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Journal of Attention Disorders published online 7 February 2014

DOI: 10.1177/1087054714521293

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Journal of Attention Disorders
1–10
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DOI: 10.1177/1087054714521293
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Abstract

Objective: Despite growing awareness of adult ADHD and its comorbidity with personality disorders (PDs), little is known about sex- and subtype-related differences. **Method:** In all, 910 patients (452 females, 458 males) affected with persistent adult ADHD were assessed for comorbid PDs with the Structured Clinical Interview of *DSM-IV* and for personality traits with the revised NEO personality inventory, and the Tridimensional Personality Questionnaire. **Results:** The most prevalent PDs were narcissistic PD in males and histrionic PD in females. Affected females showed higher Neuroticism, Openness to Experience, and Agreeableness scores as well as Harm Avoidance and Reward Dependence scores. Narcissistic PD and antisocial PD have the highest prevalence in the H-type, while Borderline PD is more frequent in the C-type. **Conclusion:** Sex- and subtype-related differences in Axis II disorder comorbidity as well as impairment-modifying personality traits have to be taken into account in epidemiological studies of persistent ADHD. (*J. of Att. Dis.* XXXX; XX(X) XX-XX)

Keywords

ADD/ADHD, ADHD Subtypes, Adult ADHD

Introduction

ADHD is a highly common and largely culture-independent neuropsychiatric disorder with an early onset and high persistency throughout the life span. It is characterized by inattention, developmentally inappropriate motor hyperactivity, maladaptive impulsivity and emotional dysregulation, resulting in impairments pertaining to virtually all domains of personal and professional life from academic performance to social functioning. In its persistent form, the clinical picture changes from childhood to adult ADHD (aADHD), where a decline in hyperactivity is accompanied by an increase in the psychological strain stemming from emotional dysregulation and difficulties with social interactions.

Despite growing awareness of and subsequent scientific interest in the adult version of the disorder, and particularly the comorbidity with personality traits and personality disorders (PDs), little is known about sex- and subtype-related differences. There is mounting evidence of elevated PD rates in individuals affected with aADHD (Burket, Sajid, Wasiak, & Myers, 2005; Cumyn, French, & Hechtman, 2009). For example, the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) reported comorbid PDs

in 62.8% of aADHD patients (Bernardi et al., 2011) compared with 20.5% in the general population.

Comorbidity With PDs (Axis II Disorders)

ADHD populations seem to be particularly predisposed to the so-called Cluster B PDs comprising narcissistic PD, borderline PD, antisocial PD, and histrionic PD, which can be understood in light of the fact that they share the expansive nature and disturbed emotionality of ADHD (Anckarsater et al., 2006; Helgeland, Kjelsberg, & Torgersen, 2005). With

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respect to borderline PD, this holds true in clinical (Fossati, Novella, Donati, Donini, & Maffei, 2002; Sobanski, 2006) and nonclinical samples (Bernardi et al., 2011). While the aADHD group presented with elevated rates for the entire Cluster B compared with a representative control sample in the NESARC, the most frequent comorbid PD in was borderline PD with 33.7%, followed by narcissistic PD with 25.2%, schizotypal PD with 22.4%, and antisocial PD with 18.9% (Bernardi et al., 2011). Interestingly, prospective (Fischer, Barkley, Smallish, & Fletcher, 2002; Mannuzza, Klein, Bessler, Malloy, & LaPadula, 1993, 1998; Rasmussen & Gillberg, 2001; Weiss, Hechtman, Milroy, & Perlman, 1985) and the majority of cross-sectional studies (Biederman, Faraone, Monuteaux, Bober, & Cadogen, 2004; Biederman et al., 1993; Sobanski, 2006) furthermore found the ubiquitously reported elevated rates of conduct and oppositional defiant disorder in childhood and adolescence to be connected to findings of an increased risk for antisocial PD in adulthood.

Personality Traits

With respect to subclinical differences in personality structure, aADHD patients score significantly higher in Neuroticism and lower in Conscientiousness (operationalized with the revised NEO personality inventory, NEO-PI-R, and the NEO Five Factor Inventory, FFI) than controls (Costa & McCrae, 1992; McCrae & Costa, 2004; Ranssen, Campbell, & Baer, 1998; Retz et al., 2004; Sobanski, 2006). Lower scores of Agreeableness initially observed in a study on prison inmates fulfilling the diagnostic criteria for aADHD, compared with those without a history of ADHD were replicated in a clinical referral sample (Retz et al., 2004; Sobanski, 2006).

