ORIGINAL ARTICLE

ADHD in Germany: Trends in Diagnosis and Pharmacotherapy

A Country-wide Analysis of Health Insurance Data on Attention-Deficit/Hyperactivity Disorder (ADHD) in Children, Adolescents and Adults From 2009–2014

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SUMMARY

Background: Attention-deficit/hyperactivity disorder (ADHD) sometimes persists into adulthood. There have been no studies from Germany until the present time on the diagnosis and treatment of ADHD over the course of patients' lives, in particular during the transition from adolescence to early adulthood.

Methods: We used nationwide routine data of the AOK statutory health-insurance fund to determine the frequency of ADHD diagnoses and prescriptions of medication for ADHD. We additionally analyzed the care of a transition cohort of initially 15-year-old ADHD patients over a period of six years.

Results: From 2009 to 2014, the prevalence of a diagnosis of ADHD rose from 5.0% to 6.1% in persons aged 0 to 17 years (with a maximum of 13.9% in 9-year-old boys) and from 0.2% to 0.4% in persons aged 18 to 69 years. The amount of ADHD medication prescribed to adults with ADHD increased over time, while the amount prescribed to children and adolescents fell. Methylphenidate was the most commonly prescribed drug, followed by atomoxetine and lisdexamfetamine. Only 31.2% of the patients in the transition cohort still carried the diagnosis of ADHD at the end of the six-year period, at age 21. The percentage of patients taking ADHD medication in this group fell from 51.8% at age 15 to 6.6% at age 21.

Conclusion: The administrative prevalence of a diagnosis of ADHD among adults and the degree of medication use for ADHD by adults have risen in recent years. This can be interpreted as an indication of the sensitization of physicians and patients to the possibility of adult ADHD. Nonetheless, the prevalence of diagnosed ADHD remains less than the prevalence revealed by epidemiologic studies. This may indicate that adults with ADHD are currently underdiagnosed and undertreated. The low rate of use of ADHD medications among adolescents with ADHD who are on the verge of adulthood leads us to the question of whether specific transitional concepts need to be developed for this age group.

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Attention-deficit/hyperactivity disorder (ADHD) is one of the most common psychiatric disorders in children and adolescents. It is important clinically and in terms of health economics (1, 2). The prevalence of ADHD diagnosed according to ICD-10 criteria among children and adolescents is approximately 1.5 to 3% (3, 4). Research based on the DSM-IV criteria, which are more broadly defined, yields a higher ADHD prevalence; US studies report higher prevalences than European ones (4–6).

As recently as some 15 years ago, the prevailing opinion was that ADHD would "outgrow" in adolescence and that treatment after this age was no longer necessary (7). However, recent studies (based on DSM-IV criteria) show that ADHD persists into adulthood (8). If strict diagnosis criteria are used, the rate of ADHD persistence is found to be approximately 40 to 50% (8), while studies that use other diagnosis criteria yield persistence figures with considerably greater spread (4 to 79%) (8–11).

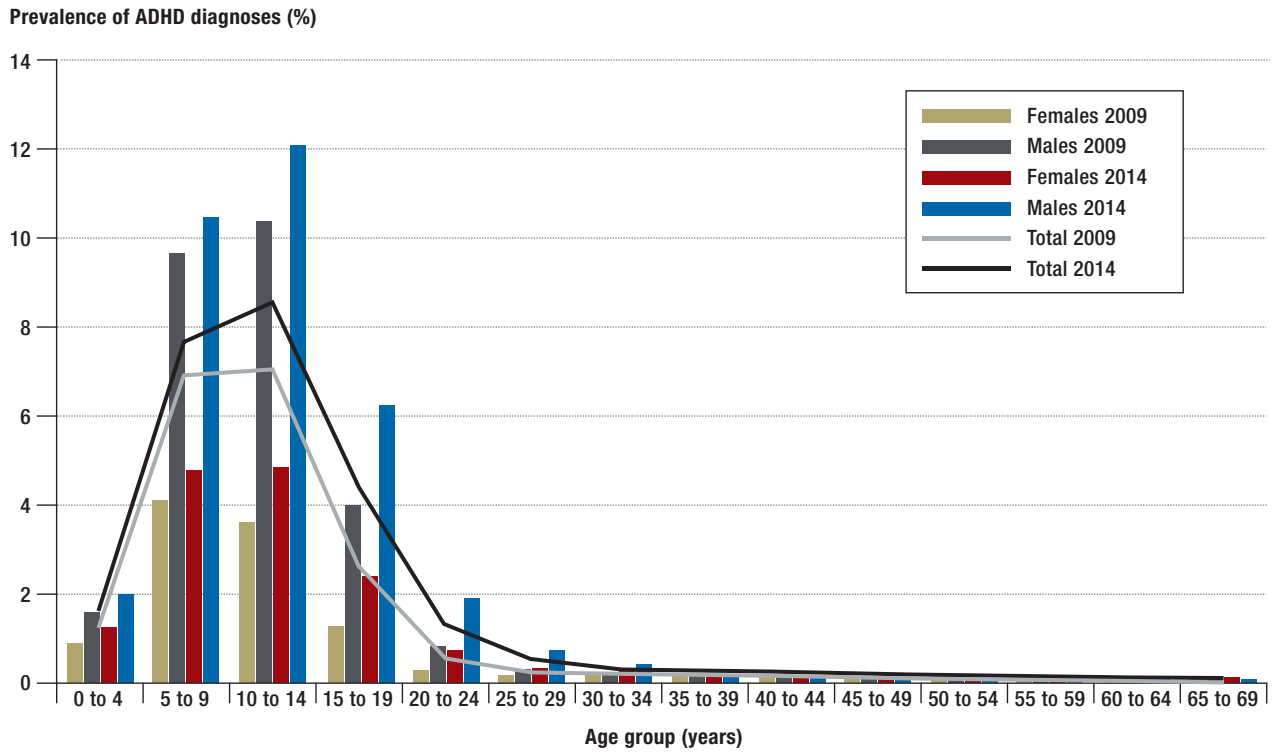
The worldwide prevalence of adult ADHD according to DSM-IV criteria is reported as 2.8% (12). ICD-10 contains no adult-specific ADHD diagnostic criteria (13), and thus there are no high-quality population-based studies on ADHD prevalence according to ICD-10.

