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The estimated prevalence and correlates of adult ADHD in a German community sample

Martina de Zwaan · Barbara Gruß ·
Astrid Müller · Holmer Graap · Alexandra Martin ·
Heide Glaesmer · Anja Hilbert · Alexandra Philipsen

Abstract Little research on the prevalence and correlates of adult ADHD has been conducted outside the United States. The aim of the present study was to estimate the prevalence and correlates of adult ADHD in a large representative sample of the German population aged 18–64 years ($n = 1,655$). Two self-rating screening instruments to assess childhood and adult ADHD symptomatology were used to estimate the prevalence of ADHD. A 4-item screening tool was used to assess probable cases of current depression and anxiety (Patient Health Questionnaire). The estimated crude prevalence rate of current ADHD was 4.7%. Adult ADHD was significantly associated with lower age, low educational level, unemployment, marital status (never married and divorced), and rural residency. No association was found with gender. Adult ADHD was strongly associated with positive screening results for depression and anxiety. ADHD is a common disorder of adulthood, is associated with significant social impairment and psychiatric co-morbidity, and should receive further research attention.

Keywords Adult ADHD · Prevalence · General population

M. de Zwaan · B. Gruß · A. Müller · H. Graap · A. Martin
Department of Psychosomatic Medicine and Psychotherapy,
University of Erlangen-Nuremberg, Erlangen, Germany

H. Glaesmer
Department of Medical Psychology and Medical Sociology,
University of Leipzig, Leipzig, Germany

A. Hilbert
Department of Clinical Psychology, University of Fribourg,
Fribourg, Switzerland

A. Philipsen (✉)
Department of Psychiatry and Psychotherapy,
Freiburg University Medical Center, Hauptstrasse 5,
79104 Freiburg, Germany
e-mail: alexandra.philipsen@uniklinik-freiburg.de

Introduction

According to the Diagnostic and Statistical Manual of Mental Disorders, fourth edition text revision (DSM-IV-TR) [2] attention-deficit hyperactivity disorder (ADHD) is characterized by developmentally inappropriate levels of inattention and/or hyperactivity–impulsivity that have been persistently present since age seven. Longitudinal evidence suggests that childhood ADHD persists into adulthood in 60–70% of cases either as a residual type or as a full clinical disorder [7, 22]. Adult ADHD should be obvious in different situations and lead to substantial distress as well as impairment in at least two areas of living. Deficits in executive functions and psychosocial impairment are important aspects of adult ADHD [20]. Current evidence defines ADHD as being associated with low academic achievement, poor work performance, unemployment, and impaired social relationships. No other disorders should explain the symptoms better; however, there is a high co-morbidity with other psychiatric disorders—and ADHD alone, without other co-morbid disorder, occurs in a minority of cases [10, 41, 43, 45]. Nevertheless, co-morbid conditions such as depression and anxiety may produce symptoms which might not be easily separable from those found in ADHD, and may erroneously be diagnosed as ADHD [46].

Overall, population-based studies have reported estimated prevalence rates of adult ADHD of between 1.0 and

7.3% [1, 3, 8, 12–15, 17, 21, 23, 32, 33, 47]. However, most of these studies collected samples of convenience with low mean ages and unbalanced gender ratios. Only few studies used representative community samples. An epidemiological study that was conducted in 10 non-European and European countries [14, 21, 32] estimated the prevalence of adult ADHD to be 3.4% in the total sample. Only individuals aged 18–44 years were included and only the results of weighted data were reported. The prevalence estimates showed a substantial variation ranging from 1.2% in Spain to 7.3% in France. The prevalence rate in Germany was 3.1%. In all countries, childhood ADHD was assessed retrospectively by a lay interviewer using the Diagnostic Interview Schedule and only a single question about the persistence of symptoms into adulthood was asked. A clinical reappraisal interview was carried out only in a subsample of 154 respondents from the US sample in order to confirm or reject a clinical diagnosis of adult ADHD. The results of these interviews were used for multiple imputations to indirectly estimate the prevalence of adult ADHD in the US and in all other countries.