Significantly higher scores of Novelty Seeking (Tridimensional Personality Questionnaire [TPQ]) and Harm Avoidance (Downey, Stelson, Pomerleau, & Giordani, 1997; C. P. Jacob et al., 2007) in aADHD have repeatedly been replicated (Cloninger, Svrakic, & Przybeck, 1993; Downey, Pomerleau, & Pomerleau, 1996; Downey et al., 1997; C. P. Jacob et al., 2007).

Sex-Related Differences

Among the aADHD population, males have a risk of developing antisocial PD than females (Biederman et al., 2004; Biederman et al., 1994; Cumyn et al., 2009) and women were more likely to suffer from borderline PD than men (Cumyn et al., 2009). In a large population sample, antisocial, passive-aggressive, and obsessive-compulsive PD were significantly increased in males compared with females (Torgersen, Kringlen, & Cramer, 2001). In contrast to this, Miller and colleagues (Miller, Nigg, & Faraone, 2007) reported no evidence for sex differences in any of the PD clusters.

With respect to personality traits, there are substantial differences between sexes in the general population of Germany, with females scoring higher than males on the NEO-PI-R subscales Neuroticism, Extraversion, Openness, and Agreeableness and all three TPQ subscales, whereas levels of Conscientiousness were comparable (Ostendorf & Angleitner, 2004; Weyers, Krebs, & Janke, 1998). Data on U.S. samples showed that females score higher on Reward Dependence and Harm Avoidance, but not on Novelty Seeking (Cloninger, Przybeck, & Svrakic, 1991). Only very few studies looked into sex-dependence of personality trait in ADHD patients. Retz-Junginger and associates found no sex differences regarding the big five (NEO-PI-R) in the aADHD group (Retz-Junginger, Rosler, Jacob, Alm, & Retz, 2010), while no data are available regarding TPQ measures.

Subtype-Related Differences

Sprafkin and coworkers reported that regardless of subtype, aADHD was predictive of the presence and severity of other psychiatric disorders in a clinical sample ($n = 487$) and a nonreferred community sample ($n = 900$; Sprafkin, Gadow, Weiss, Schneider, & Nolan, 2007). However, patients with combined type ADHD have been found to be more affected with Axis II comorbidity in terms of frequency and severity (Cumyn et al., 2009; Faraone, Biederman, Weber, & Russell, 1998; Sprafkin et al., 2007; Wilens et al., 2009).

Interactions Between Sex and Subtype

The distribution of aADHD subtypes is independent of sex; most patients belong to the combined subtype (C-type), followed by the inattentive (I-type) and the hyperactive type (H-type) as the least common (Biederman et al., 2004; Cumyn et al., 2009).

To reevaluate previous findings about personality traits and comorbid PDs (C. P. Jacob et al., 2007) and to obtain additional information about sex- and subtype-associated differences in aADHD, we assessed an extended sample with sufficient statistical power. We tested the following a priori hypotheses.

- 1a. *Comorbidity with PDs (Axis II disorders).* Comorbidity of aADHD with PDs is highly prevalent. Within the ADHD population, histrionic PD is the most frequent, followed by narcissistic and borderline PD. Cluster B PDs are more frequent than Cluster A and Cluster C PDs. The most prevalent Cluster A PD is the paranoid PD, the most prevalent Cluster B PD is the histrionic PD and the most prevalent Cluster C PD is the avoidant PD. The number of PDs in general and presence of antisocial PD in

particular possess a predictive value for lower psychosocial status.

- 1b. *Personality traits as assessed with NEO-PI-R.* Neuroticism scores are increased, while Extraversion, Openness to Experience, and Conscientiousness scores are reduced in aADHD compared with reference values. NEO-PI-R scores are predictive of the psychosocial status. *Personality traits as assessed with TPQ.* Novelty Seeking and Harm Avoidance scores are higher and Reward Dependence values are lower in aADHD patients compared with reference values. TPQ scores are predictive of the psychosocial status.
2. *Sex-related differences.* There is no association between the number of PDs and sex. The most prevalent PDs are histrionic PD in females and narcissistic PD in males. There are sex-related differences in the comorbidity of the different clusters of PDs and the personality traits assessed with NEO-PI-R and with TPQ.
3. *Subtype-related differences.* The C-type presents with more frequent and more severe comorbidity on Axis II than the other subtypes. Cluster B PDs and especially Antisocial PD is more frequent in the H-type compared with the I-type. There are subtype-related differences in the personality traits assessed with NEO-PI-R and with TPQ.
4. *Interactions between sex and subtype.* There are no relevant interactions between sex and subtype regarding the comorbidity with specific PDs, the different clusters of PDs, the personality traits assessed with NEO-PI-R and TPQ.

