual family income, and parental relationship).

ADISC-IV-P

The ADISC-IV-P (Silverman and Albano 1996) is a semi-structured interview, based on the DSM-IV-TR diagnostic system with robust psychometric properties (sufficient test-retest reliability over a 7 to 14-day period; good to excellent reliability; Kappa values for children between 7 and 16 years between 0.61 and 0.80; American Psychiatric Association 2000; Silverman et al. 2001). It was developed to facilitate the diagnosis of major childhood disorders including ADHD (i.e., evidence for the validity of the ADISC-IV-P ADHD module for diagnosis of children's ADHD has been provided; Jarrett et al. 2007), using children (ADISC-IV-C) and parent versions. For the present study, diagnosis was based on parent interviews for two reasons: (i) there is evidence of poor levels of agreement for diagnosis

Table 2 Frequencies (% within IQ groups) and comparisons of gender and socio-economic background factors in the different groups

Categories	ADHD groups		Non ADHD groups			
	ADHD (1)	Gifted/ADHD (2)	Control (3)	Gifted (4)	χ^2 ($df=3$)	Cramer's V
Frequencies of males and females						
Male	262 (74.9)b	13 (72.2)a b	74 (59.7)a	10 (66.7)a b	10.17*	.143
Female	88 (25.1)b	5 (27.8)a b	50 (40.3)a	5 (33.3)a b		
Frequencies of father's educational levels						
Secondary	144 (46.3)a	2 (12.5)b	45 (38.1)a	4 (30.9)a, b	17.1**	0.144
Trade school	86 (27.7)a	3 (18.8)a	35 (29.7)a	2 (15.4)a		
Tertiary	38 (32.2)a, b	11 (68.8)c	38 (32.2)a, b	7 (53.8)a, c		
Frequencies of father's employment categories						
Employed	244 (78.5)	14 (87.5)	94 (81.0)	12 (92.3)	1.73	0.071
Others	67 (21.5)	2 (12.5)	22 (19.0)	1 (7.7)		
Frequencies of different annual family income categories						
< $50,000	158 (45.1)	5 (27.8)	50 (40.3)	3 (20.0)	5.79	0.108
≥ $50,000	192 (54.9)	13 (72.2)	74 (59.7)	12 (72.2)		

Not employed also included home duties, pensioner, and retired fathers. Living apart included separated, divorced, and others. Each lowercase letter denotes a subset of study group categories whose column proportions do not differ significantly from each other at the .05 level. *df* for father education levels = 6

*=>p<.05

**=>p<.01

between information across the child and parent versions of the ADISC-IV (Grills and Ollendick 2003) and (ii) because clinical interviews of children can lead to unreliable diagnosis (Jensen, Rubio-Stipec, Canino, Bird, Dulcan, Schwab-Stone, & Lahey, 1999).

WISC-IV

The WISC-IV (Wechsler 2002) is a test of intellectual ability for children aged 6 to 16 years. It is individually administered and has 15 subtests. The Full-Scale IQ (FSIQ) comprises10 core subtests, and it has a standardized mean 100 (SD = 15). The FSIQ has excellent reliability (i.e., internal consistency and test-retest) and validity (Wechsler 2002). The original WISC-IV was standardized using a nationally representative sample of the US population, with subsequent publication of Australian norms (Wechsler, 2005). The WISC-IV scores in the present paper are based on the latter.

SWAN

The SWAN (Swanson et al. 2006) lists the 18 DSM-IV-TR symptoms for ADHD (the same as in DSM-5). However, unlike the way the symptoms are worded in DSM-IV-TR or DSM-5, the SWAN has the ADHD symptoms reworded so that they reflect strengths rather than weaknesses. For example, the DSM-IV criterion "Often avoids, dislikes, or reluctantly engages in tasks requiring sustained mental effort" is reworded as "Engage in tasks that require sustained mental effort." In the present study, the SWAN was completed by the participants' mothers. Respondents rated the occurrence of each symptom over the past 6 months on a five-point scale, ranging from "far below average" (scored 1) to "far above average" (scored 5), relative to other children of the same age. Although the original SWAN has a reference period of 1 month, a 6-month reference period was used to correspond with the diagnostic reference period in DSM-IV-TR. Furthermore, although the original version of the SWAN has a seven-point scale, initial piloting of the seven-point scale version of the SWAN in the service indicated virtually no endorsement of levels − 1 (slightly below average) and + 1 (slightly above average). Thus, the unit psychiatrists in-charge decided to collapse/merge levels − 1 and − 2 of the original scale into a single category (− 1; below average) and levels + 1 and + 2 into another single category (+ 1; above average), thereby resulting to the five-point scale used in the present study (− 1 = far below; − 2 = below; 3 = average; + 1 = above, + 2 = far above). Considering the present data, the internal consistency coefficient alpha values were very good to excellent: .89 (IA), .89 (HI), and .92 (IA/HI combined).