If left untreated, ADHD can have various unfavorable consequences, including higher risk of accidents, higher mortality, higher risk of depression, personality disorder, substance abuse and arrest, worse school graduation outcomes, and more frequent job loss (14).

Guidelines on ADHD therapy in children and adolescents recommend multimodal treatment, including training for parents, behavioral therapy, and pharmacotherapy (stimulants, atomoxetine) (15). Pharmacotherapy is indicated only in patients with considerable symptom severity. Pharmacotherapy is usually effective (effect sizes: 0.5 to 1.0) (16); there is insufficient evidence on the efficacy of nonpharmacological therapies (17).

Adult ADHD should be treated if the impairment is moderate to severe (severe psychosocial impairment is present in approximately 30% of affected individuals [12]) (18), using both pharmacotherapy and

FIGURE 1



ADHD diagnoses in AOK insurants for 2009 and 2014 by age and sex, based on routine data (administrative prevalence)
ADHD: Attention-deficit/hyperactivity disorder; AOK: Allgemeine Ortskrankenkassen

behavioral therapy. Moderate to large effect sizes (0.6 to 4.3) are reported for stimulant pharmacotherapy, while data on the efficacy of psychotherapeutic interventions is divergent (19, 20). Treatment response (at least 30% reduction in symptoms) is approximately 60% if medication is administered according to guidelines (21, 22).

In contrast to the international literature (e.g. 23–25), for Germany there is little data available on prevalence and therapy of adult ADHD or on their respective trends over time (26–28).

The increase in knowledge of the persistence of ADHD into adulthood is reflected in the development of guidelines and diagnostic procedures and conduct of treatment studies on the subject in recent years (29, 30). In addition, various drugs have been authorized for treatment of ADHD in adults *(eTable 1)*. The number of specialized outpatient clinics in Germany for adults with ADHD is also gradually increasing; however, in the views of experts and self-help groups care provision remains unsatisfactory (31, 32).

An associated problem is the transition of adolescents with ADHD to adult care. Ideally, this transition should be "organised, coordinated and purposeful" (33). This includes, for example, a timely search for a physician or psychotherapist with experience in ADHD treatment who works with adults (in Germany, the scope of the work of child and adolescent psychiatrists and of pediatricians legally ends when the patient turns 18, or at the latest 21) and the structured transfer of relevant information (previous treatment, comorbidities) to the new physician or psychotherapist (34). However, for many young people this transition is characterized by a lack of continuity in medical care, with negative impacts on health, wellbeing, and vocational potential (35). To date there have been only a few studies on the transition of adolescents with ADHD, and there is no such data for Germany.