Recently, Simon et al. [44] published a meta-analysis of the prevalence and correlates of adult ADHD. Even though they found 12 population-based studies, only 6 provided raw data for the prevalence and demographic variables necessary for the analysis. Thus, they excluded the large representative community-based studies described above [14, 21, 32] because these studies only provided the results of weighted data. The pooled crude prevalence of adult ADHD according to DSM-IV criteria across the 6 remaining population samples was 2.5%. However, these were highly selected samples with in part high drop-out rates and some of the studies did not meet basic methodological standards for assessing adult ADHD, e.g., they did not assess childhood symptoms even though the diagnosis in adulthood requires a positive childhood history.

The aim of the present study was to assess the estimated prevalence and correlates of current adult ADHD in a large representative community sample of the German adult population. This is the largest study conducted in Germany so far.

Materials and methods

Sample

A representative sample of the German general population was selected with the assistance of a demographic consulting company (USUMA, Berlin, Germany). The sample was selected to be representative in terms of age, gender, and education. The area of Germany was separated into 258 sample areas representing the different regions of the country. Households of the respective area and members of the household fulfilling the inclusion criteria (age at or above 14, able to read and understand the German language) were selected randomly. The household respondent was selected using a random process (kish selection grid). A first attempt was made for 4,091 addresses, of which 4,069 were valid. If not at home, a maximum of three attempts was made to contact the selected person. All subjects were visited by a study assistant, who informed them about the investigation, obtained written informed consent and presented them with the self-rating questionnaires (see below). The assistant waited until participants answered all questionnaires and offered help if persons did not understand the meaning of questions. A total of 2,520 individuals between the ages of 14 and 93 years agreed to participate and completed the self-rating questionnaires (participation rate: 61.9% of valid addresses) between November 27 and December 16, 2009. All respondents whose age was below 18 ($n = 100$) and above 64 years ($n = 695$) were excluded for the present study. There is concern about the accuracy of retrospective recall of childhood symptoms and about the validity of the self-rating instrument for current ADHD symptoms in older adults [14, 21]. In addition, participants who did not fully complete the questionnaires ($n = 70$) were excluded from further analyses. This provided a final sample of 1,655 individuals with complete data for analysis.

The population-based survey met the ethical guidelines of the international Code of Marketing and Social Research Practice by the International Chamber of Commerce and the European Society for Opinion and Marketing Research.

Assessment

Assessment of ADHD symptomatology

Childhood and adult ADHD were assessed using standard self-report screening instruments. Participants rated their ADHD symptoms in childhood retrospectively, using the German version of the short version of the Wender Utah Rating Scale (WURS-k) [38, 39, 41], which consists of 21 items to be rated on a five-point Likert-scale (0–4, "not at all" to "severe"). The internal consistency of the WURS-k in our sample was 0.0.92 (Cronbach's α). In addition to the 21 items assessing ADHD-specific symptoms in childhood, the WURS-k contains 4 control items assessing symptoms not compatible with the construct. A negative correlation between the score of the ADHD-specific items and the score of the 4 control items is considered to assess the truthfulness and consistency of the answers. As suggested by the authors, we used a cut off score of ≥ 30 to indicate the presence of a diagnosis of ADHD in childhood (age, 8–10 years). This cut off has a sensitivity of 85% and a

specificity of 75% to detect ADHD based on clinical interview.

Participants rated adult ADHD symptoms with the ADHD self-rating scale (ADHD-SR) [40, 42], which includes the 18 DSM-IV-TR items of inattention, hyperactivity, and impulsivity to be rated on a four-point Likert-scale (0–3, "not at all" to "severe"). The internal consistency in our sample was 0.92 (Cronbach's α). When comparing self-rating with expert rating good agreement was found as measured by intraclass coefficients for individual symptoms (0.41–0.92) and for the total score (0.87) of the ADHD-SR. The recommended cut-off score of ≥15 was used to indicate that participants met criteria for adult ADHD. This cut-off has a sensitivity of 77% and a specificity of 75% for adult ADHD. In addition, the ADHD-SR contains 3 items assessing whether the psychopathology (1) manifests itself in different life situations, (2) leads to substantial subjective distress, and (3) to occupational as well as interpersonal impairment. These functional deficits of ADHD support the clinical relevance of the disorder and the need for treatment. These items are also rated on a four-point Likert-scale (0–3, "not at all" to "severe"). A total score of 3 or more was used to define the presence of distress/impairment.

