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ORIGINAL CONTRIBUTION

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How often do children meet ICD-10/DSM-IV criteria of attention deficit-/hyperactivity disorder and hyperkinetic disorder? Parent-based prevalence rates in a national sample – results of the BELLA study

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Abstract *Background* There is a lack of representative prevalence rates for attention deficit-/hyperactivity disorder (ADHD) according to DSM-IV criteria and hyperkinetic disorder (HD) according to ICD-10 criteria for German subjects. *Objective* To report the results of analyses of categorical data on the prevalence rates of the symptoms of ADHD/HD and additional diagnostic criteria, as well as of the diagnoses of ADHD and HD according to symptoms and other diagnostic criteria, according to the ICD-10 and DSM-IV. Further, to report administrative prevalence rates of the diagnosis and rates of coexisting behavioural and emotional problems. *Method* Within the BELLA module of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS), a representative sample of parents of 2,452 children and adolescents aged 7–17 years completed an ADHD symptom checklist (FBB-HKS/ADHS) and additional questionnaires for the assessment of coexisting behavioural and emotional problems. *Results* The prevalence rates for the diagnoses of ADHD according to DSM-IV criteria were 5.0% and the rate for HD according to ICD-10 criteria was 1.0%. Higher prevalence rates were found in boys and in younger children. The addition of other diagnostic criteria (impairment, pervasiveness, onset, duration) resulted in a significant decrease of the prevalence rates of ADHD and HD to 2.2 and 0.6%, respectively. Higher prevalence rates were found in families of lower socioeconomic status and families from urban areas. The lifetime administrative prevalence rate was 6.5%. Children with ADHD had an increased risk for coexisting behavioural and emotional problems, especially for aggressive and antisocial behaviour problems, but also for anxiety and mood problems. *Conclusion* The results of the national sample are in line with community studies in other countries. The effects of the additional diagnostic criteria of impairment, situational pervasiveness, symptom onset and symptom duration on the prevalence rates have to be considered in other epidemiological studies.

Key words attention deficit-/hyperactivity disorder (ADHD) – hyperkinetic disorder – epidemiology – prevalence – comorbidity

ECAP 1007

Introduction

Attention deficit-/hyperactivity disorder (ADHD) or hyperkinetic disorder (HD) is characterised by symptoms of inattention, impulsivity and hyperactivity that can significantly impact many aspects of behaviour and performance, both at school and at home. The prevalence and the chronic nature of the disorder, and its potential to interfere with different areas of developmental relevance, make ADHD a major public health issue. Several studies in different cultures and countries have assessed the prevalence of ADHD. Skounti et al. [49] reviewed 39 studies conducted worldwide and found great variations in the prevalence rates. They ranged from 2.2 to 17.8%, with the majority of studies reporting prevalences between 4 and 10%. Polanczyk et al. [43] also conducted a worldwide review and found 102 studies containing 171,756 subjects from regions all over the world. The ADHD/HD worldwide-pooled prevalence was 5.29% (95% CI 5.01 – 5.56); this estimate is associated with significant variability. In the multivariate meta-regression model, diagnostic criteria, source of information, requirement of impairment for diagnosis, and geographic origin of the studies were significantly associated with ADHD/HD prevalence rates. No statistically significant differences were found between Europe (4.6%; 95% CI 3.93–5.29) and North America (6.57%; 95% CI 6.05–7.08).

Skounti et al. [49] included studies using DSM-III-R or DSM-IV criteria and found higher prevalence rates in studies using the DSM-IV criteria. Polanczyk et al. [43] replicated this finding and also found significantly lower prevalence rates in studies using the ICD-10 criteria. The main differences between DSM-IV and ICD-10 pertain to the concomitance of the three domains (inattention, hyperactivity and impulsivity), the exclusion of comorbidity and the degree of pervasiveness. The ICD-10 criteria require a full set of symptoms in all three domains, whereas the DSM-IV recognises three subtypes of the disorder—the predominantly inattentive type (ADHD-I), the predominantly hyperactive-impulsive type (ADHD-HI) and the combined type (ADHD-C). An ICD-10 diagnosis of HD is, thus, most congruent with a DSM-IV diagnosis of ADHD combined type. Swanson et al. [53] reported that ADHD prevalence according to the DSM is 5–10% in the general population, but that this number is somewhat lower, about 1–2%, when using the ICD criteria.

The majority of the studies based on the DSM-IV reviewed by Skounti et al. [49] have suggested that the predominantly inattentive type (ADHD-I) is the most common form of ADHD, followed by combined (ADHD-C) and hyperactive-impulsive type (ADHD-HI).

Beyond the presence of symptoms, both the ICD-10 and the DSM-IV require clinically significant impairment in social, academic, or occupational functioning as an additional criterion for the diagnosis. While all epidemiological studies used symptom counts as a criterion for ADHD/HD, only some of them also included an impairment criterion. In the review of Polanczyk et al. [43], the authors found that studies without a definition of impairment reported significantly higher ADHD/HD prevalence rates than those with a definition of impairment. For example, Wolraich et al. [57] reported an ADHD prevalence rate of 16.1% in a school population in the USA using the DSM-IV symptom criteria; however, when the diagnosis of ADHD included symptom counts and poor classroom functioning as a measure of impairment, the prevalence of ADHD fell to 6.8%. Also, in studies by Shaffer et al. [48] and Graetz et al. [32], the prevalence of ADHD dropped from 6.5 to 5.1% and from 7.5 to 6.8%, respectively, when clinical impairment of children was taken into account. Gordon et al. [29] showed, in a secondary analysis of several studies, that the correlation between symptom count and measures of impairment was quite low. Thus, the ADHD group that was established based on a measure of current symptoms shrunk by 77% when a criterion-based measure of impairment was added.