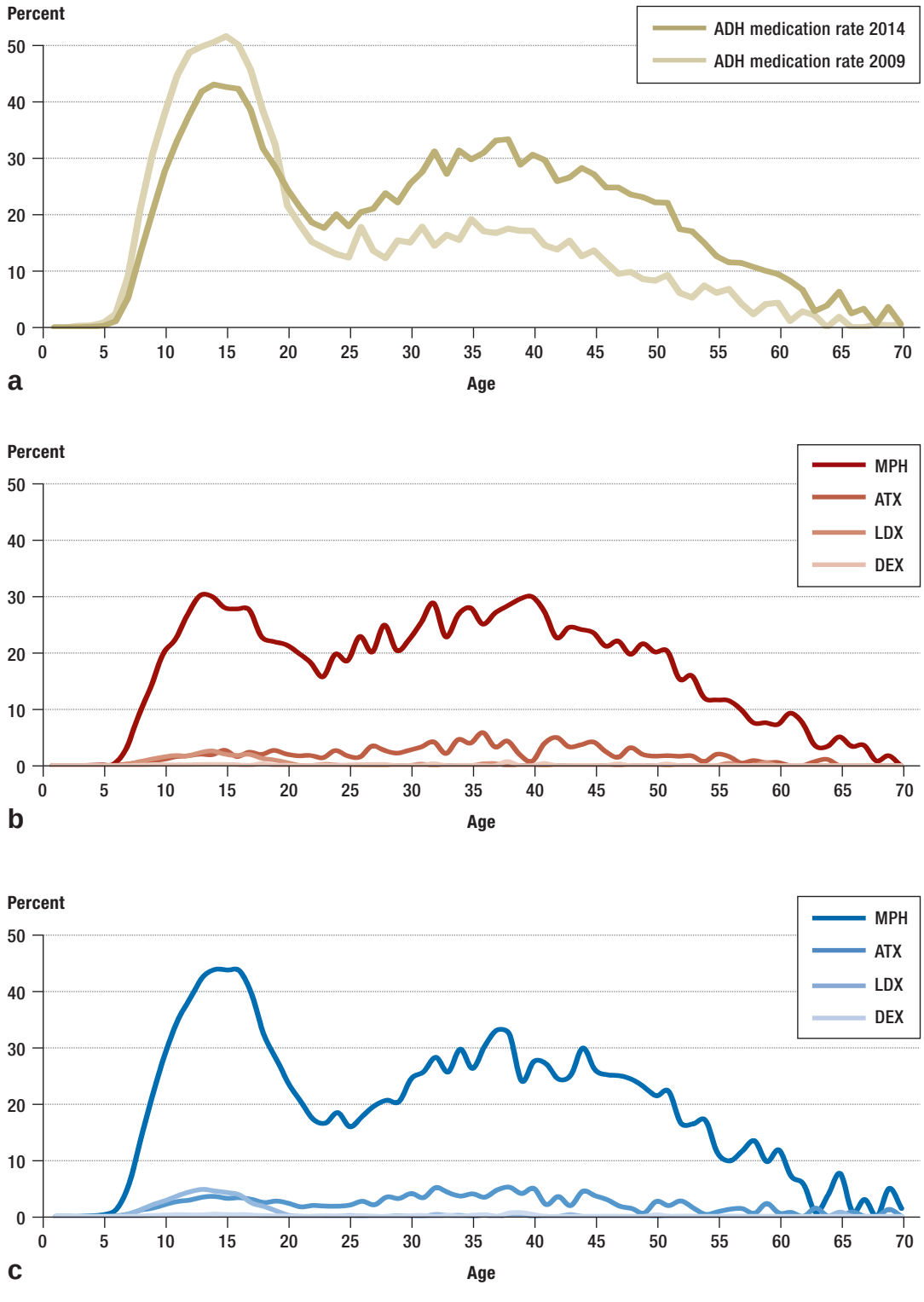
In this context, this article aims to investigate the following questions:

- Frequency of diagnosis and treatment: How did the frequency of ADHD diagnosis and pharmacotherapy for ADHD in children, adolescents, and adults change between 2009 and 2014?
- Transition: What does pharmacotherapy for adolescents with a diagnosis of ADHD look like up to the beginning of adulthood?

Methods

The analyses presented here are based on data from all members of Germany's largest statutory health insurance company, AOK (*Allgemeine Ortskrankenkassen*). In order to obtain figures on frequency of diagnosis, the number of insurants aged between 0 and 69 years with

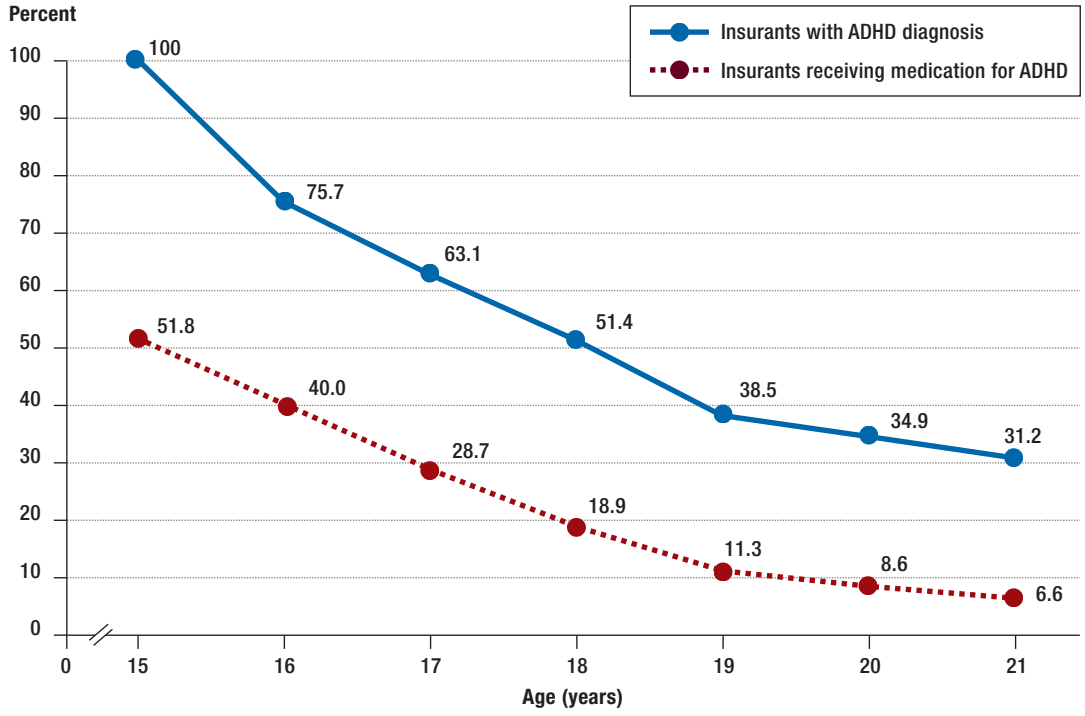
FIGURE 2



ADHD medication rates in 2009 and 2014 (a) and overview of prescribed substances in 2014 (b, c)