Only participants who fulfilled both the WURS-k criteria and the ADHD-SR criteria were diagnosed as cases of adult ADHD.

Depression and anxiety

The 4-item Patient Health Questionnaire (PHQ-4) is an ultra-brief self-report questionnaire for use as an overall screening tool for depression and anxiety [26, 29]. It consists of a 2-item depression scale (PHQ-2) [24, 28] and a 2-item anxiety scale (GAD-2) [25, 29]. Response options range from 0 ("not at all") to 3 ("nearly every day") for each of the four questions. For the PHQ-2 and the GAD-2, scale scores of ≥3 were suggested as cut-off points for probable cases of depression and anxiety, respectively [24, 25, 28]. The symptoms are assessed for the last two weeks. The PHQ-2 cut-off score of ≥3 has a sensitivity of 87% and a specificity of 78% for major depressive disorder (MDD) and a sensitivity of 79% and a specificity of 86% for any depressive disorder [28]. The two items of the PHQ-2 are "little interest or pleasure in doing things" and "feeling down, depressed, or hopeless". The two items of the GAD-2 are "feeling nervous, anxious or on edge" and "not being able to stop or control worrying".

Statistics

All statistical analyses were conducted using the statistical package PASW 18.0.0 for Windows. Descriptive information for categorical variables is given as percentages. A multivariate logistic regression analysis was conducted with adult ADHD as the dependent variable to study the association between sociodemographic correlates as well as probable cases of depression and anxiety with adult ADHD. Logits and their 95% confidence intervals were converted into odd ratios by exponentiation for ease of interpretation. Statistical significance was evaluated using 2-tailed Wald chi-square tests with an alpha level of 0.05. First, unweighted data were used for the calculation of the crude prevalence estimate of adult ADHD and for the logistic regression analysis. In addition, analyses were repeated after a weighing procedure for age, sex, and state of residency according to the distribution of these sociodemographic factors in the German adult population as given by the Federal Statistics Office.

Results

Study sample

A description of the study sample is given in Table 1. The mean age of the sample was 43.3 years (SD 12.7, range 18–64), with 54% being women. Only 16% had finished high school or had attained education beyond high school.

The screening instruments for current depression and anxiety identified 8.0 and 7.1%, respectively, of the sample as being probable cases.

Estimated prevalence and correlates of adult ADHD

The estimated prevalence of adult ADHD was 4.7% (n = 78) in our community sample of German adults aged 18–64 years. Adding the distress/impairment measure (total score of 3 or more on the three additional items of the ADHD-SR scale), the prevalence decreased to 3.6%. When the analysis was repeated with the weighted sample the prevalence estimate for adult ADHD decreased somewhat to 4.5% (n = 78).

The correlation between the WURS-k ADHD-specific symptoms and the score of the 4 control items was −0.27 (P = 0.018) in the adult ADHD sample suggesting that the individuals filled out the questionnaire truthfully.

Interestingly, ADHD had been diagnosed before by a physician in only 4 individuals (5.8%) who screened positive for adult ADHD in our sample and in 1.3% of individuals who did not screen positive for adult ADHD ($\chi^2 = 9.325$ (df = 1), P < 0.01).

