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Prevalence of ADHD in Publicly Insured Adults

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Abstract

Objective: To estimate the prevalence of adult ADHD diagnosis and treatment in U.S. Medicaid beneficiaries. **Method:** Using outpatient, inpatient, and pharmacy billing records for patients eligible for Medicaid fee-for-service benefits within 29 states from 1999 to 2010, we estimated the annual prevalence of ADHD diagnosis and treatment. **Results:** The prevalence of ADHD diagnosis increased from 2.20 per 1,000 patients in 1999 to 10.57 in 2010. Likewise, prevalence of ADHD treatment increased from 1.95 per 1,000 patients in 1999 to 13.16 in 2010. Between 40% and 65%, patients had ADHD drug prescription fills 6 months after ADHD diagnosis, whereas 45% to 55% of the beneficiaries with an ADHD drug prescription fill had ADHD diagnoses within 6 months before the prescription. **Conclusion:** In publicly insured adults, the prevalence of ADHD diagnosis and treatment increased dramatically over the years. Approximately half of the diagnosed patients are not treated, whereas half of the treated adults are not diagnosed. (*J. of Att. Dis.* 2018; 22(2) 182-190)

Keywords

ADHD, central nervous system stimulants, disease prevalence, epidemiology

Background

ADHD has been considered a childhood neurodevelopmental disorder, characterized by symptoms, including inattention, impulsivity, and hyperactivity (Davidson, 2008; Goldman, Genel, Bezman, & Slanetz, 1998). In recent years, evidence has shown that in 30% to 70% of patients with ADHD during childhood, the disorder persists into adulthood (Lara et al., 2009; Mannuzza, Klein, & Moulton, 2003; Pary et al., 2002; Silver, 2000). Different from presentation of this disorder in children, symptoms of hyperactivity among adults with ADHD diminish, whereas symptoms of inattention persist and may affect important functions in life. Adult patients with ADHD may also experience interpersonal problems and coexisting psychiatric and substance abuse disorders (Volkow & Swanson, 2013). Considering the significant consequences of ADHD among adults, it is important to examine the epidemiology of the diagnosis and treatment of ADHD in adults.

Although ADHD is well studied in the pediatric population, little is known about ADHD diagnosis and treatment in adults. Reported prevalence rates of diagnosed ADHD among adults vary across a limited number of available studies, which have used different methodological approaches and different samples of patients (Almeida Montes, Hernández García, & Ricardo-Garcell, 2007; Faraone & Biederman, 2005; Heiligenstein, Conyers, Berns, Miller, & Smith, 1998; Holden et al., 2013; Kessler

et al., 2006; Knight et al., 2014; McCarthy et al., 2012; Montejano, Sasané, Hodgkins, Russo, & Huse, 2011; Simon, Czobor, Bálint, Mészáros, & Bitter, 2009). Early studies of small sample size estimate the prevalence of ADHD diagnosis mainly by examining self-reported symptoms or via structured interviews based on the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM-IV*; American Psychiatric Association [APA], 1994) criteria (Almeida Montes et al., 2007; Faraone & Biederman, 2005; Heiligenstein et al., 1998; Kessler et al., 2006; McCarthy et al., 2012; Simon et al., 2009). To date, limited number of studies have reported population-based estimates in adults (Holden et al., 2013; Knight et al., 2014; McCarthy et al., 2012; Montejano et al., 2011), and no study has estimated the prevalence of ADHD diagnosis and treatment in adult Medicaid beneficiaries. Furthermore, most population-based studies have required presence of both ADHD diagnosis and treatment to determine the prevalence of the disorder, which may underestimate true prevalence, as treatment discontinuation is common. In terms of the

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Table 1. Numerator and Denominator Definitions for Prevalence Estimates.

Prevalence/percentage	Numerator	Denominator
Annual prevalence of ADHD	Number of patients with ≥ 1 inpatient or 2 outpatient ADHD diagnoses	Number of adults with 12-month continuous eligibility in Year X
Annual prevalence of ADHD drug use	Number of patients with ≥ 1 ADHD prescription claim	Number of adults with 12-month continuous eligibility in Year X
Percentage of patients who had ADHD prescription claims 6 months after ADHD diagnosis	Number of patients with ≥ 1 ADHD prescription claim within 6 months of follow-up	Number of eligible ADHD patients with 6-month continuous eligibility after ADHD diagnosis in the first half of Year X
Percentage of patients who had ADHD diagnosis 6 months before their ADHD prescription claim	Number of patients with ≥ 1 in- and 2 outpatient ADHD diagnoses 6 months before prescription claim	Number of eligible patients with 6-month continuous eligibility 6 months before ADHD prescription claim in the second half of Year X

prevalence of ADHD treatment among adults, majority of the previous studies only reported prevalence of treatment in young adults (age ≤ 20 ; Barry, Martin, & Busch, 2012; Johansen, Matic, & McAlearney, 2015; McCarthy et al., 2009). Only one study reported ADHD treatment rate in adults aged 20 years and older (Castle, Aubert, Verbrugge, Khalid, & Epstein, 2007).