a) AOK insurants prescribed medication to treat ADHD as a percentage of all AOK insurants with a diagnosis of ADHD, by age (2009 versus 2014)
b) Percentage of prescriptions of substances to treat ADHD in 2014 among female AOK insurants with a diagnosis of ADHD, by age
c) Percentage of prescription of substances to treat ADHD in 2014 among male AOK insurants with a diagnosis of ADHD, by age
ADHD: Attention-deficit/hyperactivity disorder; AOK: Allgemeine Ortskrankenkassen (Germany's largest statutory health insurance company);
ATX: Atomoxetine; DEX: Dexamfetamine;
LDX: Lisdexamfetamine; MPH: Methylphenidate

FIGURE 3



Percentage of AOK insurants in the transition cohort with a diagnosis of ADHD or receiving ADHD medication over time, 2008 to 2014

ADHD: Attention-deficit/hyperactivity disorder

a diagnosis of ADHD in 2009 and 2014 was identified on the basis of health insurers' data. For frequency of treatment, prescription data for ADHD drugs between 2009 and 2014 was evaluated (see *eBox* for further details on the methods used).

Diagnoses of ADHD are the ICD-10 diagnoses F90.0, F90.1, F90.8, F90.9, and F98.8 coded as confirmed in the outpatient sector. ADHD drugs are methylphenidate, atomoxetine, lisdexamfetamine, dexamfetamine, and amphetamine. The transition cohort includes all insurants with a diagnosis of ADHD who were 15 years old in 2008 and who had been continuously insured until 2014.

Results

Frequency of diagnosis

In 2009 there were 214 110 AOK insurants aged between 0 and 69 years (71.4% male, mean age 13.5 [± 31.9] years) with a diagnosis of ADHD; the corresponding figure for 2014 was 274 982 (69.7% male, mean age 14.6 [± 35.1] years). Of these, 22.0% were assigned diagnostic code F98.8 ("Other specified behavioral and emotional disorders with onset usually occurring in childhood and adolescence," including "Attention-deficit disorder without hyperactivity").

The overall frequency of ADHD among AOK insurants (aged 0 to 69 years) in 2009 was 1.2% (male insurants [M]: 1.7%; female insurants [F]: 0.7%]); the corresponding figures for 2014 were 1.5% (M: 2.1%; F: 0.9%). In the age range 0 to 17 years, the frequency of diagnosis was 5.0% (M: 7.2%; F: 2.8%) in 2009 and 6.1% (M: 8.4%; F: 3.6%) in 2014. In the age range 18 to 69 years the frequency of diagnosis was 0.2% (M: 0.3%; F: 0.2%) in 2009 and 0.4% (M: 0.5%; F: 0.3%) in 2014. Excluding ICD-10 code F98.8 the overall frequency of ADHD was 0.9% (0 to 17 years: 3.9%; 18 to 69 years: 0.2%) in 2009 and 1.1% (0 to 17 years: 4.5%; 18 to 69 years: 0.3%) in 2014.

The frequencies of ADHS diagnosis for all age groups in 2009 and 2014 are shown in *Figure 1*.

After a peak at the age of 9 years (2009: 9.2% [M: 12.8%; F: 5.4%]; 2014: 10.2% [M: 13.9%; F: 6.4%]) the frequency of diagnosis falls substantially (18-year-olds: 1.9% in 2009, 3.5% in 2014; 30-year-olds: 0.2% in 2009, 0.4% in 2014) and then continues to fall more slowly. There are no clinically significant differences between the sexes regarding peak age. For frequency of ADHD diagnosis the male/female ratio was 2.5 in 2009 and 2.3 in 2014, with roughly equal sex distribution from the age of 40 years onwards.

Frequency of ADHD diagnosis was higher in 2014 than in 2009 in all age groups.

Frequency of treatment

Figure 2 shows the frequency of pharmacotherapy among insurants diagnosed with ADHD. There are two age peaks. The first occurs at 13 to 14 years (2009: 51.7%; 2014: 43.1%) and the second at 34 years in 2009 (19.2%) and 37 years in 2014 (33.4%). Between

TABLE

An overview of recent international studies on the frequency of ADHD medication use in adolescence and adulthood

