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Who cares for patients with attention-deficit/hyperactivity disorder (ADHD)?

Insights from Nordbaden (Germany) on administrative prevalence and physician involvement in health care provision

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■ **Abstract** *Objective* To determine age and gender specific administrative prevalence of ADHD (hyperkinetic disorder, HKD, and hyperkinetic conduct disorder, HKCD, according to ICD-10-based coding) in Germany in 2003, and to assess physician involvement in medical care. *Method* Retrospective claims database analysis covering the insured population of Nordbaden, Germany (n = 2.238 million). *Results* A total of 11,875 subjects with a diagnosis of HKD/HKCD were identified (overall 12-month prevalence rate 0.53%). Prevalence was highest among children age 7–12 years (5.0%; boys, 7.2%; girls, 2.7%). Among adults age 20 years and higher, prevalence was 0.04% (males, 0.04%; females, 0.03%). 36.0% (13.0%) of children and

adolescents and 33.5% (12.5%) of adults with a diagnosis of ADHD were seen by a specialized physician at least once (four times) during the year. Physician involvement by discipline was highly skewed. *Conclusion* Diagnosis rates in children and adolescents exceeded those expected according to ICD-10 criteria, but matched DSM-IV-based estimates. In the adult population, ADHD was rarely detected. Most patients were not seen by a mental health specialist, and physician involvement was highly concentrated. Potential policy implications include a high need for expertise among pediatricians and general practitioners. The data indicate an urgent need for further research into health care utilization and quality.

■ **Key words** attention deficit-hyperactivity disorder (ADHD) – hyperkinetic disorder (HKD) – Prevalence – physician involvement – health care utilization

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Introduction

Attention-deficit/hyperactivity disorder (ADHD) is thought to be the most common behavioral problem

in children and adolescents, affecting up to one out of 20 children [12]. Although symptoms tend to decline with age [4], longitudinal studies have shown ADHD persistence into adulthood [21]. For adults, however, few epidemiological data are yet available. Further-

more, in clinical practice detection and accurate diagnosis of ADHD can present specific challenges as the presentation of symptoms may differ in adults [1, 34, 35].

Reported prevalence rates of ADHD in children and adolescents depend on diagnostic criteria used. In the United States, many if not most physicians use the definition of ADHD according to the 4th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). ADHD is characterized by pervasive presence of symptoms of inattention and/or hyperactivity-impulsivity over a period of at least 6 months [2]. Studies using DSM-IV criteria consistently report the highest prevalence rates, ranging from 11.4% to 16.1% in children aged 8–10 years, excluding outlying values [12]. Only recently, in adults a prevalence rate of 4.2% according to DSM-IV was described in a nationally representative sample of workers in the United States [18]. In the Netherlands, the prevalence of ADHD in the adult population has been estimated at 1.0–2.5% on the basis of self-reports [20].

In Europe, ADHD has been traditionally diagnosed as Hyperkinetic Disorder or Hyperkinetic Conduct Disorder (HKD or HKCD, respectively) according to ICD-10 [42]. Criteria for HKD (ICD-10 code F90.0), albeit based on a similar list of symptoms, are stricter as they require the pervasive presence of both inattention (minimum 6 out of 9 symptoms), hyperactivity (3/5) and impulsivity (1/4). If conduct disorder (ICD-10 code F91.0) is present, too, a diagnosis of Hyperkinetic Conduct Disorder (HKCD) is made (ICD-10 code F90.1). Obviously, these stricter criteria result in lower prevalence rates, reports of which for European countries converge on about 1.5% [31]. In Germany, based upon a mail survey of 165 parents of children aged between 6 and 10-years-old using a parent rating scale for ADHD, a prevalence rate of 2.4% according to ICD-10 criteria (or 6.0% according to DSM-IV in the same sample) was reported [7]. This is the same magnitude as the prevalence of 2.9% found for Tennessee elementary school children with symptoms of “impaired combined type ADHD”, the DSM-IV subtype which corresponds best to ICD-10 criteria [32, 41]. To the best of our knowledge no ICD-10-based epidemiological data are available for the adult population.

In Germany, like the United States and elsewhere, escalating diagnosis rates of ADHD in children and adolescents have given rise to concerns and debate about the quality of clinical diagnoses as well as possible over-treatment [8, 17, 19]. Against this background, the objective of the present study is to retrospectively assess the recent administrative prevalence of ADHD by age and gender using the comprehensive claims database of Nordbaden/Germany for 2003, and to discuss potential implications of

these data in light of the results of high-quality epidemiological studies. In addition, we analyze the involvement of physician specialist groups in the care of patients with a diagnosis of ADHD. In an attempt to further characterize the involvement of physician groups, we also determine the share of ADHD patients with coexisting conduct disorder by physician group. If physicians specializing in the treatment of mental health problems cared predominantly for patients with higher levels of comorbidity and impairment [11], this—we hypothesized—should be reflected in a higher share of patients with comorbid conduct disorder among those treated by specialists.

Methods

Nordbaden is a region in the Southwest of Germany with a population of 2.723 million, 82.2% of which ($n = 2.238$ m) are insured by Statutory Health Insurance (SHI) [13, 29]. On average, in 2003 key sociodemographic population characteristics [13, 29, 30] did not substantially deviate from Germany as a whole (with a population of 82.537 m, of which 70.422 m, or 85.7%, are insured by SHI). For instance, male/female ratios were identical (0.88:1). The age distribution of the Nordbaden sample compared well with the German population (figures in brackets): age 0–6 years, $n = 150,476$ or 6.7% (4.470 m or 6.4%), age 7–12 years, $n = 141,857$ or 6.3% (4.166 m or 5.9%), age 13–19 years, $n = 175,663$ or 7.9% (5.722 m or 8.1%), and age 20 years and above, $n = 1,770,464$ or 79.1% (56.064 m or 79.6%).