Method

Participants

In- and outpatients diagnosed with aADHD who were referred to the Department of Psychiatry, Psychosomatics, and Psychotherapy, University of Würzburg, were recruited between 2003 and 2009.

Data on the first 372 patients (173 females, 199 males; M age = 33.3 years, $SD = 10.3$) recruited between 2003 and 2005, have been published elsewhere (C. P. Jacob et al., 2007). The extended sample comprises 910 patients aged 18 to 65 years (452 females, 458 males; M age = 34.5 years, $SD = 10.2$). Inclusion and exclusion criteria were not modified from our previous publication (C. P. Jacob et al., 2007). Inclusion criteria were current diagnosis of aADHD according to the criteria of *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM-IV*; American Psychiatric Association, 1994), and retrospective confirmation of an onset before the age of 7 (C. P. Jacob, Philipsen, Ebert, & Deckert, 2008). Patients with substance use disorders

underwent detoxification in an in-patient setting. Criterion E of *DSM-IV*, that is, symptoms are better accounted for by another psychiatric disorder, constituted the main exclusion criterion. Further exclusion criteria were IQ below 80 (multiple choice vocabulary intelligence test B [MWT-B] < 13 points) or a diagnosis of bipolar affective disorder due to the clinical symptom overlap).

The Ethics Committee of the University of Würzburg approved of the study. After procedures and aims of the study had been fully explained, written informed consent was obtained from all participants.

Sex- and age-specific reference values for NEO-PI-R and TPQ scores were taken from published German population samples (Ostendorf & Angleitner, 2004; Weyers, Krebs, & Janke, 1998).

Measures

Diagnosis of aADHD and the assessment of psychosocial status followed the procedure described in the preceding report (C. P. Jacob et al., 2007). We recruited the cohort of aADHD patients in a four-step procedure, which was previously described in detail (C. P. Jacob et al., 2008; C. P. Jacob et al., 2007). Having first ruled out physical and mental conditions with higher explanatory value for the observed symptoms, lifetime comorbidity was examined means of the structured clinical interviews of Axis I (Structured Clinical Interview for *DSM-IV* Axis I Disorders [SCID I]) and Axis II (Structured Clinical Interview for *DSM-IV* Axis II Personality Disorders [SCID II]) disorders. We specifically focused on comorbidities persisting across the life span. IQ was assessed with the MWT-B (aADHD/IQ $M = 111.5$, $SD = 14.0$; female (f) aADHD/IQ $M = 112.5$, $SD = 13.3$; male (m) aADHD/IQ $M = 110.5$, $SD = 14.6$). Second, manifestation of aADHD was evaluated according to the *DSM-IV* criteria, which was complemented by the diagnostic checklist of ADHD (ADHS-DC; Rösler, Retz-Junginger, Retz, & Stieglitz, 2008) and input from partners, relatives, and friends. The matching of psychometric, psychopathological, and biographical information was verified. To ensure diagnostic validity, patients were examined at least twice by more than one experienced clinical investigator. Third, the presence of ADHD in childhood was probed in a structured clinical interview, with the Wender–Utah Rating Scale (WURS-K, 21 items; Biederman et al., 1994; males: $M = 37.1$, $SD = 13.8$; females: $M = 34.2$, $SD = 13.9$). and available additional information from school report cards/certificates or parents corroborating the retrospective diagnosis. Finally, extensive anamnestic information was required to conclusively demonstrate the persistent, nonepisodic course of the disorder. Psychosocial status on the basis of a standardized biographical account was quantified on a scale ranging from 0 to 9, with low scores indicating better psychosocial functioning (sample $M = 4.0$, $SD = 1.0$).