Author, year (source)	Country	Period covered	Data source	Substance(s)	Age	*n* (population)	Medication rate	Trend in medication rate
Frequency of ADHD medication in patients/insurants with a diagnosis of ADHD								
This study	Germany	2009 to 2014	AOK (Germany's largest statutory health insurance company)	MPH, ATX, LDX, DEX	18 to 69	Approx. 24 million	165/1000 (2009), 224/1000 (2014) of insurants with a diagnosis of ADHD	Increase (adults) Decrease (children/adolescents)
McManus et al. 2016 (39)	England	2014	Adult Psychiatric Morbidity Survey 2014	MPH, ATX	≥16	7546	5/1000 of individuals with positive ASRS screening finding	–
Aragonès et al. 2010 (e2)	Spain	2009	Institut Català de la Salut (primary care physicians)	MPH, ATX	18 to 44	2 452 107	321/1000 of insurants with a diagnosis of ADHD	–
Giacobini et al. 2014 (23)	Sweden	2006 to 2011	National patient and prescription registries	MPH, ATX, LDX, DEX, MOD	All	4.6 to 4.9 million	No specific information (700 to 800/1000 of all insurants with a diagnosis of ADHD)	Increase
Frequency of ADHD medication, irrespective of an ADHD diagnosis								
Burcu et al. 2016 (24)	USA	2010 to 2014	Blue Cross and Blue Shield health insurance in four US states	MPH, LDX, DEX	20 to 64	3.5 million	15/1000 (2010) 24/1000 (2014)	Increase
Geirs et al. 2014 (e9)	Iceland	2003 to 2012	National prescription registry	AMF, MPH, ATX	≥19	227 000	2.9/1000 (2003) 12.2/1000 (2012)	Increase
Karlstad et al. 2016 (25)	Denmark, Finland, Iceland, Norway, Sweden	2008 to 2012	National registry	MPH, ATX, LDX, DEX	18 to 64	15.8 million	2.4/1000 (M) (2008) 1.8/1000 (F) (2008) 4.9/1000 (total) (2012) 5.3/1000 (M) (2012) 4.4/1000 (F) (2012)	Increase (in all countries)
Zetterqvist et al. 2013 (e10)	Sweden	2006 to 2009	National registry	MPH, ATX, LDX, DEX	6 to 45	5 149 791	2.9/1000 (2006) 7.0/1000 (2009)	Increase
McCarthy et al. 2012 (e11)	England	2003 to 2008	THIN database (primary care physicians)	MPH, ATX, DEX	≥6	3 529 615	0.7/1000 (2003) 1.4/1000 (2008)	Increase

ADHD: Attention-deficit/hyperactivity disorder; AMP: Amphetamine ASRS: Adult ADHD Self-Report Scale; ATX: Atomoxetine; DEX: Dexamfetamine; F: Females; LDX: Lisdexamfetamine; M: Males; MOD: Modafinil; MPH: Methylphenidate; THIN: The Health Improvement Network

2009 and 2014 the frequency of pharmacotherapy for ADHD increased in adults but decreased in children and adolescents (*Figure 2a*). The highest frequencies of treatment occurred in 2014: 33.0% among female adolescents, 31.8% among adult females, 46.9% among male adolescents, and 36.0% among adult males *(Figure 2b, Figure 2c)*.

Methylphenidate was the most prescribed substance in almost all age groups, accounting for 75 to 100% of ADHD prescriptions. The second-most frequently prescribed substance in most age groups was atomoxetine. There was an exception among female insurants aged 9 to 15 years and 17 years and among male insurants aged 4, 6 to 15, and 64 years: in these groups lisdexamfetamine was prescribed at least as frequently as atomoxetine.

Even before the authorization in Germany of the first methylphenidate drug for adults, in April 2011 *(eTable 1)*, methylphenidate was prescribed to between 11.4% and 18.8% of insurants aged 19 to 21 years with a diagnosis of ADHD *(eTable 2)*. Between 2011 and 2014 this percentage increased to between 13.3 and 24.0 percent. The prescription rate of atomoxetine (authorized in Germany for adults in June 2013) rose from between 1.2 and 1.9% in 2012 to between 1.7 and 2.2% in 2014.

The transition cohort included 5593 15-year-old adolescents (M: 77.6%) with a diagnosis of ADHD, of whom 31.2% still had an ADHD diagnosis at the age of 21 years. During this period the medication rate fell from 51.8% to 6.6% *(Figure 3)*.

Information on contact with various medical specialties during transition is shown in the *eFigure*.

Discussion

The most important findings of this study can be summarized as follows:

- Frequency of ADHD diagnosis rose in all age groups between 2009 and 2014.
- While the percentage of adults with a diagnosis of ADHD who received pharmacotherapy for their ADHD increased, the percentage of children and adolescents receiving pharmacotherapy fell.
- The medication rate in the transition cohort fell by almost 90% within 6 years.

This study has found a higher frequency of ADHD diagnoses among AOK insurants during childhood and adolescence than other German studies (2007: 2.2% of those aged 0 to 18 years [36]; 2011: 4.1% of those aged 0 to 19 years [28]). This may be due to differences in study design (e.g. the inclusion of diagnosis F98.8 in this study). There has also been an increase in ADHD in other Western countries (37, 38). At 10.5 to 12.1% (2014), the frequency of diagnosis in boys aged 5 to 14 years is similar to that found by Grobe et al. (11.9% of 10-year-old boys [28]) and substantially higher than the ADHD prevalence of 0.6 to 5.0% reported in epidemiological studies (3, 4, 6). Many explanations have been put forward for this, including possible overdiagnosis (e.g. in the context of school adaptation processes) as well as differences between diagnostic criteria used in everyday clinical practice and those used in epidemiological studies.

Regarding the changes in the frequency of ADHD diagnosis in adults, there is an obvious comparison between the findings presented here and those of Grobe et al., who reported a 2- to 3-fold increase in the frequency of ADHD diagnosis in adults (aged 20 to 39 years) between 2006 and 2011 (28). There has also been an increase in frequency of ADHD diagnosis in adults in various other countries in recent years (23, 39, 40).

There are probably multiple reasons for this trend, including better care provision (e.g. reimbursement for ADHD drugs, new specialized ADHD outpatient clinics for adults) and increased awareness of the persistence of ADHD into adulthood, as is also the case with autism spectrum disorders (e1).