Furthermore, both the DSM-IV and ICD-10 require evidence of symptoms in two settings (e.g., in school and at home). Studies using only one informant (i.e., parent or teacher) usually report higher rates compared to studies using two informants. For example, Gomez et al. [28] reported rates of 8.8 or 9.9% when parents or teachers were asked, respectively. However, the prevalence rate dropped to 2.4% when diagnosis was based on both informants. Similar results were found in a German sample of preschool children with a drop from a DSM-IV ADHD prevalence rate of 11.3% (ICD-10 3.8%) based on parent ratings to 4.2% (ICD-10 1.2%) based on both parent and teacher ratings [11].

In addition to these methodological factors, other sociodemographic variables contribute to the variability of the prevalence rates in the different studies. The effects of gender and age on prevalence rates are well documented. In the meta-regression analysis conducted by Polanczyk et al. [43], ADHD/HD prevalence rates were stratified by age in 43 studies and by gender in 44 studies. In these studies, both age and gender were significantly associated with prevalence rates. In their review, Skounti et al. [49] found in community samples that the male-to-female ratio ranged from 1:1 to 3:1. ADHD was found to be more prevalent among males for all three subtypes [6, 21, 28, 32, 39, 41, 57, 58]. However, the proportion of girls with ADHD-I symptoms was higher compared to

other ADHD subtypes [6, 28, 33, 41, 57, 58]. The influence of age on the prevalence of ADHD was strongly supported by the findings of several studies from the United States, the United Kingdom, Spain, Canada and Germany, all of which show a decline in prevalence rates with age [14, 24, 27, 31].

Higher prevalence rates have also been associated with lower socioeconomic status in epidemiological studies in several countries, including the USA, Australia, Sweden, Colombia and Japan [26, 32, 36, 41, 52]. Scahill et al. [45] found that children with ADHD were more likely to come from low-income families with higher levels of family dysfunction. Biederman et al. [7] found that psychosocial adversity, low social class, maternal psychopathology, and family conflict in particular, all increased the risk for ADHD independently of other risk factors. Most studies found no significant difference between rural versus urban regions [10, 15, 39, 50]; however, Baumgaertel et al. [6] reported higher prevalence rates in urban schools compared to rural schools in Germany.

Comorbidity rates in children with ADHD show great variation in epidemiological studies. In their literature review, Jensen et al. [35] found a relatively high comorbidity (42.7–93.0%) between ADHD and conduct disorder/oppositional defiant disorder (CD/ODD). Gillberg et al. [25] found in their recent review of studies on comorbidity that about 50–60% of all children with ADHD meet the criteria for ODD. Lower rates of comorbidity were found between ADHD and internalising disorders, such as anxiety or depression (13.0–50.8%). Pliszka et al. [42] noted that although 5–15% of the childhood population has an anxiety disorder, 15–35% of children with ADHD also manifest significant anxiety. Pfiffner et al. [40] reported that nearly 43% of their clinically referred boys with ADHD had anxiety disorders. The Multimodal Treatment of ADHD (MTA) study also found that 33–39% of the clinically referred sample also had an anxiety disorder [36]. In a recent study on the prevalence of ADHD among Finnish adolescents, Smalley et al. [51] found increased odds ratios for the association between ADHD and anxiety (OR 2.4), mood (OR 2.9) and disruptive behavioural disorders (OR 17.3).

In the reviews cited above, studies published in German were not taken into consideration; however, these correspond well with the international findings. Görtz-Dorten and Döpfner [31] used the same ADHD symptom checklist as the present study in a local German sample of 713 children aged 4–17 years. Using symptom criteria, they found ADHD prevalence rates of 11.5% (according to DSM-IV) and an HD prevalence of 3.4% (according to ICD-10). When the functional impairment criterion was added, the prevalence rates were reduced to 7.9% (DSM-IV) and 3.0% (ICD-10). In earlier community studies with smaller samples of children aged 6–10 years, symptom criteria-based prevalence rates for ADHD (defined according to DSM-IV) were 6 and 2.4% for HD (defined according to ICD-10) [13]. In adolescents aged 11–18 years, prevalence rates of 8.4% (DSM-IV) and 1.8% (ICD-10) were found. In a community sample of 521 pre-school children aged 3–7 years, the authors [10] found 11.3% of the children fulfilled the symptom criteria of DSM-IV defined ADHD (based on parent ratings) and 3.8% met the ICD-10 criteria for HD.

Huss et al. [34] analysed the data of 14,836 children aged 3–17 years from the nationally representative German Health Interview and Examination Survey for Children and Adolescents (KiGGS). The authors assessed the administrative lifetime prevalence rate for ADHD by asking parents whether their child has received a diagnosis of ADHD/HD from a physician or a psychologist. They found an ADHD prevalence rate of 4.8% in the sample, with higher rates in boys (7.7%) compared to girls (1.8%). In that study, ADHD had been diagnosed significantly more frequently in participants with low socioeconomic status (SES) than in participants with high SES. A diagnosis of ADHD was reported less frequently in migrants. Furthermore, 4.9% of subjects were identified as potential cases based on a raw score of ≥7 on the inattention/hyperactivity scale of the strengths and difficulties questionnaire (SDQ) without having been diagnosed by a physician or psychologist.