As shown in Table 2, the estimates for adult ADHD were significantly higher among participants aged 18–24 years, among the unemployed, among participants with rural residency, and among participants who were
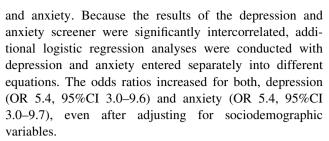
Table 1 Description of study sample ($n = 1,655$)

	N (%)
Gender	
Female	893 (54.0)
Male	762 (46.0)
Age groups (years)	
18–24	164 (9.9)
25–34	283 (17.1)
35–44	394 (23.8)
45–54	418 (25.3)
55–64	396 (23.9)
Marital status	
Married	896 (54.1)
Never married	456 (27.6)
Divorced	241 (14.6)
Widowed	62 (3.7)
Urbanicity	
Urban residency	1,465 (88.5)
Rural residency	190 (11.5)
Residency	
East Germany	314 (19.0)
West Germany	1,341 (81.0)
Education	
<12 years	1,390 (84.0)
≥12 years (finished high school)	265 (16.0)
Employment	
Working, student, homemaker	1,512 (91.4)
Unemployed	143 (8.6)
Adult ADHD	
Yes (requires a childhood diagnosis)	78 (4.7)
PHQ-2 (Depression)	
Cut-off ≥ 3	132 (8.0)
GAD-2 (Anxiety)	
Cut-off ≥ 3	118 (7.1)

ADHD attention-deficit/hyperactivity disorder, *GAD-2* Patient Health Questionnaire—2 item anxiety scale, *PHQ-2* Patient Health Questionnaire—2 item depression scale

never married and who were divorced. With regard to rural residency defined as regions with less than 20.000 inhabitants the estimates for adult ADHD were particularly high in very rural regions with less than 2,000 inhabitants ($N = 14/29$).

The estimates of adult ADHD were significantly lower among participants who had finished high school or had attained an education beyond high school. No gender differences were found, and no significant difference was found between individuals living in the Eastern or Western part of Germany.

As shown in Table 3, adult ADHD was significantly associated with positive screening results for depression

and anxiety. Because the results of the depression and anxiety screener were significantly intercorrelated, additional logistic regression analyses were conducted with depression and anxiety entered separately into different equations. The odds ratios increased for both, depression (OR 5.4, 95%CI 3.0–9.6) and anxiety (OR 5.4, 95%CI 3.0–9.7), even after adjusting for sociodemographic variables.

Using weighted data, the results of the logistic regression analyses showed highly comparable results.

Discussion

This is the largest community-based study conducted in a representative sample of the German population aged 18–64 years ($n = 1,655$) to estimate the prevalence of ADHD. The crude prevalence estimate of adult ADHD was 4.7% ($n = 78$). This is roughly in line with the results of the WHO World Mental Health (WMH) surveys conducted in 10 European and non-European countries [14, 21]. The WMH surveys estimated prevalence rates in 18- to 44-year-old participants of between 1.2 and 7.3%. In the German sample ($n = 621$) which dates back to the years 2002/2003, the estimated prevalence of adult ADHD was 3.1%. The estimates in our sample are somewhat higher compared with the earlier German sample but lower compared with the French sample (7.3%) and comparable with the samples from the Netherlands (5.0%) and the USA (3.6–5.2%).

Adult ADHD was positively and significantly associated with low educational level and unemployment. Adverse effects on psychosocial functioning have repeatedly been described in clinical studies [5, 45] but also in epidemiological studies [14, 21, 44]. The association especially between lower educational level and adult ADHD (OR 6.5) was strong in our sample. In fact, functional impairment in different life situations is required for a diagnosis of adult ADHD and can be used as an external validator of the disorder. For the main analysis, we did not include our definition of distress/impairment for a diagnosis of adult ADHD which might have increased our prevalence estimates [37]. Adding a distress/impairment measure derived from additional items on the ADHD-SR decreased the estimated prevalence of adult ADHD to 3.6%. However, this is not a well-validated measure for distress and impairment.

The failure to find an elevated prevalence of adult ADHD among men is inconsistent with other epidemiological studies. However, the odds ratios favoring men were modest in magnitude in earlier community-based studies even though the associations were significant (OR 1.5 and 1.6, respectively in 13 and 19). In the studies

Table 2 Sociodemographic correlates of adult ADHD in a German population-based sample (n = 1,655)