The frequency of ADHD diagnosis in adulthood is markedly higher in Germany than in Spain (0.04%) (e2) but substantially lower than the figures reported for Sweden (1.1% in 2006, 4.8% in 2011) (23). Overall, the frequency of ADHD diagnosis found in this study is lower than would be expected according to a meta-analysis (e3) and with an ADHD persistence rate of approximately 40 to 50%. Possible reasons for this are still insufficient care provision and frequent difficulty of diagnosis (e4).

The disappearance of the difference between the frequency of ADHD diagnosis among men and women during adulthood is largely in line with the findings of epidemiological studies (26).

The finding that the rate of prescription of ADHD drugs for children and adolescents with a diagnosis of ADHD is falling is part of a similar trend found in other research based on German data. This also shows a stagnation or decrease in methylphenidate prescriptions when stricter prescription conditions were introduced in 2010 (e5, e6).

Internationally, the rate of prescriptions for ADHD drugs among children and adolescents (regardless of whether there is a diagnosis of ADHD) is actually rising (e6). Prescription rates for children and adolescents of other classes of drugs, such as antipsychotics and antidepressants, are also increasing (e7, e8).

The increase in prescription of ADHD drugs to adults is probably due to the same factors as the increased frequency of ADHD diagnosis.

The *Table* provides an overview of international studies on the frequency of ADHD medication use in adults. The methods used in these studies vary. The decrease in drug prescriptions with increasing age during adulthood is in line with international figures (24, 25). The ADHD medication rate found in this study is lower than the rates in Spain and Sweden but higher than the rate in England *(Table)*. As in Scandinavia and England (25, 39) men were prescribed ADHD medication more frequently; in the USA, in contrast, from the age of 30 years onwards more women than men used ADHD medication (24).

It is striking that the ADHD medication rate among insurants in their 30s and 40s with a diagnosis of ADHD is 30%. This roughly corresponds to the percentage of adults with ADHD who have severe psychosocial impairment (12). However, the appropriateness of the medication rate cannot be conclusively evaluated, as there are no reference values and there are substantial differences in treatment between countries (e12).

Methylphenidate was the most commonly prescribed substance. This is in line with guideline recommendations and authorization status in Germany *(eTable 1)*. The increase in methylphenidate prescriptions in those aged over 18 years between 2011 and 2014 can be interpreted as a consequence of its authorization for adults.

The fall in the medication rate in the transition cohort from 51.8% to 6.6% is comparable to the situation in England in terms of its order of magnitude (e13). This may be interpreted either as a result of the transition phase or, alternatively, as possible evidence of very low ADHD persistence into adulthood. There is currently no comparative data on transition in ADHD (according to ICD-10 diagnosis criteria) from population-based studies.

The first of the two explanations above is supported by the fact that, independently of the transition cohort, the medication rate among all insurants with ADHD also fell toward the end of their teens *(Figure 2a)*. This could be interpreted in a similar way, especially as the percentage of AOK insurants receiving pharmacotherapy rises again in the first half of their 20s (though to a relatively low level).

On the other hand, this second peak in the medication rate may be due to the challenges of this stage of life (e.g. starting a family, parenthood) and the associated demands on organizational ability and on emotion and impulse control.

Limitations

The strength of this article is the use of secondary data: this makes it possible to collate all data on a large population and thus rules out confounding factors such as recall bias. However, it also has disadvantages, such as a potentially lower quality of coded diagnoses and a lack of additional information regarding symptom severity, comorbidities (9), psychosocial status, and indications for drug prescriptions. However, it can be assumed that the vast majority of prescriptions in this study were for the indication ADHD, as the only possible alternative indication would be narcolepsy, which is very rare (prevalence: 25 to 50/100 000) (e14).

Psychiatric disorders are more common in AOK insurants, due to their lower socioeconomic status, among other reasons (e15). Our routine data analysis may therefore have overestimated the actual prevalence of ADHD.

A further limitation is that only prescription data, not diagnoses from psychiatric outpatient centers or university outpatient centers, were available. This may have led to a slight underestimate of the frequency of diagnosis. Drugs occasionally prescribed off-label for ADHD treatment (e.g. clonidine) and other forms of ADHD therapy (e.g. neurofeedback) could not be included in the evaluation. Evaluation of psychotherapeutic treatments was not performed, as there was no information available on whether the underlying indication was ADHD or another psychological disorder.

Conclusion

The frequency of ADHD diagnosis in adults has increased in recent years. This may be interpreted as evidence of increased awareness of adult ADHD on the part of physicians and patients. However, the frequency of ADHD diagnosis in adults is lower than the prevalence reported in epidemiological studies, which indicates that a significant proportion of cases remain undiagnosed and highlights the need for further expansion of care for adult ADHD patients. The significant drop in pharmacotherapy for ADHD during the transition to adulthood raises the question of whether specific concepts (e16, e17) should be developed for transition.

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Conflict of interest statement

Prof. Philipsen has received consultancy and lecture fees and reimbursement of travel expenses from Eli Lilly, MEDICE Arzneimittel Pütter GmbH & Co. KG, Novartis, Shire, and Lundbeck.

Prof. Bachmann and Prof. Hoffmann declare that no conflict of interest exists.