In retrospective analyses of the claims database covering the insured population in two different regions in Germany, Köster et al. [37] and Schlander et al. [47] found similar administrative prevalence rates of 57% for boys and 1–3% for girls aged 7–10/12 years.

The aim of the present study was to analyse the prevalence rates of the symptoms of ADHD/HD and the additional diagnostic criteria (impairment, pervasiveness, onset, duration), as well as the diagnoses of ADHD and HD according to symptom criteria and additional criteria from the ICD-10 and DSM-IV. Additionally, we report administrative prevalence rates of the diagnosis and rates of co-existing behavioural and emotional problems.

Methods

Design and sample

The conceptualisation, design and procedure of the Mental Health Module (BELLA study) of the German Health Interview and KiGGS are described in detail in

Ravens-Sieberer et al. [44]. Participants in the BELLA study were recruited randomly from a nationally representative sample of 17,641 families with children aged 3–17 years participating in the KiGGS study. The KiGGS and BELLA surveys took place between May 2003 and May 2006 in 167 cities and communities within Germany. In the KiGGS study, the overall response rate was 66.6%. A random selection of 4,199 families from the KiGGS sample with children aged 7–17 were asked to participate in the BELLA study. Of all eligible families, 70% agreed to participate and 68% (1,389 girls and 1,474 boys) were surveyed. Of these 2,863 families that participated in the BELLA study, 1,142 families had children aged 7–10 years, 780 families had children aged 11–13 years and 941 families had children aged 14–17 years. From each family, one parent was interviewed by means of a standardised computer-assisted telephone interview (CATI). Children aged 11 years and older were interviewed as well. In addition, the participants were asked to fill out a mailed paper and pencil questionnaire. Sample data were weighted to correct for deviation of the sample from the age-, gender-, regional- and citizenship-structure of the German population.

Instruments

In order to determine the presence of ADHD, the German ADHD Rating scale (FBB-HKS/ADHS) was completed by the parents. This scale is part of the comprehensive Diagnostic System for Mental Disorders in Childhood and Adolescence (DISYPS-KJ, [16]; DISYPS-II; [17]) and is comparable to other DSM-IV-based rating scales. It includes 20 items representing the 18 symptom criteria of both the ICD-10 and the DSM-IV, as well as additional items assessing symptom onset, symptom duration, pervasiveness and functional impairment (see Table 1 for abbreviated wordings).

Parents indicated the severity of each symptom on a 4-point Likert scale with values of not true (0),

Table 1 Prevalence rates of symptoms (rating 2 or 3 = "predominantly true" or "especially true"; N = 2,452)

Item (abbreviated)	Male n = 1,250 (%)	Female n = 1,202 (%)	Relative risk* Male–female
Inattention			
01 No close attention to details	21.8	12.8	1.71
02 Difficulty sustaining attention	13.1	6.4	2.05
03 Does not seem to listen	8.8	4.5	2.00
04 Fails to finish work	7.5	4.2	1.81
05 Has difficulty organising tasks and activities	10.3	5.6	1.85
06 Avoids tasks that require mental effort	18.5	9.6	1.93
07 Loses things necessary for tasks or activities	8.6	4.2	2.08
08 Is easily distracted	23.7	14.7	1.61
09 Is forgetful in daily activities	10.7	5.8	1.84
Hyperactivity and impulsivity			
10 Fidgets with hands or feet or squirms in seat	14.4	7.0	2.06
11 Leaves seat in classroom	3.4	0.7	5.05
12 Has difficulty playing quietly	4.6	2.1	2.23
13 Runs about or climbs excessively	2.8	1.2	2.40
14 Feelings of extreme restlessness (ICD only)	5.0	2.9	1.73
15 Persistent pattern of excessive motor activity (ICD only)	3.8	1.8	2.05
16 Is "on the go" or acts as if driven by a motor (DSM only)	9.5	6.2	1.55
17 Blurts out answers	7.8	4.9	1.60
18 Has difficulty awaiting turn	8.2	4.3	1.88
19 Interrupts or intrudes on others	7.2	3.8	1.88
20 Talks excessively	10.6	11.2	NS
Distress and functional impairment			
21 Is significantly distressing	3.7	2.7	NS
22 Impairment in academic / occupational functioning	4.8	2.7	1.75
23 Impairment in social functioning with adults	2.8	2.3	NS
24 Impairment in social functioning with peers	1.8	1.2	NS
Pervasiveness			
25 Problem severity in the family	3.2	2.1	NS
26 Problem severity at school	4.5	2.3	1.93
27 Problems severity outside of family / school	1.9	1.1	NS
Onset and duration			
28 Onset before the age of 7 (yes/no)	4.6	1.7	2.79
29 Duration more than 6 months (yes/no)	5.8	2.8	2.04

*All relative risks are significant with $P < 0.05$

somewhat true (1), predominantly true (2), and especially true (3), with higher scores indicative of more severe ADHD symptoms. The definition of the intensity or frequency of a symptom as described by the DSM-IV or ICD-10 is part of the item description (i.e., is often easily distracted by external stimuli). The ICD-10 and DSM-IV wordings of the symptom criteria are nearly identical for all but one criterion, which was assessed by two items (item 15 and 16; see Table 1). One criterion in ICD-10 covers an additional factor (feelings of extreme restlessness in adolescents and adults), which was assessed by an extra item (item 14; see Table 1).