In principle, in the context of the German health care system medical services for outpatients were provided by professionals in private practice, who were complemented by a small number of hospital-based specialists with a specific license to treat outpatients insured by the SHI (collectively referred to as “*Kassenärzte*”). The number of physicians in private practice in Nordbaden was 4,905 or 219.1 per 100,000 persons insured (Germany: 127,711 or 181.4/100,000), of whom were: (a) general practitioners including specialists in internal medicine working as family doctors: 2,102 or 93.9/100,000 (Germany: 70,747 or 86.3/100,000) and (b) pediatricians in private practice 211 or 9.3/100,000 (Germany: 6,093 or 8.7/100,000). Of note, however, in relative terms the number of child and adolescent psychiatrists in Nordbaden (30 or 1.3/100,000) was almost twice as high as the German average (519 or 0.7/100,000).

The population under study comprised all persons insured by SHI in the region of Nordbaden. An individual monthly gross income exceeding 3,825 Euro (the so called “*Krankenversicherungspflichtgrenze*”) was required for parents in 2003 to be allowed to opt

Table 1 Twelve-month administrative prevalence of ADHD (Hyperkinetic Disorder [HKD, ICD-10 F90.0] and Hyperkinetic Conduct Disorder [HKCD, ICD-10 F-90.1]) in the population covered by Statutory Health Insurance (SHI) in Nordbaden/Germany in 2003 (N = 2.238 million).

Age group	Population	"HKD" prevalence		"HKCD" prevalence		ADHD ("HKD" + "HKCD") prevalence		
[Years/Gender]	n	n	%	n	%	n	%	95% CI
0–6	150,476	1,446	0.96%	447	0.30%	1,893	1.26%	1.20–1.32%
Hereof:								
Male	77,387	1,007	1.30%	324	0.42%	1,331	1.72%	1.63–1.81%
Female	73,089	439	0.60%	123	0.17%	562	0.77%	0.71–0.83%
7–12	141,857	5,027	3.54%	2,019	1.42%	7,046	4.97%	4.85–5.08%
Hereof:								
Male	72,901	3,653	5.01%	1,567	2.15%	5,220	7.16%	6.97–7.35%
Female	68,956	1,374	1.99%	452	0.66%	1,826	2.65%	2.53–2.77%
13–19	175,663	1,432	0.82%	874	0.50%	2,306	1.31%	1.26–1.37%
Hereof:								
Male	89,935	1,087	1.21%	704	0.78%	1,791	1.99%	1.90–2.08%
Female	85,728	345	0.40%	170	0.20%	515	0.60%	0.55–0.65%
20+	1,770,464	532	0.03%	98	0.01%	630	0.04%	0.03–0.04%
Hereof:								
Male	805,172	301	0.04%	55	0.01%	356	0.04%	0.04–0.05%
Female	965,292	231	0.02%	43	0.00%	274	0.03%	0.03–0.03%
Total	2,238,460	8,437	0.38%	3,438	0.15%	11,875	0.53%	0.52–0.54%
Hereof:								
Male	1,045,395	6,048	0.58%	2,650	0.25%	8,698	0.83%	0.81–0.85%
Female	1,193,065	2,389	0.20%	788	0.07%	3,177	0.27%	0.26–0.28%

out of the SHI system; within the SHI system, children were co-insured with their parents at no extra premiums. The SHI system provided comprehensive coverage of medical services, without co-payments by children and adolescents below the age of 18 years, and with only moderate out-of-pocket payments required from adults, which were capped by a social hardship clause. Within the SHI system, physicians were reimbursed on a fee-for-service basis, making underreporting unlikely and hence justifying the expectation that patient visits were indeed well captured within the claims database.

In accordance with established policies and principles for protection of privacy and confidentiality [22, 38], the complete administrative datasets from the Nordbaden region for all four quarters of 2003 were given to the research team, with all personal identifiers (of patients and service providers) replaced by pseudonyms by the Regional Association of the Statutory Health Insurance Physicians (Kassenaerztliche Vereinigung, KV) Nordbaden (now KV Baden-Wuerttemberg). A data analysis plan and formal data transfer protocol had been established and approved by the data protection officer of the KV Nordbaden. Informed patient consent was not required according to relevant German regulations since the use of pseudonyms effectively ensured that no research data could be traced back to individual patients or their physicians [38].

From the four separate claims databases received for Q1 through Q4 2003, all records with an ICD-10 code F90.0 or F90.1 were retrieved, patient pseudonyms identified, and for each pseudonym the data sets were searched electronically for all claims data for all quarters of 2003. This way a 12-month patient-based database was established for subsequent retro-

spective evaluations. Patients with a diagnosis of both HKD (F90.0) and HKCD (F90.1) during 2003 were categorized as having HKCD. Also patients coded F90.0 with an additional diagnosis of conduct disorders (F91) or mixed disorders of conduct and emotions (F92) during 2003 were reclassified as "HKCD".

For analysis of physician contacts, clinical disciplines were classified as follows: general practitioners (GPs, including specialists in internal medicine working as family doctors, collectively referred to as "APIs"), pediatricians, psychiatrists, neurologists, child and adolescent psychiatrists, behavioral and psychological therapists, all in private practice; as well as pediatricians, child and adolescent psychiatrists and other physicians employed by hospitals but entitled to treat outpatients under the German SHI system.