Procedure

For the collection of the archival data, children and parents participated in separate interviews and testing sessions with breaks over a 2-day period. Information, not used in the present study, was also obtained from teachers using various checklists and questionnaires. In all cases, parental and child consent forms were completed prior to the assessment. The consent from both parents and children gave permission for all relevant data collected during the intake clinical assessment (or provided by others) to be used in future research and was approved by the Royal Children Hospital ethics committee as part of the outpatient's unit comprehensive examination of psychopathology in children and adolescents. The data collected covered a comprehensive demographic, medical (primarily neurological and endocrinological), educational, psychological, familial, and social assessment of the children and their families. All psychological data were collected by research assistants, who were advanced postgraduate students in clinical psychology, and under the supervision of two registered clinical psychologists.

The research assistants were provided with extensive supervised training and practice by the two psychologists prior to them collecting data. Training of the ADISC-IV-P included observations of it being administered by the psychologists. The research assistants commenced administering the ADISC-IV-P only after they attained competence in its administration, as assessed by the two registered psychologists. There was adequate inter-rater reliability for the diagnoses made between the research assistants and the psychologists and between research assistants (average kappa value across all diagnoses = .88).

Standard procedures were used for the administration of all measures. Approximately 85% of the parent ADISC-IV-P interviews involved mothers only, and the remainder involved fathers only or both fathers and mothers together. Using the categorical data from the parent ADISC-IV-P, clinical diagnosis was determined by two consultant child and adolescent psychiatrists who independently reviewed the records. The inter-rater reliability for diagnoses of the two psychiatrists was very high (kappa = .90).

Statistical Analyses

Chi-square analysis (using Fisher's Exact test) was used to compare the different groups for all categorical variables (i.e., gender, father's educational levels, father's employment categories, and annual family income categories). Effect sizes for these analyses are reported in terms of Cramer's *V* and interpreted as per Cohen's (1988) suggestion (small = 0.1, medium = 0.3, and large = 0.5). For all sets of continuous variables (except age and FSIQ), multivariate analysis of covariance (MANCOVA), with group membership (ADHD, gifted/ADHD, control, and gifted) as the between-participant factor, was conducted. In these analyses, the ADHD domain scores and the ADHD symptom scores from the SWAN were the dependent variables. Given that existing data show gender is robustly associated with ADHD symptom severity (Abikoff et al. 2002; Kuhne et al. 1998; Newcorn et al. 2001), and given that gender showed some group differences (see "Participants") in the present study, it was entered as a covariate in the MANCOVAs involving the SWAN ADHD symptom ratings. Although the groups did not differ significantly for age, this variable was also entered as a covariate in these analyses to remove any possible influence by it. For significant MANCOVAs, one-way ANCOVAs were conducted to ascertain variables that were significant. One-way ANOVAs examined group difference for age and FSIQ. For all significant ANOVAs/ANCOVAs, post-hoc comparisons were conducted to ascertain how the groups compared to each other. For the MANCOVAs/ANCOVAs/ANOVAs, effect sizes are reported in terms of partial eta squared (η_p^2). Cohen's guidelines for interpreting η_p^2 (.14 = large, .06 = medium, .01 = small) were used, and statistical significance was set at an alpha level of .05, two-tailed.

Results

Comparisons of Groups for ADHD Domain Scores

The omnibus F value for the MANCOVA comparing the groups for the IA, HI, and total ADHD domain scores was significant (F [6, 1002] = 27.37, $p < .001$; $\eta_p^2 = .141$). Table 3 shows the mean (and standard deviation) scores for the ADHD domain scores for the different groups and the results of the group comparisons for these scores. As can be seen in this table, the groups differed from each other for IA, HI, and total ADHD scores. For all these variables, the two ADHD groups (ADHD and gifted/ADHD) had higher sores than the two non-ADHD groups (control and gifted). The ADHD group had either higher (for IA and total ADHD) or comparable (for HI) scores compared to the gifted/ADHD group, and the two non-ADHD groups did not differ from each other for IA, HI, and total ADHD scores. These findings can be interpreted as indicating differential validity of the four groups and therefore contending that ADHD was a valid diagnosis among the gifted children.