Impairment in academic/occupational functioning, social functioning with adults and with children was assessed using three items with the 4-point Likert scale described above. Another item assessed distress due to the symptoms (as defined by the ICD-10). Another three items assessed the problem severity of the symptoms in the family, the school and in other places outside of the family and school. These items are used as an indication of the situational pervasiveness of the symptoms. Two additional items assessed the onset and the duration of the problems as additional criteria for the diagnosis of ADHD/HD.

Exploratory factor analyses of the 18 symptom criteria rated by parents in field samples of children aged 6–10 years [13], adolescents aged 11–17 years [30], and children and adolescents aged 4–18 years [17, 31], extracted two factors, describing inattention and hyperactivity-impulsivity, according to the DSM-IV classification. For pre-school children, these two dimensions could be replicated in confirmatory factor analyses [12]. However, three-factor solutions could also be extracted, involving inattention, hyperactivity and impulsivity separately [17, 31]. Internal consistencies of the subscales inattention, hyperactivity and impulsivity and hyperactivity-impulsivity and the total score were satisfactory to very good in the different representative samples (α = 0.78–0.90). In the age range of 4–17 years, significant age effects were found for the total ADHD score and all subscale scores, indicating decreasing age trends. In this issue, Erhart et al. [20] analysed the psychometric properties of the FBB-HKS in the same representative sample used for the present analysis and found two- and three-factorial solutions, both in exploratory and confirmatory factor analyses, representing the DSM-IV and ICD-10 groupings of symptoms and adequately accounting for the inter-item correlations. In this analysis, good internal consistencies of the total score and the subscale-scores were also found. In their pan-European study with a similar ADHD rating scale, Döpfner et al. [19] reported satisfactory results for the internal consistency of the two scales inattention (Cronbach's α = 0.81) and hyperactivity-impulsivity (Cronbach's α = 0.87).

In order to identify externalising behavioural problems, the externalising scale of the German version of the Child Behavior Checklist (CBCL, [3]) was administered in the BELLA questionnaire for parents. The CBCL externalising problems scale includes two subscales assessing delinquent behaviour with 13 items and aggressive behaviour with 20 items. The items contain statements regarding the behaviour of the young person that can be rated as "not true," "somewhat or sometimes true" or "very true or often true." Higher scores indicate a higher level of symptomatology. The German version of these scales has been proven to be factorially valid and internally consistent [16]. In order to calculate comorbidity rates, a cut-off score for each of the scales was defined with a T-score ≥67 according to the German norms [3].

Information on anxiety disorders was obtained with the German version of the Screen for Child Anxiety Related Emotional Disorders—Questionnaire (SCARED) [8, 9] in separate telephone interviews through self- and parent-reports. This questionnaire contains 38/41 items [8, 9] that can be assigned to five subscales according to the factor structure of the instrument: somatic/panic, generalised anxiety, separation anxiety, social phobia, and school phobia. The present report provides results of the reduced version with five items, including one item from each factor, and shows similar psychometric properties compared with the full SCARED [8]. Comorbidity rates were calculated on the basis of a raw score of >4 as cut-off for separation anxiety and social phobia. The chosen cut-offs were as follows: for somatic/panic, raw scores >9; for general anxiety, raw scores >8; and for school, phobia raw scores >3. For the total score, the cut-off was >15.

The Center for Epidemiological Studies Depression Scale for Children (CES-DC) [22, 23, 54] was administered as self-report and as parent-report version in separate structured telephone interviews. In each version, 20 items cover positive mood as well as cognitive, behavioural, affective, and somatic symptoms associated with depression. Each item was rated on a 4-point Likert scale (0 = not at all, 1 = a little, 2 = some, 3 = a lot). Comorbidity rates in the parent-report and the self-report were calculated on the basis of a raw score of >15 as cut-off. For psychometric properties of the CES-DC see Barkmann et al. [5] in this issue.

Socioeconomic status (SES) was assessed using the Winkler-Index [56], which classifies the families as low, medium and high SES, taking into account the income, education and parental working position.

Statistical analyses

The statistical analyses are based on the weighted sample data to represent the age-, gender-, regional- and citizenship-structure of the German population (reference data 31 December 2004). The number of cases reported in the tables and in the text refers to weighted data and thus might deviate from the number of cases reported in former descriptions of the sample. Parent ratings on the FBB-HKS/ADHS were obtained from 2,452 parents.

Results

Table 1 shows the prevalence rates (ratings of 2 = predominantly true or 3 = especially true) for boys and girls of each of the symptoms of ADHD as defined by the ICD-10 and the DSM-IV as well as the relative risk for boys of increased symptom prevalence rates. The prevalence rates for inattention symptoms ranged from 7.5 to 23.7% for boys and from 4.2 to 14.7% for girls. For symptoms of hyperactivity and impulsivity, the prevalence rates ranged from 2.8 to 14.4% for boys and from 0.7 to 11.2% for girls. The relative risk indices were statistically significant for all except one item (item 20: talks excessively) and ranged between 1.55 (item 16: is on the go) and 5.05 (item 11: leaves seat), indicating higher symptom prevalence rates for boys.