Table 1. Sex-Related Differences in Personality Disorders.

| Personality disorder | All aADHD | | Male | | Female | | p value |
|----------------------|-----------|------|------|------|--------|------|---------|
| | n | % | n | % | n | % | |
| | 878 | | 438 | 49.9 | 440 | 50.1 | |
| Paranoid | 113 | 12.9 | 74 | 16.9 | 39 | 8.9 | .0004 |
| Schizotypic | 1 | 0.1 | 1 | 0.2 | 0 | 0.0 | .50 |
| Schizoid | 6 | 0.7 | 3 | 0.7 | 3 | 0.7 | 1.0 |
| Any Cluster A | 116 | 13.2 | 77 | 17.6 | 39 | 8.9 | .0001 |
| Histrionic | 196 | 22.3 | 63 | 14.4 | 133 | 30.2 | <.0001 |
| Narcissistic | 226 | 25.7 | 163 | 37.3 | 63 | 14.3 | <.0001 |
| Borderline | 157 | 17.9 | 62 | 14.2 | 95 | 21.6 | .005 |
| Antisocial | 55 | 6.3 | 48 | 11.0 | 7 | 1.6 | <.0001 |
| Any Cluster B | 451 | 51.4 | 234 | 53.5 | 217 | 49.3 | .22 |
| Avoidant | 163 | 18.6 | 72 | 16.4 | 91 | 20.7 | .12 |
| Dependent | 32 | 3.6 | 8 | 1.8 | 24 | 5.4 | .006 |
| Obsessive-compulsive | 160 | 18.2 | 84 | 19.2 | 76 | 17.3 | .48 |
| Passive-aggressive | 116 | 13.2 | 58 | 13.3 | 58 | 13.2 | 1.0 |
| Depressive | 96 | 10.9 | 44 | 10.1 | 52 | 11.8 | .45 |
| Any Cluster C | 374 | 42.6 | 178 | 40.7 | 196 | 44.5 | .27 |

Note. p values for difference between male and female aADHD patients (Fisher's exact test). aADHD = adult ADHD.

Life-events contributing points to the score were psychiatric in-patient treatment, education (discontinued, two or more classes repeated), family status (divorced, separated, married 2 or more times), occupational qualification (unskilled, unemployed), delinquency, suicidal and aggressive behavior.

Comorbidity with PDs was assessed with the SCID II, which was available for 878 patients. The SCID II was performed in combination with self-report ratings and corresponding interviews in strict adherence to the guidelines. The NEO-PI-R is an instrument designed to gauge the five domains of personality according to the dimensional personality model of Costa and McCrae (1992). These domains are Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness. The TPQ follows a biological model of personality traits derived from animal research that was proposed by Cloninger and colleagues (Cloninger, Svrakic, & Przybeck, 1993). They suggested that Harm Avoidance, Reward Dependence, and Novelty Seeking are heritable and directly relate to the monoamine systems of the brain. NEO-PI-R and TPQ data were available for 860 and 881 aADHD patients, respectively.

Statistical Analysis

Frequencies of PDs were calculated for the entire aADHD sample and the sex- or subtype-specific samples. Fisher's exact test was used to analyze differences in prevalence between groups (by sex or subtype), and ANOVA were used for the assessment of differences in quantitative personality traits (NEO-PI-R, TPQ). To investigate interactions of sex

and subtype on the personality traits or the prevalence of PDs, regression models were computed. Differences in psychosocial status between groups (e.g., with and without a specific PD) were tested by means of an ANOVA. Personality traits (as measured by NEO-PI-R and TPQ values) were compared with published German reference values by standardizing each patient's score with the appropriate age- and sex-specific population mean and standard deviation and comparing the resulting scores with zero with the sign test. The relationship between the number of PDs or personality traits and psychosocial status was investigated by means of linear regression. All reported p values are nominal and should be interpreted against appropriate levels of significance to account for multiple testing.

Results

1a. Comorbidity with PDs (Axis II disorders)

aADHD shows high rates of comorbidity with PDs (Table 1). The most prevalent PDs overall were narcissistic PD followed by histrionic, avoidant, and borderline PD. In comparison, the expected comorbidity with antisocial PD was relatively low. Comparing the clusters, most of the reported PDs belonged to Cluster B PDs, followed by cluster C and the generally rare cluster A. Within Cluster B, the most common PD was narcissistic PD followed by histrionic PD and borderline PD, while paranoid PD was most common in Cluster A and avoidant PD was most prevalent in Cluster C. Patients with at least one PD had significantly

Table 2. Sex-Related Differences in Personality Traits.