Table 3 Mean (and standard deviation) scores for the inattention, hyperactivity/impulsivity, and total ADHD rating scores in the different groups and results of the one-way ANCOVAs

ADHD dimension scores	Group				Group comparison		
	ADHD (1)	Gifted/ADHD (2)	Control (3)	Gifted (4)	F (df = 3)	p	η_p^2
Number	350	18	124	15			
Inattention	35.07 (5.47)	31.44 (8.74)	27.94 (5.50)	26.53 (5.71)	55.1	<.001	.248
Hyperactivity/impulsivity	33.06 (6.30)	32.36 (4.18)	27.00 (4.92)	27.88 (4.19)	37.18	<.001	.182
ADHD—total	68.49 (9.82)	63.81 (10.89)	54.90 (9.53)	54.87 (9.23)	59.18	<.001	.262

As the Box's test of equality of covariance matrices was significant, F values were based on Pillai's trace. For the Levene's test of equality of error variances, the values for all ADHD dimensions were not significant. Bonferroni correction was applied for group comparisons

η_p^2 partial eta squared

Comparisons of Groups for ADHD Symptoms

The omnibus F value for the MANCOVA comparing the groups for the individual ADHD symptom scores was significant (F [54, 1458] = 4.97, $p < .001$; $\eta_p^2 = .155$). Table 4 shows the mean (and standard deviation) scores for the 18 ADHD symptoms for the different groups and the results of the group comparisons for the symptoms. As shown, there were group differences for all symptoms. Also, for all of the nine IA symptoms (symptom numbers 1–9), and all of the nine HI symptoms (symptom numbers 10–18), the two ADHD groups (ADHD and gifted/ADHD) had consistently higher mean scores than the two non-ADHD groups (control and gifted).

Considering differences between the two ADHD groups, although the ADHD group reported consistently higher scores than the gifted/ADHD for all nine IA symptoms and the HI symptoms (numbers) 10, 11, 13, 14, 17, and 18, the picture was reversed for HI items 12 (modulate motor activity), 15 (modulate verbal activity), and 16 (reflect on questions). For these three items, the scores of the ADHD/gifted group were higher than the ADHD non-gifted group. Accordingly, these symptoms might be especially useful for the diagnosis of ADHD among individuals who are gifted (in order to differentiate them from non-gifted ADHD individuals).[1]

Discussion

The aim of the present study was to examine the ADHD symptom characteristics and differences (severity for the IA and HI dimensions as well as the total individual ADHD symptoms) of ADHD, gifted/ADHD, control, and gifted groups of children. As predicted, for all three ADHD dimensions (IA, HI, and total ADHD), there were group differences, with the two ADHD groups (ADHD and gifted/ADHD) reporting higher sores than the two non-ADHD groups (control and gifted). Additionally, compared to the gifted/ADHD group, the ADHD group had higher scores for IA and total ADHD and comparable scores for HI. At the individual symptom level, the groups also differed with the two ADHD groups (ADHD and gifted/ADHD) presenting consistently higher scores than the two non-ADHD groups. Interestingly, the two non-ADHD groups also had comparable symptom scores. Additionally, and despite the consistently higher scores of the non-gifted ADHD group across all other items, in three specific HI symptoms (i.e., 12 [modulate motor activity], 15 [modulate verbal activity] and 16 [reflect on questions]), the ADHD-gifted group showed higher scores than the non-

[1] Post-hoc power analyses: As it is possible that limited power because of the low sample size in the gifted/ADHD (N = 18) and gifted (N = 15) groups in the study may have contributed to non-significant results, G*Power 3 (Faul, Lang, & Buchner, 2007) was used to conduct post-hoc power analyses for the MANCOVA involving the ADHD domains and the IA and HI dimensions. G*Power does not provide direct computation of power for MANCOVA designs. However, this can be computed via the ANCOVA option. As a MANCOVA is essentially an ANCOVA with Bonferroni correction, the p values for the alphas need to be adjusted (critical p value or α/number of comparisons) in G*Power. For the analysis involving the domains and symptoms, power ($1 - \beta$) was set at .80, and α, two-tailed, was set at .008 (.05/number of comparisons, i.e., .05/6). Cohen's f effect sizes for these analyses were computed using the respective sample partial eta squared (η_p^2) values and the determine option in G*Power. For the analysis involving the domains, Cohen's f effect size was .405 (large effect size), and the actual power was .999. For the analysis involving the symptoms, Cohen's f effect size was .428 (large effect size), and the actual power was .998. Thus, there was sufficient power for both analyses in the study. Furthermore, bootstrapping, which amplifies sample power, at the minimum recommended level of 1000 resamples (Hayes, 2013), was employed to replicate all correlation and analysis of variance analyses resulting to non-significantly different findings.