Table 1 also includes the prevalence rates of the additional criteria assessed with the FBB-HKS/ADHS. Severe distress or functional impairment (ratings of 2 = predominantly true or 3 = especially true) were reported by 1.8–4.8% of the parents of boys and by 1.2–2.7% of the parents of girls. The relative risk score (RR) of item 22 (impairment in academic/occupational functioning) was statistically significant, indicating a higher prevalence rate for boys.

The three pervasiveness items indicate that severe problems (ratings of 2 = predominantly true or 3 = especially true) were present most often at school and less often with the family or outside of the family and the school. Interestingly, 76% of the children with problems in the family also had problems at school, but only 58% of children with problems at school also had problems in the family. In 4.6% of the boys and in 1.7% of the girls, the described problems had an onset before the age of 7 years. In 5.8% of the boys and in 2.8% of the girls, the described problems lasted more than 6 months.

In the total sample, the prevalence rates for the diagnoses of ADHD according to the DSM-IV symptom criteria were 5.0% and of HD according to ICD-10 symptom criteria were 1.0%. Figure 1 shows the prevalence rates of the diagnoses of ADHD and HD based on symptom criteria in different age groups, indicating a decline in ADHD (HD) from 6.4% (1.8%) for the 7- to 10-year-old children to 3.9% (0.3%) for the 14 to 17-year-old children.

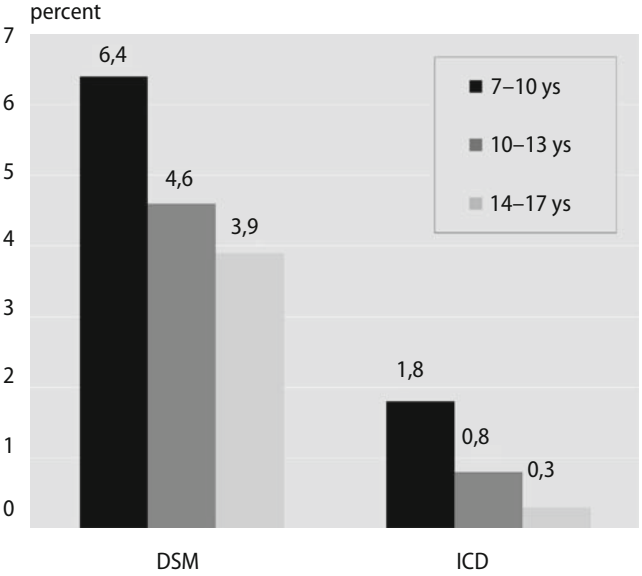

Fig. 1 Prevalence rates of ADHD and HD according to DSM-IV and ICD-10 symptom criteria in different age groups

Table 2 Prevalence of subtypes of ADHD (DSM-IV, symptom-based diagnosis), total sample

	DSM-IV			
	ADHD-I (%)	ADHD-HI (%)	Combined (%)	Any Diag. (%)
Total (N = 2,452)	3.6	0.6	0.8	5.0
7–10 (n = 857)	4.2	0.9	1.3	6.4
11–13 (n = 627)	3.3	0.5	0.8	4.6
14–17 (n = 969)	3.3	0.3	0.3	3.9

Table 2 describes the prevalence rates for the subtypes of ADHD according to the DSM-IV in different age groups. In all age groups, the predominantly inattentive subtype (ADHD-I) was the most prevalent diagnosis, whereas the predominantly hyperactive-impulsive subtype (ADHD-HI) was the least frequent diagnosis.

Figure 2 shows the prevalence rates of ADHD according to DSM-IV symptom criteria in boys and girls in different age groups, and indicates a decline of the prevalence rates in both gender groups with age and a higher prevalence in males in all age groups.

Figure 3 shows the reduction of the prevalence rates of ADHD/HD according to symptom and additional criteria. DSM-IV criterion D refers to "clear

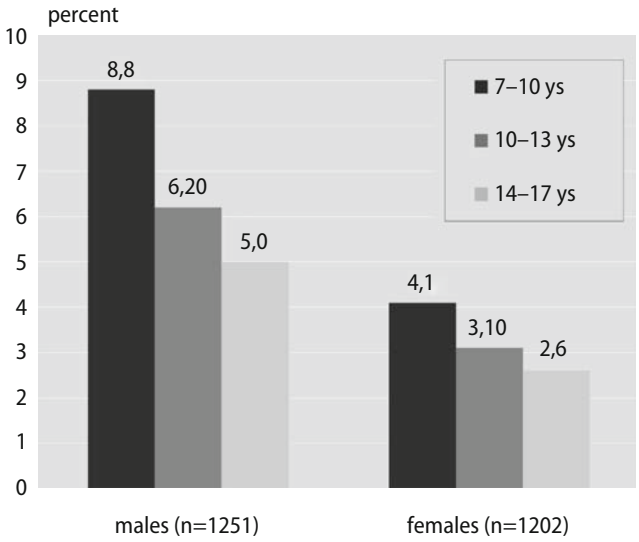

Fig. 2 Prevalence rates of ADHD according to DSM-IV symptom criteria in boys and girls and different age groups

evidence of clinical significant impairment in social, academic, or occupational functioning" [1]. The addition of this criterion (requiring that at least one of the three impairment items 22–24 was rated as 2 = predominantly true or 3 = especially true) resulted in a reduction of the prevalence rates for ADHD from 5.0% to 4.1%.