To address the gaps in the existing literature, the goal of this study was to estimate the prevalence of diagnosed adult ADHD and its treatment in U.S. Medicaid beneficiaries, as well as to examine proximate relationships between prescribing ADHD medications and ADHD diagnosis.

Method

Study Design

We conducted a repeated cross-sectional study using Medicaid Analytic eXtract (MAX) files of 29 states to identify all adult Medicaid beneficiaries in fee-for-service (FFS) and primary care case management (PCCM) plans aged 18 to 64 years. The MAX data are a set of patient-level data files that provide monthly information on patients' Medicaid eligibility, demographics, diagnoses, and medical procedures performed at outpatient and inpatient settings as well as medication dispensing records submitted for reimbursement.

Definitions

ADHD patients were identified based on having at least one inpatient or two outpatient visits with International Classification of Disease, Version 9, Clinical Modification (ICD-9-CM) diagnosis code of 314.xx (314.00—attention deficit disorder without mention of hyperactivity, 314.01—attention deficit disorder with hyperactivity, 314.1—hyperkinesis with developmental delay, 314.2—hyperkinetic conduct disorder, 314.8—other specified manifestations of hyperkinetic syndrome, and 314.9—unspecified hyperkinetic syndrome) in each specific study year.

ADHD medication use was determined based on having at least one prescription fill record of an ADHD medication. ADHD medications included all dosage forms of methylphenidate, mixed amphetamine salts, pemoline, and the nonstimulant medication atomoxetine.

Statistical Analysis

We report four estimates involving ADHD diagnosis and treatment using different eligibility requirements, and numerator and denominator definitions (Table 1). For each year from 1999 through 2010, we identified all individuals 18 to 64 years old who were continuously enrolled in Medicaid for the entire 12 months of the measurement year (e.g., from January 1–December 31, 2001). The annual prevalence of ADHD was then calculated as the proportion of eligible patients who had at least one inpatient or two outpatient service claims with ICD-9-CM code 314.xx. The annual prevalence of ADHD medication use was calculated as the proportion of eligible patients who had at least one pharmacy claim for an ADHD medication in the study year. We stratified estimates of ADHD diagnosis and ADHD medication use prevalence by age and gender, and the prevalence of ADHD medication use by methylphenidate, mixed amphetamine salts, and atomoxetine preparations.

To estimate the prevalence of treatment in patients with diagnosed ADHD, we identified patients who had at least one inpatient or two outpatient service claims with ICD-9-CM code 314.xx in the first half of the calendar year (i.e., January 1–June 30). We then followed these patients for 6 months starting from the date of their ADHD diagnosis to determine the proportion of patients who had at least one pharmacy claim for an ADHD medication during the follow-up period. In each annual cohort, eligible patients were required to have at least 6 months of continuous eligibility after the date of their first ADHD diagnosis. Reversing the approach of the previous analysis, we also estimated the proportion of patients who had at least one ADHD diagnosis in the 6-month period before their first dispensing of an ADHD medication in the second half of a calendar year.

Table 2. Demographic Characteristics of Study Samples by Year.

Characteristics	Year											
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sample size (n)	1,952,942	2,035,380	2,178,294	2,171,520	2,571,952	2,462,090	2,275,483	1,775,431	1,437,463	1,342,189	1,288,942	1,313,374
Age (%)	39.75	39.86	39.21	39.23	39.22	39.12	39.03	40.29	40.39	39.92	39.86	39.43
18-25	18.36	18.05	19.79	19.33	19.66	20.00	20.26	18.67	19.12	20.14	19.10	19.75
26-35	21.62	21.27	21.74	22.01	21.87	22.05	22.27	19.72	19.33	20.16	21.40	22.30
36-45	22.84	23.14	22.59	22.86	22.27	21.71	21.06	20.44	19.45	18.66	19.10	18.63
46-55	19.41	20.05	19.76	19.98	20.30	20.49	20.66	23.11	23.29	22.89	22.91	22.61
55 and older	17.76	17.48	16.12	15.82	15.90	15.75	15.74	18.06	18.80	18.16	17.49	16.70
Gender (%)												
Male	35.08	35.16	34.22	34.89	34.96	35.14	35.11	37.90	38.55	38.35	39.33	39.88
Female	64.92	64.84	65.78	65.11	65.04	64.86	64.89	62.10	61.45	61.65	60.67	60.12

(i.e., July 1-December 31). Thus, in each calendar year, we required eligible patients to have at least 6 months of continuous enrollment before their first ADHD treatment pharmacy claim.

SAS Version 9.4 (SAS Institute, Cary, North Carolina) was used to perform the data management and statistical analyses. The study was approved by the Institutional Review and Privacy Boards at the University of Florida and the Centers for Medicare & Medicaid Services.