| | Male | | Female | | <i>p</i> -value | Male reference values | | Female reference values | | <i>p</i> value |
|------------------------|----------------|-----------|----------------|-----------|-------------------|-----------------------|-----------|-------------------------|-----------|-----------------------|
| | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> | | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> | |
| NEO-PI-R | <i>n</i> = 428 | | <i>n</i> = 432 | | (male vs. female) | <i>n</i> = 4,219 | | <i>n</i> = 7,505 | | (aADHD vs. reference) |
| Neuroticism | 108.7 | 24.6 | 122.6 | 25.1 | <0.0001 | 84.2 | 22.5 | 95.0 | 23.3 | <.0001 |
| Extraversion | 100.1 | 21.6 | 100.3 | 23.7 | 0.91 | 109.6 | 20.4 | 111.0 | 19.5 | <.0001 |
| Openness to Experience | 109.4 | 19.1 | 114.2 | 21.2 | 0.0005 | 120.4 | 20.1 | 125.7 | 18.6 | <.0001 |
| Agreeableness | 107.7 | 16.9 | 116.0 | 16.1 | <0.0001 | 108.6 | 17.3 | 114.9 | 16.4 | .9 |
| Conscientiousness | 92.3 | 21.2 | 89.9 | 22.8 | 0.12 | 114.1 | 20.7 | 113.8 | 19.7 | <.0001 |
| TPQ | <i>n</i> = 441 | | <i>n</i> = 440 | | | <i>n</i> = 80 | | <i>n</i> = 80 | | |
| Novelty Seeking | 19.5 | 5.7 | 19.0 | 5.9 | 0.14 | 12.8 | 5.8 | 15.1 | 4.6 | <.0001 |
| Harm Avoidance | 18.2 | 7.1 | 20.9 | 6.7 | <0.0001 | 14.7 | 6.4 | 16.3 | 6 | <.0001 |
| Reward Dependence | 16.1 | 4.5 | 18.6 | 4.2 | <0.0001 | 14.8 | 4.7 | 17.5 | 4.7 | <.0001 |

Note. Reference values from Ostendorf and Angleitner (2004; NEO-PI-R) and Weyers, Krebs, and Janke (1998; TPQ). *p* values for difference between male and female aADHD patients (ANOVA) or between aADHD patients and published reference values (sign test for age- and sex-standardized scores, see "Method" section). NEO-PI-R = revised NEO personality inventory; TPQ = Tridimensional Personality Questionnaire; aADHD = adult ADHD.

more problems on the psychosocial level than those without PD ($M = 4.1$ vs. 3.8 , $p = .001$). This effect is also apparent in a linear regression; the number of PDs positively predicts the number of psychosocial problems ($p < .0001$). Individually examining each cluster, the presence of one or more Cluster A or C PDs did not modulate psychosocial status. However, having at least one Cluster B PD significantly increased the number of psychosocial problems ($M = 4.1$ vs. 3.9 , $p = .0002$). With respect to specific PDs, especially antisocial PD ($M = 4.6$, $p < .0001$), borderline PD ($M = 4.4$, $p < .0001$), and passive-aggressive PD ($M = 4.4$, $p = .0002$) negatively impacted on psychosocial status. It is important to note however that particularly schizoid and schizotypic PD are too infrequent to draw strong conclusions based on our limited sample.

1b. Personality traits

aADHD patients showed significantly elevated levels of Neuroticism (NEO-PI-R) and lower Conscientiousness, Openness to Experience and Extraversion scores compared with the published German reference values (Table 2). Scores for Agreeableness in aADHD patients did not differ from published reference values. Higher Neuroticism scores and lower Conscientiousness scores are associated with lower psychosocial status (respectively).

Furthermore aADHD probands presented significantly higher Novelty Seeking (TPQ), Reward Dependence, and Harm Avoidance scores than the German references sample. High scores in Harm Avoidance were tentatively associated with a poorer psychosocial status ($p = .02$).

2. Sex-related differences

The raw number of PDs did not discriminate between sexes (1.6 and 1.5, respectively), albeit there were differences with regard to the preferentially expressed specific PD. For males, narcissistic PD was the most prevalent, whereas for females histrionic PD was the most frequent. Cluster A disorders are significantly more prevalent in affected males than females. Comparing rates of individual PDs, antisocial, narcissistic, and paranoid PD are significantly more frequent in males than in females, while borderline, histrionic, and dependent PD are significantly more frequent in females than in males.