The pervasiveness criterion is defined in the DSM-IV as "some impairment from the symptoms is present in two or more settings" (defined that at least two of the three pervasiveness items 25–27 were rated at least with 1 = somewhat true) [1]. The addition of this criterion resulted in a further reduction of the prevalence rates for ADHD from 4.1 to 3.9%.

The addition of the onset criterion (before age of 7) resulted in a further reduction of prevalence to 2.5% and, finally, adding the duration criterion (more than 6 months) resulted in a prevalence rate of 2.2%. Overall, by adding the four criteria to the symptom criteria, the prevalence rates for DSM-IV-defined ADHD were reduced from 5.0 to 2.2%.

In the ICD-10, the additional criteria are defined somewhat differently. The impairment criterion is extended and includes impairment or distress. Therefore, we defined that at least one of the four distress and impairment items 21 to 24 was rated as 2 = predominantly true or 3 = especially true. The pervasiveness criterion is more stringently defined (the symptom criteria should be met from more than a single situation) and we therefore also use a more stringent definition (at least two of the three items, 25 to 27, were rated ≥2 = predominantly true). The addition of these criteria reduced the prevalence from 1.0 to 0.6% using this metric.

The prevalence rates of DSM-IV diagnoses based on symptom criteria were also analysed in different subgroups. Lower prevalence rates were found in children with migrant status (2.5%) than in children with non-migrant status (5.2%). Moreover, children from a lower social class (defined according to the Winkler-Index) had higher DSM-IV prevalence rates (7.3%) compared to children from the middle (5.1%) and upper (2.9%) classes (Chi-square 13.28; $P < 0.001$). Between children from Eastern Germany (new federal states of Germany) and Western Germany, no statistically significant differences in prev-

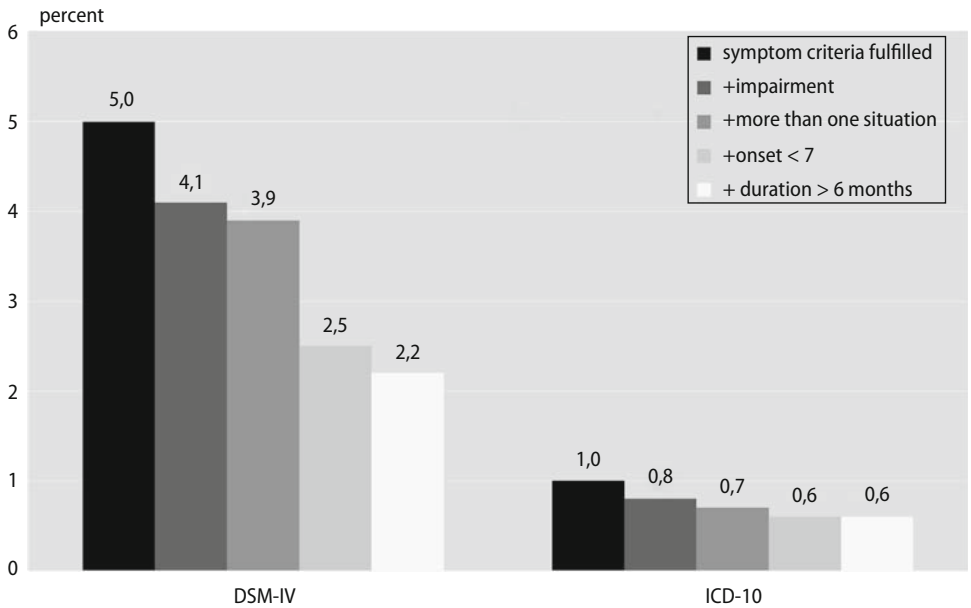

Fig. 3 Prevalence rates of ADHD/HD in children aged 7–17 years according to DSM-IV and ICD-10 symptom criteria and additional criteria

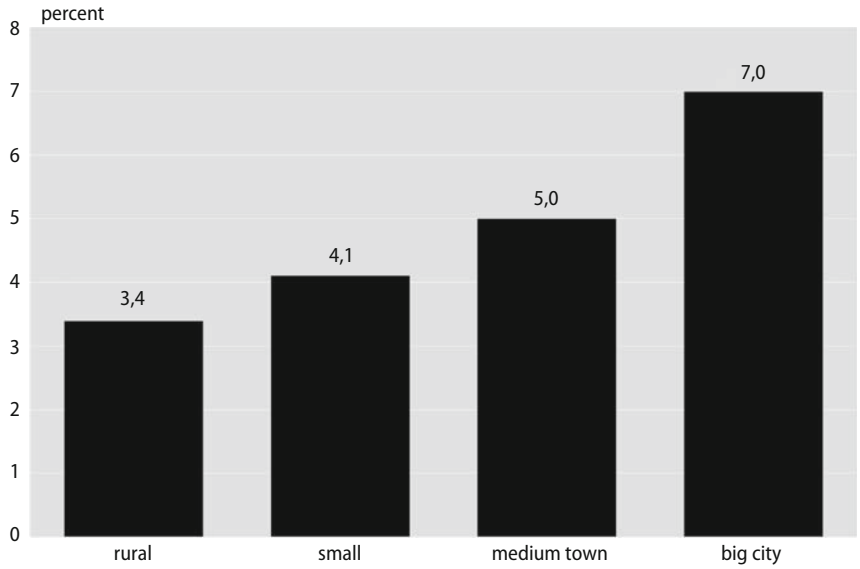

Fig. 4 Prevalence rates of ADHD according to DSM-IV symptom criteria and degree of urbanisation