For an encounter-based analysis of the involvement of mental health care specialists, "specialists" (from here on we will refer to this group of physicians simply as specialists) were defined to include neurologists, psychiatrists, child and adolescent psychiatrists, whether in private practice or in hospitals (the latter group, hospital-based physicians, if entitled to treat SHI patients). Double-counts of patients and physicians were identified and eliminated for statistical analyses.

Results

Diagnosis of HKD or HKCD showed that 11,875 patients were identified in Nordbaden in 2003 (cf. Table 1), translating into an overall one-year administrative prevalence rate of 0.53%; of these, 8,678 were male (prevalence: 0.83%) and 3,197 were female

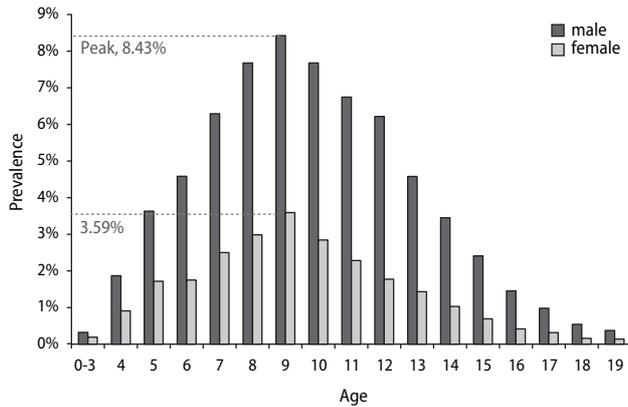


Fig. 1 ADHD prevalence by age and gender in children and adolescents

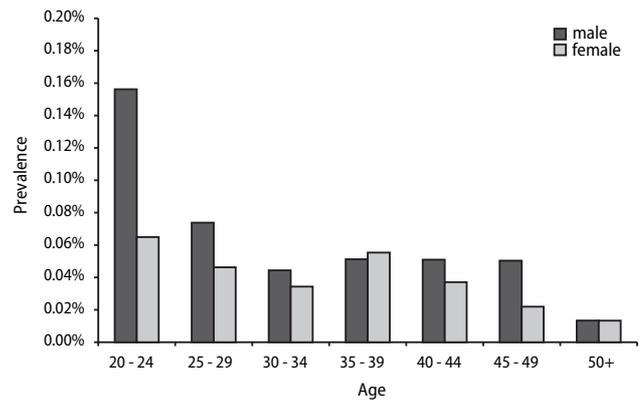


Fig. 2 ADHD prevalence by age and gender in adults

(prevalence: 0.27%). For children age 6 years or less, 12-month prevalence rates were 1.26% in total, 1.72% for boys and 0.77% for girls; for children age 7–12 years, 4.97% (boys, 7.16%; girls, 2.65%), age 13–19 years, 1.31% (males, 1.99%; females, 0.60%). In addition, $n = 630$ adults, age 20 years or more, with a diagnosis of HKD or HKCD were identified; of those, $n = 356$ were male (prevalence rate 0.04%) and $n = 274$ were female (prevalence rate 0.03%). Prevalence was highest at age 9 (peak; overall: 6.1%; boys, 8.4%; girls, 3.6%; cf. Fig. 1).

Boys and young male adults were more frequently diagnosed with ADHD than girls and females below age 30 years (ratio 2.8/1 in 6–19 years-old, 2.1/1 in 20–30 years-old). Prevalence differences by gender dissipated with increasing age and disappeared in patients over 30 years (Fig. 2).

The overall share of patients with concomitant conduct disorder (HKCD) was 29% of all with a diagnosis of “hyperkinetic disorder” (cf. Table 1). In the age group below 6 years, it was 23.6%, with a small difference by gender only (boys, 24.3%; girls, 21.9%). The proportion of patients with conduct disorder was higher in boy’s age 7–12 years (30.0%; as opposed to 24.8% in girls of similar age; overall in this age group, 28.7%); and it was highest in adolescents age 13–19 (37.9%), with increases observed in both males (39.3%) and females (33.0%). In adults, rates of coexisting conduct disorder were lowest (15.6%), with no observable difference by gender.

The analysis of physicians involved (cf. Table 2) showed specialist involvement in medical care of patients with ADHD in 36% of all patients. Across all age groups, less than 15% of patients with a diagnosis of ADHD were seen at least four times during the year by a mental health care specialist, our proxy for treatment by, or under the supervision of, a specialist (cf. below, Discussion). Overall, male patients were somewhat more likely to be seen (at least once during

the year: 37.1% vs. 32.5% of females; at least four times: 13.5% vs. 11.4%) by a specialist. Statistical analysis by age group confirmed this relatively moderate difference related to gender among the group of 7–12-years-old patients only. In this patient group, 40.7% (15.6%) of boys and 35.6% (12.9%) of girls with a diagnosis of ADHD were seen by a specialist at least once (four times) during the year (for confidence intervals, please refer to Table 2).

Overall analysis by physician groups involved in care did not reveal significant differences in the share of patients with coexisting conduct disorder (as a percentage of all ADHD patients seen by the respective physician group), though the figure for practitioners (28.5%) was a little lower than those for specialists (30.9%) and pediatricians (31.0%). However, more detailed analyses showed that comorbid conduct disorder was diagnosed more frequently among those patients who were seen more often by specialists (among those patients seen at least once, 30.9%; those seen at least four times, 35.4%; compared to 27.9% of those not seen by a specialist during the year, i.e., those who were seen by non-specialists only; see Table 3).