Table 4 Mean (and standard deviation) scores for the inattention and hyperactivity/impulsivity symptoms in the different groups and results of the one-way ANCOVAs

ADHD symptom scores	Group				Group comparison		
	ADHD (1)	Gifted/ADHD (2)	Control (3)	Gifted (4)	F (df = 3)	p	η_p^2
Number	350	18	124	15			
1. Attention to detail	3.76 (0.98)	3.28 (1.02)	2.90 (1.03)	2.38 (0.72)	27.89	<.001	.143
2. Sustain attention	3.75 (0.88)	3.44 (1.20)	2.89 (0.80)	2.94 (1.12)	30.77	<.001	.156
3. Listens when spoken to	3.79 (0.78)	3.56 (0.98)	3.16 (0.75)	2.75 (0.45)	24.63	<.001	.129
4. Finishes tasks	4.18 (0.79)	3.94 (1.43)	3.35 (0.88)	3.53 (0.99)	31.96	<.001	.161
5. Organize tasks	4.03 (0.83)	3.78 (1.22)	3.30 (0.82)	3.19 (0.98)	24.87	<.001	.130
6. Mental effort	3.89 (0.89)	3.03 (1.09)	2.99 (0.97)	2.25 (0.68)	44.19	<.001	.209
7. Keep track things	3.88 (0.88)	3.58 (1.29)	3.07 (0.87)	3.19 (0.98)	23.88	<.001	.125
8. Ignore extraneous stimuli	3.98 (0.84)	3.72 (1.36)	3.13 (0.87)	3.13 (0.74)	31.80	<.001	.160
9. Remember daily activities	3.68 (0.90)	3.11 (1.08)	3.03 (0.89)	2.69 (0.60)	21.85	<.001	.116
10. Sit still	3.90 (0.93)	3.89 (0.76)	3.12 (0.79)	3.31 (0.87)	26.31	<.001	.136
11. Stay seated	3.78 (0.93)	3.56 (0.62)	2.88 (0.79)	3.56 (0.89)	31.86	<.001	.160
12. Modulate motor activity	3.46 (0.95)	3.61 (0.78)	2.89 (0.82)	2.25 (0.68)	19.71	<.001	.106
13. Play quietly	3.49 (0.94)	3.06 (0.54)	2.84 (0.84)	3.00 (0.89)	17.88	<.001	.097
14. Settle down/rest	3.74 (0.89)	3.44 (0.51)	3.12 (0.83)	3.19 (0.54)	17.08	<.001	.093
15. Modulate verbal activity	3.67 (0.99)	3.83 (0.69)	3.11 (0.80)	3.25 (0.58)	11.42	<.001	.064
16. Reflect on questions	3.64 (0.91)	3.83 (0.51)	2.94 (0.75)	2.88 (0.34)	23.90	<.001	.125
17.Await turn	3.59 (0.92)	3.44 (0.78)	2.93 (0.83)	3.13 (0.96)	19.06	<.001	.102
18. Enter conversations/games	3.81 (0.90)	3.69 (1.09)	3.17 (0.90)	3.31 (0.70)	16.67	<.001	.091

As the Box's test of equality of covariance matrices was significant, F values were based on Pillai's trace. Bonferroni correction was applied for group comparisons

η_p^2 partial eta squared

ADHD gifted group. Taken together, these findings appear to indicate that (i) ADHD is a valid diagnosis among children who are gifted as also suggested by others (e.g., Antshel et al. 2007; Minahim and Rohde 2015; Rommelse et al. 2015), (ii) gifted children might tend to be less inattentive than non-gifted ADHD children, and (iii) ADHD gifted children appear to differ (report higher scores) from the non-ADHD gifted children mainly considering specific HI behaviors involving modulation of motor and verbal activity as well as reflecting on questions.

Implications

The findings in the study have implications for the diagnosis of ADHD among gifted individuals with high levels of inattention, hyperactivity, and impulsivity behaviors and also the role of high intelligence (giftedness) among individuals with ADHD. First, the present findings are consistent with the view that the high levels of IA and HI, which are noted in some children who are gifted, may well reflect ADHD. This conclusion is warranted because the comparisons conducted supported the distinctiveness of ADHD and giftedness. Thus, an individual who is gifted and who qualifies for the diagnostic criteria of ADHD (is eligible and) should be diagnosed with ADHD. Second, with reference to the ADHD symptoms, the present findings showed that HI symptom numbers 12 (modulate motor activity), 15 (modulate verbal activity), and 16 (reflect on questions) could be relatively more useful than the other symptoms for identifying ADHD among children who are gifted. In this respect, it is worth noting that symptoms 12, 15, and 16 could essentially constitute three secondary HI behaviors resulting from the need of gifted-ADHD for higher stimulation. The practical implication of these findings is that clinicians may wish to focus on these symptoms when diagnosing ADHD among children with high intelligence. Given this, it is interesting to speculate that different criteria may need to be applied (for example, lower symptom thresholds, especially for the HI symptom group) for the diagnoses of ADHD among children who are gifted.