Characteristic	Participants with adult ADHD with characteristic %	Prevalence of ADHD among participants with characteristic %	Analysis[a] Odds ratio	95% CI	χ^2	P-value
Gender						
Female	55.1	4.8	1.0	–	–	–
Male	44.9	4.6	0.8	0.5–1.4	0.34	0.50
Age (years)						
18–24	20.5	9.8	2.8*	1.0–7.5	4.52	0.03
25–34	14.1	3.9	1.2	0.5–3.1	0.26	0.60
35–44	23.1	4.6	1.5	0.7–3.4	1.25	0.26
45–54	24.4	4.5	1.3	0.6–2.8	0.59	0.44
55–64	17.9	3.5	1.0	–	5.30	0.25
Education						
<12 years	97.4	5.5	6.5*	1.5–27.3	6.60	0.01
≥12 years[b]	2.6	0.8	1.0	–	–	–
Marital status						
Married	35.9	3.1	1.0	–	6.62	0.08
Never married	39.7	6.8	2.2*	1.1–4.4	4.95	0.02
Divorced	20.5	6.6	1.9*	1.0–3.9	3.91	0.04
Widowed	3.8	4.8	1.3	0.3–5.1	0.22	0.63
Employment						
Working, student, homemaker	74.4	3.8	1.0	–	–	–
Unemployed	25.6	14.0	2.1*	1.1–4.0	6.15	0.01
Urbanicity						
Urban residency	70.5	3.8	1.0	–	–	–
Rural residency	29.5	12.1	4.6*	2.6–8.2	28.47	<0.001

* $P < 0.05$

[a] Multivariate logistic regression analysis with ADHD as the dependent variable. Statistics are Wald χ^2. $df = 1$–4

[b] Finished high school

Table 3 Screening for depression and anxiety in adult ADHD participants (n = 1,655)

Screening	Prevalence of ADHD		Prevalence of positive screening		Analysis[a]			
	Among participants who screened positive %	Among participants who screened negative %	Among participants with ADHD %	Among participants without ADHD %	Odds ratio[b]	95% CI	χ^2	P-value
Depression (PHQ-2 ≥ 3)	17.4	3.6	29.5	6.9	2.9	1.3–6.4	6.87	<0.01
Anxiety (GAD-2 ≥ 3)	19.5	3.6	29.5	6.0	2.6	1.1–5.9	5.56	0.01

GAD-2 Patient Health Questionnaire—2 item anxiety scale, *PHQ-2* Patient Health Questionnaire—2 item depression scale

[a] Multivariate logistic regression analyses with ADHD as the dependent variable adjusting for all sociodemographic variables. Statistics are Wald χ^2, $df = 1$

[b] Compared with PHQ-2 < 3 and GAD-2 < 3

included in the meta-analysis of Simon et al. [44], no significant gender effects on prevalence were found, thus supporting our finding [1, 13, 17, 23, 33]. There is evidence that male participants affected with ADHD outnumber females by a ratio of 2–3:1 in epidemiological studies in childhood; however, there is evidence that in adults the gender ratio tends to be more balanced [6, 41].

Significant age differences were found in our study. ADHD was almost 3-times more common in the age group 18–24 years compared with the oldest age group

(55–64 years) which is in line with the results of other studies. The other age groups did not differ significantly from the oldest age group with regard to ADHD estimates. Several studies reported that symptoms of ADHD decline with age [8, 14, 18, 21]. This might represent a true decline or remission of symptoms with increasing age but might also be explained by a lack of validity of the DSM-IV-TR criteria for ADHD when applied to adults and their environment [4, 31, 44]. The DSM-IV-TR ADHD criteria were developed for children, may not include developmentally appropriate symptoms and thresholds for adults, and might therefore underestimate the prevalence of ADHD especially in older adults. Most population-based studies were conducted in young adults [44]. The epidemiological studies in the representative community-based samples published so far have even excluded individuals aged 45 and older because of concerns about the accuracy of retrospective recall of childhood ADHD among older respondents [14, 21]. However, there is no evidence that the diagnostic criteria for adult ADHD are less valid for individuals aged 45–64 years compared with younger adults, e.g., aged 25–44 years.