For all age groups except for adult cases, ADHD patients seen by specialists were more often diagnosed as having coexisting conduct disorder compared with patients not seen by specialists (cf. Table 3); this difference was highest among the very young patients (up to age 6 years) and did not exceed 10 percentage points in any of the age groups examined.

Further analyses were conducted to address the concentration of ADHD care within physician groups. The three most important groups were child and adolescent psychiatrists (“CAPs”, representing a subgroup of our “specialist” definition) who saw (after elimination of double-counts) 3,369 individuals with a diagnosis of ADHD in 2003, pediatricians accounting for 5,605 individuals with ADHD, and

Table 2 Physician specialists involved in care of patients with a diagnosis of ADHD, data from Nordbaden/Germany, 2003

Age group		Subjects with ADHD	Subjects with ADHD seen at least once in 2003 by a physician specialist			Subjects with ADHD seen at least four times in 2003 by a physician specialist		
[Years/Gender]		n	n	%	95% CI	n	%	95% CI
0–6		1,893	338	17.9%	16.2–19.7%	97	5.1%	4.2–6.2%
Hereof:								
	Male	1,331	251	18.9%	16.8–21.1%	70	5.3%	4.1–6.6%
	Female	562	87	15.5%	12.6–18.4%	27	4.8%	3.2–6.9%
7–12		7,046	2,773	39.4%	38.2–40.5%	1,049	14.9%	14.0–15.7%
Hereof:								
	Male	5,220	2,123	40.7%	39.3–42.0%	814	15.6%	14.6–16.6%
	Female	1,826	650	35.6%	33.4–37.8%	235	12.9%	11.4–14.5%
13–19		2,306	939	40.7%	38.7–42.8%	314	13.6%	12.2–15.1%
Hereof:								
	Male	1,791	723	40.4%	38.1–42.7%	241	13.5%	11.9–15.1%
	Female	515	216	41.9%	36.6–46.3%	73	14.2%	11.3–17.5%
20+		630	211	33.5%	29.8–37.3%	79	12.5%	10.1–15.4%
Hereof:								
	Male	356	130	36.5%	31.5–41.8%	52	14.6%	11.1–18.7%
	Female	274	81	29.6%	24.2–35.3%	27	9.9%	6.6–14.0%
Total		11,875	4,261	35.9%	35.0–36.8%	1,539	13.0%	12.4–13.6%
Hereof:								
	Male	8,698	3,227	37.1%	36.1–38.1%	1,177	13.5%	12.8–14.3%
	Female	3,177	1,034	32.5%	30.9–34.2%	362	11.4%	10.3–12.6%

Table 3 Share of patients with Hyperkinetic Conduct Disorder (HKCD) as an indicator of disease severity by specialist involvement

Age group		Subjects with ADHD	Of those, subjects with HKD (F90.0)			Of those, subjects with HKCD (F90.1)		
[Years/Gender]		n	n	%	95% CI	n	%	95% CI
0–6		1,893	1,446	76.4%	74.4–78.3%	447	23.6%	21.7–25.6%
Hereof:								
	Patients not seen by specialists	1,555	1,217	78.3%	76.1–80.3%	338	21.7%	19.7–23.9%
	Patients seen at least once by specialists	338	229	67.8%	62.5–72.7%	109	32.2%	27.3–37.5%
	Patients seen at least four times by specialists	96	66	68.8%	58.5–77.8%	30	31.3%	22.2–41.5%
7–12		7,046	5,027	71.3%	70.3–72.4%	2,019	28.7%	27.6–29.7%
Hereof:								
	Patients not seen by specialists	4,273	3,091	72.3%	71.0–73.7%	1,182	27.7%	26.3–29.0%
	Patients seen at least once by specialists	2,773	1,936	69.8%	68.1–71.5%	837	30.2%	28.5–31.9%
	Patients seen at least four times by specialists	1,026	661	64.4%	61.4–67.4%	365	35.6%	32.6–38.6%
13–19		2,306	1,432	62.1%	60.1–64.1%	874	37.9%	35.9–39.9%
Hereof:								
	Patients not seen by specialists	1,367	849	62.1%	59.5–64.7%	518	37.9%	35.3–40.5%
	Patients seen at least once by specialists	939	583	62.1%	58.9–65.2%	356	37.9%	34.8–41.1%
	Patients seen at least four times by specialists	310	177	57.1%	51.4–62.7%	133	42.9%	37.3–48.6%
20+		630	532	84.4%	81.4–87.2%	98	15.6%	12.8–18.6%
Hereof:								
	Patients not seen by specialists	419	336	80.2%	76.0–83.9%	83	19.8%	16.1–24.0%
	Patients seen at least once by specialists	211	196	92.9%	88.5–96.0%	15	7.1%	4.0–11.5%
	Patients seen at least four times by specialists	77	71	92.2%	83.8–97.1%	6	7.8%	2.9–16.2%
Total		11,875	8,437	71.0%	70.2–71.9%	3,438	29.0%	28.1–29.8%
Hereof:								
	Patients not seen by specialists	7,614	5,493	72.1%	71.1–73.1%	2,121	27.9%	26.9–28.9%
	Patients seen at least once by specialists	4,261	2,944	69.1%	67.7–70.5%	1,317	30.9%	29.5–32.3%
	Patients seen at least four times by specialists	1,509	975	64.6%	62.1–67.0%	534	35.4%	33.0–37.9%

practitioners (“APIs”) who saw 2,603 ADHD patients during the year. Results for these groups are presented in Fig. 3, which shows the cumulative distribution of ADHD patients for each group.