alence rates were found (East: 4.1%; West: 5.1%; Chi-square 0.81; $P > 0.05$). As shown in Fig. 4, the degree of urbanisation was associated with the prevalence rates, with a linear increase in prevalence rates from rural areas to big cities (Chi-square 8.99; $P < 0.029$).

Overall, 6.5% of parents reported that their children had already received a diagnosis of ADHD/HD by a physician or a psychologist (data not shown). This administrative prevalence rate was higher for boys (10.2%) than girls (2.7%). Only 29.1% of the children with this administrative lifetime diagnosis fulfilled the DSM-IV diagnostic symptom criteria rated by the parents, and 42.7% of the children that fulfilled the DSM-IV diagnostic symptom criteria also had received a diagnosis of ADHD/HD by a physician or a psychologist.

Furthermore, 6.7% of the children were rated by their parents on the inattention/ hyperactivity scale of the SDQ with a score ≥7, which was chosen as a cut-off for suspected cases in the study of Huss et al. [34] and Schlack et al. [46]. However, only 36% of children who had an elevated SDQ-score also fulfilled the DSM-IV diagnostic symptom criteria (rated by the parents), and 49.2% of children who fulfilled the DSM-IV diagnostic symptom criteria also had increased SDQ-scores (data not shown).

Table 3 shows the prevalence of coexisting behavioural and emotional problems as rated by the parents with subscales of the CBCL, the SCARED and the CES-D. The relative risks (RR) and the odd ratios (OR) for coexisting behavioural and emotional problems in children with ADHD (according to DSM-IV symptom based cut-offs) were higher compared to children without ADHD. The highest RRs were found for aggressive and antisocial behaviour with an eight- to twelve-fold increase of the risk for aggressive and antisocial behaviour in children with ADHD compared to children without ADHD, and a comorbidity rate of 57% for aggressive behaviour and 37% for antisocial behaviour. The highest comorbidity rate was found with anxiety disorders, with 64.5% of the children with ADHD displaying this comorbidity. However, due to the high prevalence of these problems in the total sample, the RR was only 2.5.

Discussion

In a representative German sample of 2,452 children and adolescents aged 7–17 years, prevalence rates of 5.0% for the diagnoses of ADHD according to DSM-IV symptom criteria and of 1.0% for ICD-10 diagnoses based on symptom criteria were found. This prevalence rate is in line with the prevalence rates found in other countries and cultures and with other

Table 3 Coexisting behavioural and emotional problems in children with DSM-IV symptom based diagnosis of ADHD, relative risks (RR) and odds ratios (OR)

Mental health problems	Assessment	% in cases with ADHD	RR (in ADHD+)	OR
Aggression	CBCL-AB	57.4	8.0	17.4
Antisocial	CBCL-AS	37.4	12.6	8.2
Anxiety (total)	SCARED-total	64.5	2.5	5.3
Somatic/panic	SCARED	6.6	7.2	7.7
Gen. anxiety	SCARED	44.6	3.3	5.1
Separation anxiety	SCARED	26.4	2.0	2.4
Social phobia	SCARED	22.2	2.3	2.9
School phobia	SCARED	24.0	5.5	6.9
Depression	CES-DC parent	34.7	3.7	5.2
Depression	CES-DC self	31.2	2.0	2.5

assessment instruments. In their international review, Polanczyk et al. [43] found an overall rate of 5.3% and a rate of 4.6% for Europe in general. The ICD-10 symptom-based prevalence rate is similar to the estimation of Swanson et al. [53] of 1–2% for ICD-10 HD. A previous study from Germany by Görtz-Dorten and Döpfner [31] reported substantially higher prevalence rates for DSM-IV symptom-based diagnoses (11.5%) and ICD-10 symptom-based diagnoses (3.4%) with the same assessment tool. However, the Görtz-Dorten and Döpfner [31] study was conducted in an urban area, included younger children and had higher attrition rates.

In all age groups, the predominantly inattentive subtype was the most prevalent diagnosis, whereas the predominantly hyperactive-impulsive subtype was the least frequent diagnosis. This is in line with the majority of the studies based on the DSM-IV included in the review of Skounti et al. [49], in which the predominantly inattentive type was diagnosed most often, followed by the combined and the hyperactive-impulsive type.

In this study, 4.8% of parents of boys and 2.7% of parents of girls reported significant impairment of their child in academic/occupational functioning and 2.8/2.3% (boys/girls) in social functioning with adults due to ADHD symptoms. This indicates that the symptom criteria for an ICD-10 diagnosis may be too strict, since a substantial percentage of the children are rated as impaired, but fail to reach the symptom criteria for a diagnosis.