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KEY MESSAGES

- Between 2009 and 2014 the frequency of ADHD diagnosis (raw, nonstandardized data) in those aged 0 to 17 years rose from 5.0 to 6.1%. In those aged 18 to 69 years it rose from 0.2 to 0.4%.
- While the prescription of ADHD medication to adults with a diagnosis of ADHD rose between 2009 and 2014, for children and adolescents it fell during the same period.
- The most commonly prescribed substance was methylphenidate, followed by atomoxetine and lisdexamfetamine.
- In the transition cohort, which consisted of individuals aged 15 to 21 years, the medication rate fell from 51.8% to 6.6%.
- As this cohort's socioeconomic status is lower, the actual prevalence of ADHD in Germany is probably lower than that reported here.

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Supplementary material
For eReferences please refer to:
www.aerzteblatt-international.de/ref0917

eTables, eBox, eFigure,:
www.aerzteblatt-international.de/17m0141

Supplementary material to:

ADHD in Germany: Trends in Diagnosis and Pharmacotherapy

A Country-wide Analysis of Health Insurance Data on Attention-Deficit/Hyperactivity Disorder (ADHD) in Children, Adolescents and Adults From 2009–2014

by Christian J. Bachmann, Alexandra Philipsen, and Falk Hoffmann

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eTABLE 1

Overview of drugs authorized in Germany for the treatment of ADHD in children, adolescents, and adults

Substance	Trade name(s)	Duration of effect	Market launch	Indication(s) in children/adolescents*1	Indication(s) in adults*1
Stimulants					
Methylphenidate*2 (immediate-release)	Ritalin Medikinet Methylpheni TAD Methylphenidat (ratiopharm) Methylphenidat (Hexal)	1 to 4 hours	1970 2000 2004 November 2004 2003	Treatment of ADHD from 6 years onwards: – following detailed examination and diagnosis according to ICD or DSM – as part of overall treatment strategy – if other measures (e.g. psychotherapy) have been unsuccessful – under the supervision of a specialist in behavioral disorders Narcolepsy (Ritalin only)	–
Methylphenidate*2 (extended-release)	Equasym Retard	7 to 8 hours	July 2006	See above (shaded background)	–
	Medikinet retard (C), Medikinet adult (A)	6 to 8 hours	January 2005 (C), April 2011 (A)	See above (shaded background)	Treatment beginning in adulthood; continuation of treatment for ADHD existing since childhood
	Ritalin LA (C), Ritalin adult (A)	6 to 8 hours	August 2007 (C), May 2014 (A)	See above (shaded background)	Beginning of treatment; continuation of treatment
	Concerta Methylphenidat (neuraxpharm)	9 to 12 hours	January 2003 February 2014	See above (shaded background)	Continuation of treatment
Dexamfetamine		5 to 6 hours	December 2011	Insufficient response to previous atomoxetine treatment for ADHD and methylphenidate treatment for ADHD; for further conditions see above	–
Lisdexamfetamine		12 to 14 hours	June 2013	Insufficient response to previous methylphenidate treatment for ADHD; for further conditions see above	–
Other					
Atomoxetine		Continuous	March 2005 (C), June 2013 (A)	Treatment of ADHD from age 6 years onwards as part of overall treatment strategy	Beginning of treatment; continuation of treatment
Guanfacine		Continuous	January 2016 (C)	Insufficient response to previous stimulant treatment for ADHD; for further conditions see above	–

ADHD: Attention-deficit/hyperactivity disorder; A: Adults; C: Children and adolescents aged up to 18 years

*1Some indications abbreviated

*2All methylphenidate drugs currently available in Germany are shown with their trade names for better traceability, as authorizations and durations of effect vary.

eTABLE 2

Percentages of insurants with prescriptions for substances to treat ADHD (AOK insurants aged 15 to 21 years with a diagnosis of ADHD, 2009 to 2014)

Year	Sub-stance	Age (years)						
		15	16	17	18	19	20	21
2009	MPH	47.15	42.79	35.37	29.18	18.85	16.27	13.43
	ATX	4.72	4.62	4.52	4.76	3.38	2.23	2.43
	LDX	–	–	–	–	–	–	–
	DEX	–	–	–	–	–	–	–
2010	MPH	46.70	41.96	35.76	28.18	16.07	13.78	11.42
	ATX	4.36	4.16	4.19	4.70	3.05	1.95	1.26
	LDX	–	–	–	–	–	–	–
	DEX	–	–	–	–	–	–	–
2011	MPH	45.19	41.08	34.99	29.42	17.71	15.78	13.28
	ATX	4.45	3.78	3.59	3.88	2.60	1.97	1.17
	LDX	–	–	–	–	–	–	–
	DEX	0	0.03	0.01	0.02	0.02	0	0
2012	MPH	44.27	39.80	33.74	28.86	24.00	19.09	17.64
	ATX	3.94	3.55	3.28	2.39	1.93	1.57	1.21
	LDX	–	–	–	–	–	–	–
	DEX	0.18	0.13	0.16	0.11	0.02	0.03	0
2013	MPH	42.65	39.11	32.86	27.82	22.71	20.14	18.12
	ATX	3.51	3.06	2.70	2.44	1.79	1.72	1.56
	LDX	1.17	0.73	0.54	0.19	0.02	0.02	0.03
	DEX	0.24	0.19	0.20	0.16	0.02	0.02	0.09
2014	MPH	38.84	35.59	29.20	26.03	22.74	20.06	17.33
	ATX	2.83	2.81	2.31	2.70	2.24	1.69	1.89
	LDX	3.22	2.25	1.62	0.97	0.30	0.02	0.03
	DEX	0.29	0.19	0.18	0.10	0.06	0	0