Eighty percent or 24 out of 30 child and adolescent psychiatrists (CAPs) participated in care of patients with a diagnosis of ADHD. The top 50% of CAPs accounted for 92.1% of all ADHD patients seen by CAPs. The top 20% of this specialized physician group accounted alone for 58.3% of patients, each of these top-20% CAPs having seen 333 individuals with ADHD in 2003, on average. In contrast, the lower 40%

of the CAPs accounted for 3.4% of all ADHD patients seen by CAPs, having seen on average 9.8 patients.

Concentration was higher among pediatricians and practitioners: Among pediatricians, the top 10 (5; 20; 30) percent of physicians accounted for 48.7% (34.9%; 66.2%; 78.5%, respectively) of patients seen by their group; each of these top 10% pediatricians saw 134.3 individuals with ADHD during the year, on average. The top 5% of pediatricians saw, on average, 202.2 patients per during the year.

Among practitioners, concentration was highest (cf. Fig. 3), with the top 10 (5; 20; 30) percent of these

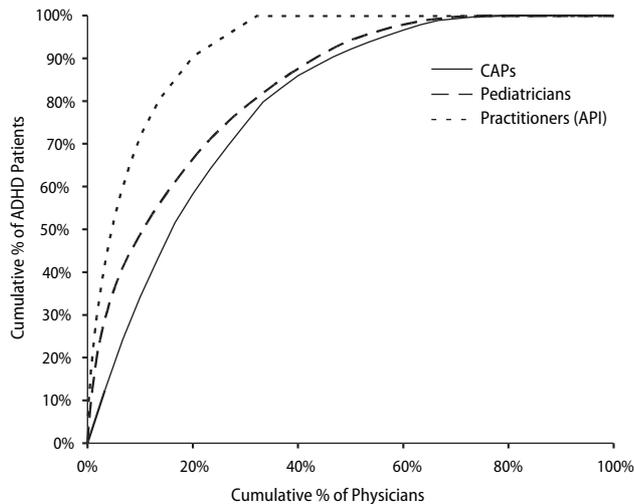


Fig. 3 Physician involvement in diagnosis and treatment of ADHD in Nordbaden: concentration of patients among key physician groups

physicians accounting for 71.3% (51.9%; 90.3%; 98.2%, respectively) of patients seen by their group; each of the top 5% practitioners saw 13.3 individuals with ADHD during the year, on average. More than two third (67.7%) of practitioners reported no patients with ADHD, implying they did not participate in medical care for ADHD.

Discussion

A key strength of retrospective claims databases is that they allow to examine medical care utilization as it occurs in routine clinical care [23]. In principle, administrative prevalence data provide information about the contacts of patients with the respective parts of the health care system. Given the comprehensive coverage of services by the German Statutory Health Insurance combined with the fee-for-service reimbursement system for physicians in private practice, it seems reasonable to assume that these data reflect the rate at which a disorder is recognized in practice. There is little if any reason to suspect underreporting of such encounters—of course, apart from those cases that may have remained unrecognized by health care providers.

A potential source of bias is the restriction of the dataset to patients covered by Statutory Health Insurance (SHI), thereby excluding some of the higher income families. Though perhaps tempting, caution should be exercised regarding attempts to extrapolate our findings to the privately insured population, as there may be differences of prevalence by type of insurance [28]. Yet, with a sample population in excess of 2 million and coverage of more

than 82% of the regional population in Nordbaden, we believe these data can nevertheless be expected to provide some important insights. Since the population in Nordbaden does not seem to differ substantially from the German average, at least in principle, some generalizations should be possible from the present sample.

By way of caution, we also emphasize that previous studies in the United States have indicated regional variation in health care utilization patterns, which include reported prevalence rates of ADHD [6, 25]. For Germany, relevant data are available on regional variance of psychostimulant prescriptions only [27]. Prescribed defined daily doses of methylphenidate were found, in the year 2001, to range from 1.31 in the region of Sachsen-Anhalt to 4.72 in the region of Rheinhessen and 5.82 in the (urban) region of Bremen—whereas the figure for Nordbaden was 3.37, relatively close to the average of 2.74 in Germany as a whole.

As for retrospective claims data analyses in general, an important limitation of the data is the lack of verifiable information about the quality of diagnosis and coding. The observed administrative prevalence of “HKD” and “HKCD” of 4.97% in children age 7–12 years in Nordbaden in 2003 appears consistent with a continuing trend toward increasing awareness and detection of ADHD in children and adolescents [8, 19]. Coded according to ICD-10, it appears extraordinarily high in light of high-quality epidemiological studies indicating a “true prevalence” of hyperkinetic disorder (HKD and HKCD) in the range of 1.5–2.9% in school age children [7, 31, 41]. A number of possible explanations seem conceivable, an obvious one being that many physicians might indeed prefer the broader DSM-IV criteria [2, 30] to establish a diagnosis of ADHD - whereas the reporting system enforces ICD-10-based coding [42]. This hypothesis was supported by an ad hoc survey we conducted with a convenience sample of six German pediatricians, who indeed without exception confirmed that they adhered to DSM-IV diagnostic criteria but were required by the administrative system to code according to ICD-10. In addition to the common, though not exactly accurate use of ADHD and HKD as interchangeable synonyms in parts of the literature, we believe this interpretation lends justification to our current use of terminology, using the (broader) term “ADHD” instead of hyperkinetic disorder (“HKD”). Our survey cannot, however, rule out alternative explanations, including potentially poor quality of diagnoses.