Third, because the present findings showed that for most symptoms, (i) there was comparable severity across the ADHD/gifted and ADHD groups and (ii) that the two ADHD groups were more deviant (considering IA, HI, and total ADHD) than the gifted without ADHD and control groups, it can be argued that high IQ/giftedness does not as significantly influence the severity of the ADHD symptoms (compared to non ADHD populations). Therefore, findings do not support the twice-exceptional concept (Budding and Chidekel 2012) except maybe in the cases of HI symptoms 12 (modulate motor activity), 15 (modulate verbal activity), and 16 (reflect on questions). This concept suggests that in the presence of ADHD, gifted children are at greater risk for more severe ADHD symptoms, which are only applicable for the three aforementioned symptoms. Similarly, results do not uniformly support the cognitive reserve concept (Minahim and Rohde 2015) which suggests that in the presence of ADHD, gifted children will show lower ADHD severity (given the aforementioned differences).

Fourth, as the present findings showed that for all three ADHD dimensions (IA, HI, and total ADHD), the gifted/ADHD had higher sores than the gifted group, it follows that both IA and HI symptoms had somewhat comparable (overall) abilities to differentiate gifted children with and without ADHD. Subsequently, clinicians may need to focus on both IA and HI symptoms and behaviors (rather than only IA symptoms and behaviors) and specifically HI behaviors of low modulation of motor and verbal activity as well as reflecting questions, when diagnosing ADHD among children with high intelligence. This view is inconsistent with the conclusion made in the systematic review by Rommelse et al. (2015) that in the presence of high intelligence, IA, but not HI, shows clinical features comparable to ADHD.

Limitations and Further Research

Although the present study provides novel and credible empirical evidence for ADHD symptom characteristics among gifted children, they may need to be viewed with some limitations in mind. First, the relatively low sample sizes for the gifted ($N = 15$) and ADHD/gifted ($N = 18$) groups need to be considered. However, power analyses indicated that despite this, the study had sufficient power (.80) to identify group differences at the critical value (α at $p < .05$), two-tailed. In this respect, although concerns may be raised about the power of the study, in reality, it was extremely difficult to obtain children for the four groups. Furthermore, bootstrapping (1000 resamples) enhanced analyses were conducted and replicated the findings. Second, the findings reported here are based on one sample of archival data, using diagnostic determinations based on the ADISC IV-P. Therefore, these may not be generalized and warrant further investigation and cross-validation on other well-diagnosed samples and diagnostic determination procedures before they can be accepted and used with confidence. Third, as all the participants in the present study were from the same clinic, it is possible that this may constitute an additional bias for the sample examined. Fourth, because the ADHD symptoms were obtained using maternal ratings of the SWAN (Swanson et al. 2006), the findings obtained in the study could be unique to maternal ratings the SWAN and not to other measures or clinical interview based data. Fifth, as the present study was based on DSM-IV diagnoses, the relevance of the findings for DSM-5 is not directly clear. However, as the symptoms, subtypes (presentations) and diagnosis proposed for ADHD in DSM-5 (American Psychiatric

Association 2013) are quite similar to those in DSM-IV (APA, 1994) and DSM-IV-TR (APA 2000); this may be of little consequence. Sixth, as the definition of giftedness in terms of high IQ (FSIQ ≥ 120) was adopted, the findings may be restricted to this group of children and not to giftedness in general as giftedness in a much broader concept (Fernández et al. 2017; Peyre et al. 2016; Pfeiffer 2012; Renzulli 1978). Seventh, it is known that that oppositional defiant disorder (ODD) is robustly associated with the severity of ADHD symptoms (Abikoff et al. 2002; Kuhne et al. 1998; Newcorn et al. 2001). As this was not controlled for in the present analyses, the possible confounding effect by the presence of ODD in the participants with ADHD cannot be ruled out. Given the above, there is certainly a need for further investigation and cross-validation of the present study, in ways that would counterbalance the limitations highlighted here.

Compliance with Ethical Standards

Conflict of Interest The authors of the present study do not report any conflict of interest.

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