When impairment, pervasiveness, symptom onset and symptom duration were added as further diagnostic criteria, the prevalence rates resulting from diagnoses based on either the DSM-IV or the ICD-10, were reduced substantially. For the DSM-IV, the prevalence rates dropped from 5.0 to 2.2% and for the ICD-10, the drop was from 1.0 to 0.6%. The reduction of prevalence rates, when taking impairment and situational pervasiveness into account, has been reported in several other studies [11, 31, 32, 48]. The largest reduction in the DSM-IV prevalence was found by adding the onset criterion (before the age of 7). Several recent studies have questioned the strict criterion of an age of onset at or before 7 years, and suggest a somewhat broader onset criterion [2, 4], while others support the continued inclusion of this criterion [55]. The fact that the reduction for ICD-10 diagnoses was much smaller supports the findings of Applegate et al. [2] and Willoughby et al. [55] that especially less severe cases and those diagnosed as predominantly inattentive satisfy the age of onset criterion less frequently.

This study not only replicated the well-known gender effect for all age classes, but also showed a decline in prevalence rates with increasing age in both males and females, as was also demonstrated by Polanczyk et al. [43]. Based on the DSM-IV symptom criteria, the prevalence rates dropped from 8.8% in 7- to 10-year-old boys to 5.0% in 14- to 17–year-old boys, which is a reduction of 43%. Somewhat smaller reductions of the prevalence rates were found for girls (36%).

A surprisingly strong association was found between the socioeconomic status of the families and ADHD prevalence rates, with increasingly higher rates in lower social classes. In the lower social class, the DSM-IV symptom-based prevalence rate was 2.5-fold higher compared to the rate in the higher social classes. This result is in line with several epidemiological studies reporting an association between higher prevalence rates in lower classes in several countries, including the USA, Australia, Sweden, Colombia and Japan [26, 32, 36, 41, 52]. Biederman et al. [7] found SES and other components of Rutter's indicators of family adversity to be significantly associated with the risk for ADHD and several measures of adverse functional outcome, even after controlling for parental ADHD, maternal smoking during pregnancy and gender. These findings provide further support for the contribution of adverse psychosocial factors to the risk for ADHD and its association with morbidity and dysfunction. Huss et al. [34] found an increased administrative lifetime prevalence rate for ADHD in participants with low SES in the larger sample of the German Health Interview and KiGGS.

We also found higher prevalence rates in bigger cities compared to rural areas. This finding is contrary to most published studies, which have reported no significant difference in rural or urban regions [10, 15, 39, 50]. However, in the only German study on this issue, Baumgaertel et al. [6] also reported higher prevalence rates in urban schools compared to rural schools. Since it is not clear whether this finding applies only to the German society, the relationship between urbanisation and other variables, such as SES, have to be explored in subsequent analyses.

In this analysis, 6.5% of parents reported that their children had already received a diagnosis of ADHD/HD from a physician or a psychologist. This figure is slightly higher than the 4.8% reported by Huss et al. [34], which is accounted for by the fact that the present study analysed 7- to 17-year-old children whereas the KiGGS study encompassed 3- to 17-year-old children. Huss et al. [34] found lower prevalence rates in pre-school aged children, which were excluded from this study. However, we only found a small overlap between these administrative lifetime prevalence rates and the prevalence rates calculated on the basis of the parent-report of symptoms of ADHD. Only 29.1% of children with an administrative lifetime diagnosis fulfilled the DSM-IV diagnostic

symptom criteria rated by parents and only 42.7% of children who fulfilled the DSM-IV diagnostic symptom criteria had also received a diagnosis of ADHD/HD from a physician or a psychologist. The fact that the majority of children with ADHD according to DSM-IV symptom criteria have not been diagnosed may be explained by the fact that these children were not referred to a physician or psychologist. The finding that more than two thirds of the children with an administrative lifetime diagnosis did not fulfil the DSM-IV symptom criteria is much more surprising. However, the length of time following the diagnosis and subsequent treatments may explain some of these cases. Moreover, these diagnoses were established by a very heterogeneous group of physicians and psychologists, which may vary in their consistency of using the ICD-10 or the DSM-IV diagnostic criteria. Further analyses are necessary to disentangle these factors. We also found a lack of sensitivity and specificity for the SDQ inattention/ hyperactivity subscale for the detection of ADHD defined by DSM-IV symptom criteria. This scale was used in the Huss et al. [34] analysis.

As expected, we also found increased rates of coexisting behavioural and emotional problems rated by the parents on several scales. In line with published studies summarised by Jensen et al. [35], Gillberg et al. [25], and Pliszka et al. [42], the highest relative risks and odds ratios were found for aggressive and antisocial behaviour with an eight- to twelve-fold increase of the risk for aggressive and antisocial behaviour in children with ADHD, whereas the relative risks for anxiety problems and depressive symptoms were increased at a lower level.

This is the first representative German study on the prevalence of ADHD/HD according to the criteria defined by the current diagnostic schemes. However, some limitations have to be mentioned. The analyses are based on parent reports using rating scales and structured telephone interviews (for some of the coexisting problems). Neither diagnostic interviews nor teacher information were included in this study. Moreover, the results presented here are restricted to analyses of categorical data. However, multivariate analyses with dimensional data will need to be conducted in order to use the full information of the data set. Nonetheless, the results of this report fit quite well with the existing empirical literature on ADHD and contribute to the growing empirical knowledge about ADHD.

Conflict of interest All authors declare no conflict of interest.

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