Interestingly, a specialized physician saw only about 36% of patients with a diagnosis of ADHD at least once during the year. Assuming that on average effective treatment provision or supervision by a

specialist requires at least four annual visits, we interpret the number of patients with at least four documented specialist contacts as a proxy, yielding a rate of 13% (Table 2). Even taking into account the existence of data edge effects in the present database (which we cannot quantify in the absence of reliable information on average length of treatment in the population studied), this finding indicates that specialized physicians treat only a minority of ADHD patients in this German region. We consider this finding as especially remarkable in light of the above average number of child and adolescent psychiatrists in Nordbaden—actually, in relation to the regional population, twice as many compared to Germany as a whole. If anything, the rate of patients treated by, or under regular supervision of, specialists in Germany should thus be even lower than the numbers found for Nordbaden in 2003. These observations suggest that community-based pediatricians and general practitioners have an important role in the care of patients with ADHD. As a consequence, pediatricians as well as practitioners, including specialists in internal medicine practicing as family doctors, will need to understand diagnosis, associated comorbidity, and appropriate treatment of patients with ADHD.

Regarding coexisting conduct disorder, our data indicate higher prevalence among boys than girls, and an increasing share of patients with HKCD among those diagnosed with ADHD over time during childhood and adolescence. A diagnosis of coexisting conduct disorder was more than 50% more likely among adolescents with ADHD (37.9%) compared to preschoolers with ADHD (23.6%). The overall rate of comorbid conduct disorder of 29% in our sample is consistent with the rates found in a large United States study by Wolraich and colleagues [40] and with that reported in a systematic review by Green and colleagues [15]. Regarding the age-related pattern that we observed, we cannot infer any causal relationship with hypothetical factors such as disease progression over time, the potential role of preceding conditions like oppositional defiant disorder [14], or of going through puberty, on the basis of our cross-sectional data analysis. It is noteworthy, however, that conduct disorders were diagnosed less frequently in adults, and gender differences dissipated in the latter group of ADHD patients.

Given the absence of information on disease severity in claims databases, we used the coexistence of conduct disorder (i.e., HKCD patients expressed as share of all patients with a diagnosis of ADHD [HKD or HKCD]) as a marker for impairment. We hypothesized that patients seen by specialists might have higher levels of comorbid conduct disorder than those managed in primary care settings. In fact, we

found a somewhat higher percentage of children and adolescents with a concomitant diagnosis of conduct disorder among those seen more frequently by specialists (cf. Table 3).

But the overall difference in the share of patients with comorbid conduct disorder seen by specialists, pediatricians, and practitioners was much less pronounced than we had expected on grounds of studies from the United States, which reported that children with ADHD who are diagnosed and managed by primary care physicians have less psychiatric comorbidity and milder impairments than those seen in specialist settings [33, 39]. Our data rather concur with results of a case-control study reported by Busch and colleagues, who found no difference in comorbidity or functional impairment between patients referred to psychiatric clinics and children with a diagnosis of ADHD from pediatric sites of a large health maintenance organization [9].

Our data further indicate that physician involvement in medical care for patients with ADHD is highly concentrated among a small number of providers. Among child and adolescent psychiatrists, the 20% top providers of care account for 58.3% of all patients with ADHD seen by this group and account for 333 patients each, dwarfing the lower 40% with just 9.8 patients during the year, on average. The concentration of care is even more pronounced among pediatricians; the top 5% see 202 patients per year and account for 35% of all ADHD patients seen by this discipline, while the lower 50% account for a mere 2.2% and see less than 2 patients per year, on average. Perhaps less surprisingly, we found the highest concentration among practitioners (“APIs”, cf. above), with the top 10% accounting for more than 70% of all ADHD patients seen by this group. This phenomenon is compatible with a high level of specialization of a relatively small number of physicians who carry the burden of ADHD. At the same time, it may reflect the fact that ADHD is still regarded by many health care providers as a controversial subject [8, 10], and hence indicate a high degree of polarization between physicians actively involved and others skeptical about the disease entity and its management. Furthermore, the low involvement of practitioners might be related to low awareness of ADHD in the adult population.

To the best of our knowledge, the present study represents the first report on the administrative prevalence of ADHD in adults in a European sample. Though puzzling, the male-to-female ratio of about 3:2 in adults - compared to approximately 3:1 in children and adolescents—is in line with other findings, in this case from the United States, on ADHD in adults [5]. This does not hold, however, for the overall prevalence rate in the adult population in our German

sample: in striking contrast to the high-administrative prevalence rates found for children and adolescents, we identified only 630 adult patients who were recognized by their physicians to have ADHD. This very low figure (a rate of 0.03% or in absolute terms just one-third of the number of children age 6 years or younger with a diagnosis of ADHD) appears surprising in light of longitudinal studies reporting up to 70% adult persistence of childhood ADHD [36, 37]. In particular, it is difficult to reconcile with the high-prevalence rate found in children and adolescents in the same geographical region. Furthermore, it is substantially lower than the prevalence rate of at least 1% recently found in an adult population-based sample in the Netherlands [20]. In other studies conducted in the United States, adult ADHD prevalence rates higher than 4% were reported [18].

These data strongly suggest a very real risk that a diagnosis of ADHD might be missed in many adults presenting with related problems, such as antisocial behavior, mood and anxiety disorders, alcohol and drug abuse problems, other psychiatric disorders, and criminal behaviors, all known to be associated with ADHD [3, 14].