Looking at personality traits, females with aADHD showed significantly higher scores of Neuroticism (NEO-PI-R), Openness to experience, and Agreeableness as well as Harm Avoidance (TPQ) and Reward Dependence compared with aADHD males.

3. Subtype-related differences

aADHD subtypes differed significantly in the number and type of comorbid PDs. The C-type had the highest comorbidity rates with PDs ($p = .0003$). Specifically, borderline, histrionic, and passive-aggressive PD are most common in C-type. Avoidant PD is significantly more frequent in I-type than in C-type or H-type. Cluster B PDs were least frequent in I-type, while Cluster C PDs were least frequent in H-type (Table 3).

The C-Type reported the highest levels of Neuroticism and Novelty Seeking. For the H-type, Extraversion and

Table 3. Subtype-Related Differences in Personality Disorders.

| Personality disorder | Combined Type | | Inattentive Type | | Hyperactive Type | | p value |
|----------------------|---------------|------|------------------|------|------------------|------|---------|
| | n | % | n | % | n | % | |
| | 581 | 66.2 | 231 | 26.3 | 66 | 7.5 | |
| Paranoid | 74 | 12.7 | 29 | 12.6 | 10 | 15.2 | .80 |
| Schizotypic | 0 | 0.0 | 0 | 0.0 | 1 | 1.5 | .08 |
| Schizoide | 3 | 0.5 | 2 | 0.9 | 1 | 1.5 | .37 |
| Any Cluster A | 75 | 12.9 | 31 | 13.5 | 10 | 15.2 | .81 |
| Histrionic | 154 | 26.5 | 30 | 13.0 | 12 | 18.2 | .0005 |
| Narcissistic | 155 | 26.7 | 46 | 20.0 | 25 | 37.9 | .01 |
| Borderline | 124 | 21.3 | 30 | 13.0 | 3 | 4.5 | .0005 |
| Antisocial | 41 | 7.1 | 9 | 3.9 | 5 | 7.6 | .18 |
| Any Cluster B | 318 | 54.7 | 97 | 42.2 | 36 | 54.5 | .003 |
| Avoidant | 108 | 18.6 | 55 | 23.8 | 0 | 0.0 | .0005 |
| Dependent | 26 | 4.5 | 6 | 2.6 | 0 | 0.0 | .13 |
| Obsessive-compulsive | 109 | 18.8 | 40 | 17.4 | 11 | 16.7 | .88 |
| Passive-aggressive | 90 | 15.5 | 25 | 10.9 | 1 | 1.5 | .001 |
| Depressive | 70 | 12.1 | 25 | 10.9 | 1 | 1.5 | .02 |
| Any Cluster C | 257 | 44.2 | 105 | 45.6 | 12 | 18.2 | .001 |

Note. p values for difference between subtypes of aADHD patients (Fisher's exact test). aADHD = adult ADHD.

Table 4. Subtype-Related Differences in Personality Traits.

| NEO-PI-R | Combined Type | | Inattentive Type | | Hyperactive Type | | p value |
|------------------------|---------------|------|------------------|------|------------------|------|---------|
| | M | SD | M | SD | M | SD | |
| | n = 573 | | n = 222 | | n = 65 | | |
| Neuroticism | 119.7 | 24.4 | 111.5 | 25.4 | 94.1 | 26.8 | <.0001 |
| Extraversion | 101.5 | 22.1 | 93.3 | 22.8 | 112.0 | 20.5 | <.0001 |
| Openness to Experience | 113.1 | 20.2 | 110.2 | 20.5 | 106.0 | 18.8 | .01 |
| Agreeableness | 111.1 | 17.1 | 115.2 | 15.7 | 107.1 | 18.0 | .0005 |
| Conscientiousness | 88.6 | 21.3 | 89.9 | 20.5 | 116.3 | 17.8 | <.0001 |
| TPQ | n = 585 | | n = 230 | | n = 66 | | |
| Novelty Seeking | 20.0 | 5.6 | 17.8 | 5.9 | 17.8 | 6.1 | <.0001 |
| Harm Avoidance | 20.0 | 7.0 | 20.3 | 6.5 | 13.5 | 6.7 | <.0001 |
| Reward Dependence | 17.6 | 4.5 | 16.6 | 4.3 | 17.0 | 5.2 | .01 |

Note. p values for difference between subtypes of aADHD patients (ANOVA). NEO-PI-R = revised NEO personality inventory; TPQ = Tridimensional Personality Questionnaire; aADHD = adult ADHD.