The prevalence of adult ADHD was 12.1% in rural areas and 3.8% in urban areas. Adjustment for other sociodemographic variables had no impact on urban–rural odds ratios (Table 2). The strong association between living in a rural area and adult ADHD (OR 4.5) is difficult to explain and stands in contrast to most published studies in childhood and adulthood that did not find an association between urbanicity and ADHD [19, 21] or even reported a higher prevalence in urban as compared with rural towns and cities [11, 13]. Faraone and Biederman [13] hypothesized that for some ADHD adults the quick pace of urban living might be more attractive than the slower pace of rural life. However, it must be kept in mind that the concrete manifestation of urban and rural areas varies widely around the world and that the German countryside is much more populated than the countryside in the United States [35]. In addition, definitions of rural and urban may vary across studies. Rural residency in adulthood might also be an indicator for functional impairment and low income [9] which might explain the higher prevalence of adult ADHD particularly in very rural areas in our sample. This association has not been thoroughly studied in ADHD in adulthood and should be addressed further.

In clinical trials, most adults with ADHD suffer from additional psychiatric disorders during their lifetime, mainly affective disorders, anxiety disorders, substance use disorders, and eating disorders [10, 45]. In epidemiological studies, the association between adult ADHD and psychiatric co-morbidity is usually very strong with odds ratios between 3.0 and 5.0 for any mood disorder, any anxiety disorder, and any substance use disorder [14, 21]. Fayyad

et al. [14] even reported an OR of 7.2 for three or more co-occurring disorders. In our study, we used a screening tool (PHQ-4) with sufficient specificity and sensitivity to assess current prevalence rates of depression and anxiety. Thirty percent of the participants with adult ADHD screened positive for depression and anxiety as compared with well below 10% of participants without adult ADHD. The odds ratios were 2.8–2.7 when depression and anxiety were entered into the regression analysis together. The odds increased to 5.4 for depression and for anxiety when entered into separate logistic regression analyses. Even though causality cannot be established in our cross-sectional study, there is evidence from other community-based studies that the onset of ADHD precedes the onset of most co-morbid psychiatric disorders, suggesting that early successful treatment of childhood ADHD might have an influence on the development and course of secondary disorders [14].

Strengths of the study include the population-based assessment in a large sample and the identification of sociodemographic characteristics which allow us to evaluate potential selection bias and correct this bias using Federal Statistics Office population data. However, our findings have to be interpreted in the context of several important limitations. First, we used screening instruments to estimate the prevalence of ADHD, depression, and anxiety. Due to the large sample size, differential diagnoses (e.g., substance abuse) that may cause ADHD-like symptoms were not systematically assessed. Thus, an overestimation of ADHD particularly in young adults being at high risk for substance abuse compared with other age groups cannot be excluded [27]. Second, the use of self-report instruments to assess ADHD does not take into account information from an informant such as parents or partners. Methodological studies comparing adult self-reports and informant reports of ADHD symptoms have documented the same general pattern of underestimation in self-reports by adults as in those by children [16, 48]. In addition, there is considerable concern about the ability to recall ADHD symptoms in childhood [30]. The authors [30] found that 78% of adults who had received a diagnosis of ADHD in childhood were correctly identified by blinded reviewers 14–20 years later. In a control group, 11% were incorrectly identified as having had childhood ADHD. Even though this relates to a sensitivity and specificity of 78 and 89%, the authors argue that especially the use of general adult population surveys with an estimated prevalence of ADHD of only 5% would be expected to yield substantial overestimation of childhood ADHD. However, Murphy and Schachar [34] compared subject and informant ratings of childhood and current ADHD symptoms in two adult samples and found significant correlations between subjects' and informants' ratings of $r = 0.79$ and $r = 0.69$, respectively. The

methods employed in this study to estimate the prevalence of ADHD have been validated extensively [38–41] and have been used in other samples [36]. The combination of data from 2 questionnaires to classify the participants as putative cases of adult ADHD most likely allows a valid approximation of ADHD formal diagnosis in adulthood.

In summary, our results of a high prevalence rate of adult ADHD in a community-based German sample are in line with epidemiological studies in other countries, suggesting that adult ADHD is a common disorder that is associated with considerable psychiatric co-morbidity and functional impairment and should receive further clinical and research attention.

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