In conclusion, our data confirm that health care claims database analyses can add to our understanding of the provision of clinical care [26]. The high-administrative prevalence of ADHD in children and adolescents indicates a strong need for further research addressing the reliability of ADHD diagnoses in routine clinical practice in Germany, as prevalence rates in the Nordbaden region do exceed ICD-

10-based estimates from epidemiological studies. A survey based on a convenience sample of local pediatricians supports the hypothesis that prevalence rates found may be explained by the actual use of DSM-IV diagnostic criteria by many physicians. If confirmed, this hypothesis would raise questions about the validity of forcing physicians to use an ICD-10-based reporting system providing codes for HKD and HKCD only.

In contrast, the encounter-based prevalence rate of ADHD in the adult population is very low and clearly inconsistent with the high-diagnosis prevalence of ADHD in children and adolescents in the same geographical region. It seems likely that in a substantial number of adult patients ADHD remain unrecognized.

Currently, health care provision for patients with a diagnosis of ADHD is highly concentrated among a small number of physicians. There could be a concern about the numbers being diagnosed and treated without specialist involvement. The important role of health service provision by pediatricians and general practitioners suggests a high need for expertise among these non-specialists in managing a clinical disorder as complex as ADHD, behaviors of which may overlap or coexist with other mental health conditions [24]. Another rational response might be a different organization of service tracks, although this would require changes of the institutional context of the German health care system, where traditionally no shared-care arrangements have been in place [16].

References

1. Adler LA, Spencer T, Faraone SV, Reimherr FW, Kelsey D, Michelson D, Biederman J (2005) Training raters to assess adult ADHD: reliability of ratings. *J Atten Disord* 8:121–126
2. American Psychiatric Association (1994) Diagnostic and statistical manual of mental disorders (DSM-IV), 4th edn. American Psychiatric Association, Washington, DC
3. Biederman J (2004) Impact of comorbidity in adults with attention-deficit/hyperactivity disorder. *J Clin Psychiatr* 65(Suppl 3):3–7
4. Biederman J, Mick E, Faraone SV (2000) Age-dependent decline of symptoms of attention deficit hyperactivity disorder: impact of remission definition and symptom type. *Am J Psychiatr* 157:816–818
5. Biederman J, Faraone SV, Spencer T, Wilens T, Mick E, Lapey KA (1994) Gender differences in a sample of adults with attention deficit hyperactivity disorder. *Psychiatry Res* 53:13–29
6. Brownell MD, Yogendran MS (2001) Attention-deficit hyperactivity disorder in Manitoba children: medical diagnosis and psychostimulant treatment rates. *Can J Psychiatr* 46:264–272
7. Bruehl B, Doepfner M, Lehmkuhl G (2000) Der Fremdbeurteilungsbogen fuer hyperkinetische Stoerungen (FBB-HKS)—Praevalenz hyperkinetischer Stoerungen im Elternurteil und psychometrische Kriterien. *Kindheit und Entwicklung* 9:115–125
8. Buitelaar JK, Rothenberger A (2004) Foreword—ADHD in the scientific and political context. *Eur Child Adolesc Psychiatry* 13(Suppl 1):1–6
9. Busch B, Biederman J, Cohen LG, Sayer JM, Monuteaux MC, Mick E, Zallen B, Faraone SV (2002) Correlates of ADHD among children in pediatric and psychiatric clinics. *Psychiatr Serv* 53:1103–1111
10. DeGrandpre R (2000) *Ritalin nation: rapid-fire-culture and the transformation of human consciousness*. Norton, New York
11. Epstein MA, Shaywitz SE, Shaywitz BA, Woolston JL (1991) The boundaries of attention deficit disorder. *J Learn Disabil* 24:78–86
12. Faraone SV, Sergeant J, Gillberg C, Biederman J (2003) The worldwide prevalence of ADHD: is it an American condition? *World Psychiatry* 2:104–113