Conscientiousness ($p < .0001$) scores were higher than in either of the other subtypes, while Harm Avoidance scores were the lowest in this type. Last, Agreeableness was most pronounced in I-type aADHD (Table 4).

4. Interactions between sex and subtype

Differences in comorbid PDs and personality traits are in line with the observed differences between sexes and subtypes, that is, the effects of sex and subtype are additive.

There are no significant sex-by-subtype interactions (all $ps > .18$) in the prevalence of PDs and mean NEO-PI-R and TPQ scores.

Discussion

PDs and personality traits have been investigated in a large clinical referral sample of patients with persistent ADHD, the most severe form of the disorder as it is characterized by a spectrum of impairments across the entire lifespan:

1a. Comorbidity with PDs (Axis II disorders)

We replicated findings that the comorbidity of aADHD with Axis II disorders is very common in clinical (Burket et al., 2005; Cumyn et al., 2009) and nonclinical samples (Bernardi et al., 2011) as well as relevant in terms of psychosocial level of functioning (C. P. Jacob et al., 2007).

The published studies are not entirely consistent regarding the order of prevalence of the specific comorbid PDs. This might reflect differences due to ascertainment of community-based samples versus clinical samples that likely present with a higher burden of additional or more severe cognitive and emotional impairments. We report evidence that narcissistic PD might be the most prevalent comorbidity of aADHD. In the NESARC, the most frequent PD in aADHD was borderline PD, followed by narcissistic PD (Bernardi et al., 2011). The results of the study of Fossati et al. support the hypothesis of an association between childhood manifestation of ADHD and adult borderline PD diagnosis (Fossati et al., 2002).

Sobanski and coworkers provided evidence for a subgroup of aADHD with comorbid borderline PD (Sobanski, 2006). One of the core symptoms of both disorders is emotion dysregulation, while the differences of this putative underlying dysfunction are not yet discovered. This might be supported by the evidence that borderline PD and antisocial PD lowered psychosocial status.

In comparison with the initial cross-sectional (Biederman et al., 2004; Biederman et al., 1993; Sobanski, 2006) and several prospective studies (Fischer et al., 2002; Mannuzza et al., 1993; Mannuzza, Klein, Bessler, Malloy, & LaPadula, 1998; Rasmussen & Gillberg, 2001; Weiss et al., 1985), comorbidity with antisocial PD was relatively infrequent in our study. Still, the focus on the comorbidity of aADHD with antisocial PD might be justified due to the substantial impact of this PD. Particularly aADHD patients with comorbid antisocial PD had a significantly lower psychosocial status (C. P. Jacob et al., 2007) and there is evidence of elevated comorbidity of antisocial PD in subgroups such as prison inmates with a putative aADHD (Retz et al., 2004). Further studies are needed to elucidate the role of aADHD as an independent factor for life-persistent criminality, as specific treatment may help to ameliorate the legal outcome and prognosis of the disorder.

The most prevalent comorbid PDs belong to Cluster B, which are characterized by dramatic, emotional, or erratic traits. The high comorbidity of aADHD with Cluster B PDs might reflect a profound etiological and thus neurobiological overlap, as there are replicated findings that Cluster B PDs are more frequent in aADHD populations than Cluster C PDs and Cluster A PDs.

Different models have been proposed regarding the relationship between PDs and aADHD. For example, the overlap between aADHD, Cluster B PDs—mainly Borderline

PD—and bipolar disorder might either be indicative of unresolved issues with differential diagnosis or truly reflect common etiological factors. Candidates for such common risk factors can be found on different levels. On the level of psychopathology, emotion regulation deficits represent common core symptoms. Several lines of evidence point to common neurobiological bases of these disorders. Recently protein phosphatase 2, regulatory subunit B, gamma PPP2R2C has been described as one candidate for such a common neurobiological risk factor (C. Jacob et al., 2012). Initial findings furthermore indicate the relevance of Gene \times Environment interactions in the pathogenesis of PDs and aADHD (C. Jacob et al., 2010). However, a change in personality might also be a consequence of aADHD (C. P. Jacob et al., 2007). Seeing that aADHD symptoms cause enduring psychological stress, the observed symptoms of PDs in aADHD patients might reflect a specific class of coping strategies. Longitudinal studies are needed to investigate the long-term stability of comorbid PDs in aADHD.