ADHD: Attention-deficit/hyperactivity disorder; AOK: Allgemeine Ortskrankenkassen (Germany's largest statutory health insurance company); ATX: Atomoxetine; DEX: Dexamfetamine; LDX: Lisdexamfetamine; MPH: Methylphenidate

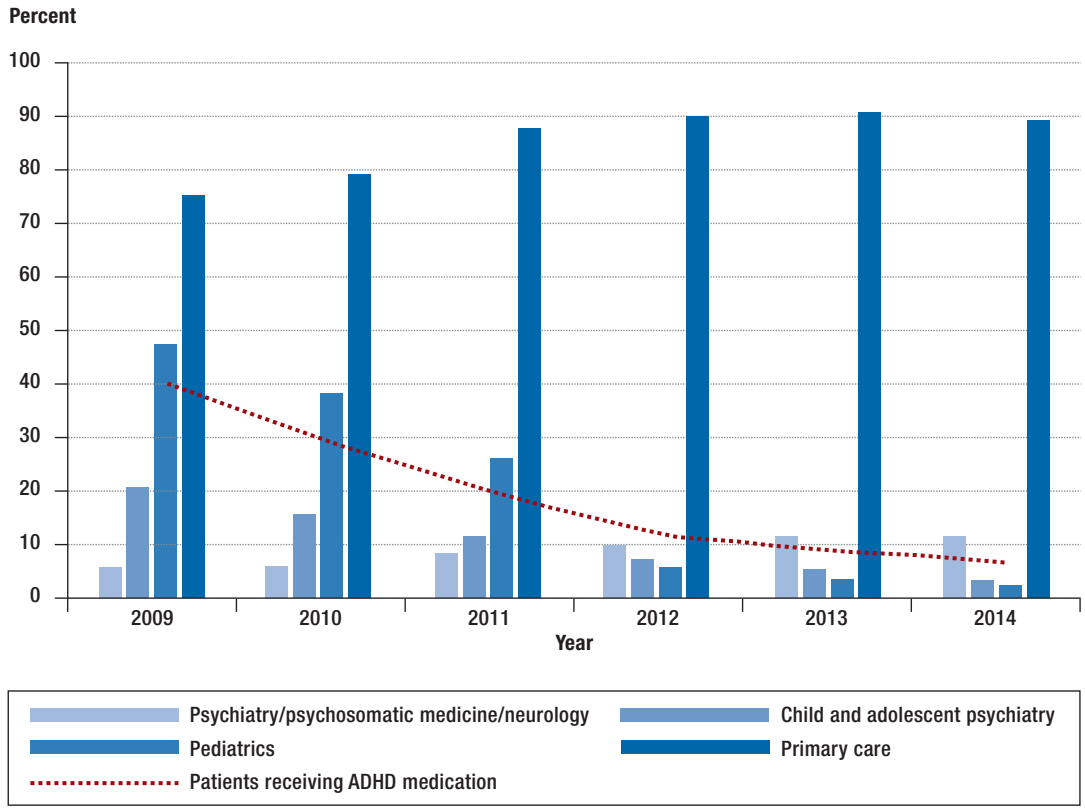
eBOX

Methods

- Data
  - Our analyses involved data from all the approximately 24 million members of Germany's largest statutory health insurance company, AOK (*Allgemeine Ortskrankenkassen*), who were insured for at least one day in every quarter of the year in question.
  - To be classified as having ADHD, insurants had to have one of the following ICD-10 diagnoses (index diagnoses) coded as confirmed in the outpatient sector in the year in question: F90.0, F90.1, F90.8, F90.9, F98.8.
  - The following substances were included for analysis of prescription of ADHD drugs: methylphenidate (ATC code N06BA04), atomoxetine (N06BA09), lisdexamfetamine (N06BA12), dexamfetamine (N06BA02), and amphetamine (N06BA01).
  - The following treating specialties were investigated using specialty codes: child and adolescent psychiatry, pediatrics, primary care, and psychiatry/psychosomatic medicine/neurology.
  - Data was processed by the AOK's Institute of Science (WIdO) and made available to the authors in aggregated form for analysis.

- Analysis
  - *Frequency of diagnosis and treatment*
    The percentage of insurants aged between 0 and 69 years with an index diagnosis in the calendar year in question (2009 and 2014) was investigated. For insurants with an index diagnosis, the prescription of ADHD drugs between 2009 and 2014 was also evaluated. Insurants for whom there was no diagnosis in one or more years were not included. Analyses were stratified by age, sex, and prescribed substance.
  - *Transition*
    The total cohort consisted of all insurants with an index diagnosis who were 15 years old in 2008 and were insured continuously until 2014. For the period from 2008 to 2014 the information recorded for each year included whether there was an index diagnosis, whether a drug was prescribed, and whether there was contact with specialized or other physicians. Analyses were stratified by sex.

eFIGURE



Contact between transition cohort members and physicians: percentage distribution between specialties, 2009 to 2014
ADHD: Attention-deficit/hyperactivity disorder