13. Federal Ministry for Health and Social Affairs (Bundesministerium fuer Gesundheit und Soziales, BMGS). Statistik ueber Versicherte, gegliedert nach Status, Alter, Wohnort, Kassenart: GKV Statistik KM6. Available online at http://www.bmg.bund.de/downloads/2004_KM6.pdf
14. Gillberg C, Gillberg IC, Rasmussen P, Kadesjo B, Soderstrom H, Rastam M, Johnson M, Rothenberger A, Niklasson L (2004) Co-existing conditions in ADHD—implications for diagnosis and intervention. *Eur Child Adolesc Psychiatry* 13(Suppl 1):80–92
15. Green M, Wong M, Atkins D, et al (1999) Diagnosis and treatment of attention-deficit/hyperactivity disorder in children and adolescents. Technical Review No 3. Agency for Health Care Policy and Research, AHCPR Publication No 99–0050, Rockville, MD
16. Hoeger C, Rothenberger A (1998) Provision of child and adolescent psychiatric services in the Federal Republic of Germany. *Eur Child Adolesc Psychiatry* 7(3):176–180
17. Kelleher KJ, McInerney TK, Gardner WP, Childs GE, Wasserman RC (2001) Increasing identification of psychosocial problems: 1979–1996. *Pediatrics* 105:1313–1321
18. Kessler RC, Adler L, Ames M, Barkley RA, Birnbaum H, Greenberg P, Johnston JA, Spencer T, Ustun TB (2005) The prevalence and effects of attention deficit/hyperactivity disorder on work performance in a nationally representative sample of workers. *J Occup Environ Med* 47:565–572
19. Koester I, Schubert I, Doepfner M, Adam C, Ihle P, Lehmkuhl G (2004) Hyperkinetische Stoerungen bei Kindern und Jugendlichen: Zur Haeufigkeit des Behandlungsanlasses in der ambulanten Versorgung nach den Daten der Versichertenstichprobe AOK Hessen/KV Hessen. *Zeitschrift fuer Kinder- und Jugendpsychiatrie und Psychotherapie* 32:157–166
20. Kooij JJ, Buitelaar JK, van den Oord EJ, Furer JW, Rijnders CA, Hodiamont PP (2005) Internal and external validity of attention-deficit hyperactivity disorder in a population-based sample of adults. *Psychol Med* 35:817–827
21. Mannuzza S, Klein RG, Moulton JL III (2003) Persistence of attention-deficit/hyperactivity disorder into adulthood: what have we learned from the prospective follow-up studies? *J Atten Disord* 7:93–100
22. Meier A (2003) Der rechtliche Schutz patientenbezogener Gesundheitsdaten. Verlag Versicherungswirtschaft, Karlsruhe, pp 263–311
23. Motheral B, Brooks J, Clark MA, Crown WH, Davey P, Hutchins D, Martin BC, Stang P (2003) A checklist for retrospective database studies—report of the ISPOR Task Force on retrospective databases. *Value Health* 6:90–97
24. Rappley MD (2005) Attention deficit-hyperactivity disorder. *New Engl J Med* 352:165–173
25. Scahill L, Schwab-Stone M (2000) Epidemiology of ADHD in school-age children. *Child Adolesc Psychiatr Clin N Am* 9:541–555
26. Schneeweiss S, Avorn J (2005) A review of uses of health care utilization databases for epidemiologic research on therapeutics. *J Clin Epidemiol* 58:323–337
27. Schubert I, Selke GW, Osswald-Huang P-H, Schroeder H, Nink K (2002) Methylphenidat-Verordnungsanalyse auf der Basis von GKV-Daten, Wissenschaftliches Institut der AOK (WidO), Bonn
28. Shatin D, Levin R, Ireys HT, Haller V (1998) Health care utilization by children with chronic illnesses: a comparison of Medicaid and employer-insured managed care. *Pediatrics* 102:e44
29. Statistical Office of the European Communities. Population by age in Germany. Available online at <http://www.epp.eurostat.cec.eu.int>
30. Statistisches Landesamt Baden-Wuerttemberg. Bevoelkerung am 31.12.2004 nach Altersjahren, Nationalitaet und Geschlecht; Regierungsbezirk Karlsruhe. Available online at <http://www.statistik.baden-wuerttemberg.de/SRDB/>
31. Taylor E, Doepfner M, Sergeant J, Asherson P, Banaschewski T, Buitelaar J, Coghill D, Danckaerts M, Rothenberger A, Sonuga-Barke E, Steinhausen HC, Zuddas A (2004) European clinical guidelines for hyperkinetic disorder—first upgrade. *Eur Child Adolesc Psychiatry* 13(Suppl 1):7–30
32. Tripp G, Luk SL, Schaughency EA, Singh R (1999) DSM-IV and ICD-10: a comparison of the correlates of ADHD and hyperkinetic disorder. *J Am Acad Child Adolesc Psychiatry* 38:156–164
33. Wasserman RC, Kelleher KJ, Bocian A, Baker A, Childs GE, Indacochea F, Stulp C, Gardner WP (1999) Identification of attentional and hyperactivity problems in primary care: a report from pediatric research in office settings and the ambulatory sentinel practice network. *Pediatrics* 103:e38
34. Wasserstein J (2005) Diagnostic issues for adolescents and adults with ADHD. *J Clin Psychol* 61:535–547
35. Weiss M, Murray C, Weiss G (2002) Adults with attention-deficit/hyperactivity disorder: current concepts. *J Psychiatr Pract* 8:99–111
36. Wender PH, Wolf LE, Wasserstein J (2001) Adults with ADHD. An overview. *Ann N Y Acad Sci* 931:1–16
37. Wenwei Y (1996) An investigation of adult outcome of hyperactive children in Shanghai. *Chin Med J* 109:877–880
38. Wichmann HE, Raspe HH, Joeckel KH [Deutsche Arbeitsgemeinschaft fuer Epidemiologie, DAE], and Hamm R, Wellbrock R [Arbeitskreis Wissenschaft der Konferenz der Datenschutzbeauftragten des Bundes und der Laender] (1998) Epidemiologie und Datenschutz
39. Wolraich M (1998) Current assessment and treatment practices: Consensus Development Conference Statement: Diagnosis and Treatment of Attention Deficit Hyperactivity Disorder (ADHD). National Institutes of Health, Bethesda, MD
40. Wolraich M, Hannah J, Pinnock TY, Baumgaertel A, Brown J (1999) Comparison of diagnostic criteria for attention-deficit hyperactivity disorder in a county-wide sample. *J Am Acad Child Adolesc Psychiatry* 35:319–324
41. Wolraich ML, Hannah JN, Baumgaertel A, Feurer ID (1998) Examination of DSM-IV criteria for attention deficit/hyperactivity disorder in a county-wide sample. *J Dev Behav Pediatr* 19:162–168
42. World Health Organization (1992) International statistical classification of diseases and related health problems (ICD-10), 10th edn. The World Health Organization; 1992, Geneva, Switzerland