1a. Personality traits

In accordance with published studies, we demonstrate that aADHD patients show significantly higher scores of the anxiety- and depression-related dimension of Neuroticism (NEO-PI-R, NEO-FFI, respectively; Ranseen et al., 1998; Retz et al., 2004; Sobanski, 2006) and Novelty Seeking (TPQ; Downey et al., 1996; Downey et al., 1997; C. P. Jacob et al., 2007). This might reflect emotion dysregulation as a core feature of aADHD. Also replicated are the significantly lower scores in Conscientiousness. The subscales contributing to this score—including degree of organization, persistence, control, and motivation in goal-directed behavior—illustrate the importance as another core feature of aADHD. There is inconsistent data concerning the other subscales of NEO-PI-R and TPQ.

2. Sex-related differences

In the present sample, we found no association between number of Axis II disorders and sex, but distinct differences in specific PDs. Sprafkin et al. (2007) found limited sex-dependent interactions in a clinical sample, noting that sex did not appear to moderate the association between aADHD and the prevalence of comorbid psychiatric disorders in clinical samples, and that men and women with aADHD can have similar phenotypic features. Findings of genetic epidemiology suggest that differences between the sexes are small (Boomsma et al., 2010).

However, sex-related differences in the frequency of specific PDs should be taken into account in future studies. Our data indicate that the most prevalent PDs are narcissistic PD in males and histrionic PD in females. We replicated that antisocial PD is less frequent in females than in males

(Biederman et al., 2004; Biederman et al., 1994; Cumyn et al., 2009), while borderline PD is more frequent in females than in males (Cumyn et al., 2009). The findings of our study concerning an increased prevalence of antisocial PD in males and of borderline and histrionic PD in females are in line with the data of Torgersen et al. (2001).

Analogously, sex-related differences of specific personality traits should be taken into account in future studies. Affected females showed higher scores in Openness to experience (NEO-PI-R), and in anxiety- and depression-related traits Neuroticism (NEO-PI-R) and Harm Avoidance (TPQ) as well as in Openness to experience (NEO-PI-R), Agreeableness (NEO-PI-R), and Reward Dependence (TPQ). The sample size of Retz-Junginger et al. who did not find sex differences regarding the big five in their aADHD group was limited (Retz-Junginger et al., 2010). Our results in aADHD probands are partially in line with these in the German general population that are elevated in all three TPQ subscales (Weyers et al., 1998) and the NEO-PI-R subscales with the exception of Conscientiousness (Ostendorf & Angleitner, 2004). Our results are in line with data from U.S. samples showing that females scored higher on Reward Dependence and Harm Avoidance, but not on Novelty Seeking (Cloninger et al., 1991).

3. Subtype-related differences

For the first time, we report subtype-related differences in NEO-PI-R and TPQ. The anxiety and depression-related traits Neuroticism (NEO-PI-R) and Conscientiousness are higher in the H-type, than in the C-type and the I-type.

Strengths and Limitations

Strengths of this study are the number of the included patients and the uniformity of the diagnostic procedure. This is a clinical referral sample, which is not representative for the general population.

Conclusion

There is increasing evidence that emotion dysregulation is a core symptom of aADHD. Patients diagnosed with aADHD shows the highest degree of comorbidity with those Cluster B PDs that share problems with emotional regulation as well as mood disorders. Furthermore, aADHD probands show an increased comorbidity with mood disorders as well as significantly higher Neuroticism and Harm Avoidance scores reflecting emotion dysregulation as a core symptom of aADHD.

Taken together, our findings provide further evidence for fundamental sex- and subtype-related differences in the comorbidity of aADHD with Axis II disorders as well as personality traits that have to be taken into account in future studies.

Authors' Note

Astrid Dempfle and Klaus-Peter Lesch contributed equally.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: C.P.J. has received speaker's honoraria by Medice and Novartis and is a member of the advisory boards of Medice and Novartis.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study was supported by the DFG (GrantRE1632/1-1./1-3 and/5 to AR, KFO 125 to AR, CPJ, AW, SW, HS and KPL; SFB 581 to KPL, SFB TRR 58 to AR and KPL; GR 1912/5-1, to HG), BMBF (01GV0605 to KPL), BMBF (IZKF Würzburg, 01KS9603, to KPL; IZKF N-27-N, to AR), and the EC (NEWMOODLSHM-CT-2003-503474, to KPL).

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