Results

From 1999 to 2010, we identified approximately 1,288,942 to 2,571,952 eligible adults in each year, with 34.22% to 39.88% females and the average age ranged from 39.03 to 40.39 years (Table 2). The prevalence of adult ADHD diagnosis increased approximately fivefold from 2.20 per 1,000 patients in 1999 to 10.57 per 1,000 patients in 2010 (Figure 1). Likewise, the prevalence of ADHD treatment increased considerably from 1.95 per 1,000 patients in 1998 to 13.16 per 1,000 patients in 2010 (Figure 1). Notably, in the later study years, the annual prevalence of ADHD treatment use surpassed the ADHD prevalence. Overall, the prevalence estimates of ADHD diagnosis and ADHD medication use increased across all age groups from 1999 to 2010 (Figures 2 and 3). Prevalence of both diagnosis and medication use showed a consistent age trend with the largest prevalence in younger age groups. Compared with females, male patients showed higher prevalences of both ADHD diagnosis and medication use, but the prevalence rate ratio for females comparing prevalence in 2010 to prevalence in 1999 was slightly higher than that of males, with 5.6 versus 3.9 for ADHD diagnosis and 7.6 versus 5.9 for ADHD medication use (Figure 4).

Comparing utilization pattern of the various ADHD medications, the prevalence of methylphenidate use increased from 1.21 per 1,000 patients in 1999 to 4.50 per 1,000 patients in 2010, whereas the prevalence of mixed amphetamine salts use increased disproportionately from 0.50 per 1,000 patients in 1999 to 6.98 per 1,000 patients in 2010 (Figure 5). The prevalence of atomoxetine use

Figure 1. Annual ADHD diagnosis and medication use prevalence among adults.

Figure 2. Annual ADHD diagnosis prevalence among adults by age groups.

increased from 0.90 per 1,000 patients in 2003 to a peak with 2.23 per 1,000 patients in 2005, which was followed by a decrease to 1.68 per 1,000 patients in 2010.

Over the study period, approximately 40% to 65% of patients with an ADHD diagnosis in the first half of the

Figure 3. Annual ADHD medication use prevalence among adults by age groups.

Figure 4. Annual ADHD diagnosis and medication use prevalence among adults by gender.

calendar year had at least one ADHD prescription fill claim in 29 U.S. states. Likewise, about 44% to 52% of all patients who filled an ADHD prescription had at least one inpatient or two outpatient service claims with a diagnosis of 314.xx during the 6 months before their ADHD prescription (Figure 6). Both percentages increased over the years.

Discussion

This study examined the prevalence of ADHD diagnosis and treatment among adult Medicaid beneficiaries. The study results highlight four important insights in ADHD diagnosis and medication use among adults. First, in this study, the prevalence estimates of ADHD diagnosis were about twice of the estimates in previous studies using administrative databases in various geographic areas of the United States (Knight et al., 2014; Montejano et al., 2011). In a U.S. commercial population with employer-sponsored insurance, the estimated prevalence was about 1.20 to 4.02 per 1,000 patients from 2002 to 2007 (Montejano et al., 2011). The

other study reported the prevalence of ADHD in a managed care population at 3.12 to 4.15 per 1,000 patients from 2006 to 2009 (Knight et al., 2014). This could be partially explained by the different study populations. Compared with privately insured patients, Medicaid beneficiaries in general are of lower social economic status, which has been shown to be one of the causes or the consequences of mental disorders (Hudson, 2005; Miech, Caspi, Moffitt, Wright, & Silva, 1999). However, the higher prevalence rate we observed may be in part explained by different case definition such as the requirement to have both a diagnosis and pharmacological ADHD treatment in the previous studies (Knight et al., 2014). To avoid underestimating the prevalence caused by untreated ADHD among adults, we did not use prescription claims in addition to diagnosis claims to determine manifestation of ADHD. When analyzing the proximity of diagnosis and treatment, we observed that only about 40% to 65% of the diagnosed patients had ADHD treatment within 6 months after diagnosis, which confirmed our concerns for untreated adult ADHD. Our findings provided insights on the measurement of ADHD diagnosis among adults using automated databases in future research, which should take how adult ADHD and treatment were diagnosed and treated in the actual clinical setting into consideration. During the study periods of the existing studies on adult ADHD, including this study, the diagnosis of adult ADHD was guided by the *DSM-IV*. However, *DSM-IV* was criticized because the diagnostic criteria for ADHD were primarily focused on children, which leads to underdiagnosis of many teens and adults with symptoms of ADHD (APA, 1994; Applegate et al., 1997). In 2013, *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*; APA, 2013) was updated according to the evidence of the reduction in symptoms with increasing age. Adults as well as teens can now be diagnosed more easily because *DSM-5* raises the age limit of when symptoms should be documented, that is, from age 7 to age 12 and lowers the number of symptoms from 6 to 5 for diagnosis in individuals of age 17 and above (APA, 2013). With the implementation of *DSM-5*, the prevalence of adult ADHD after 2013 will be expected to be higher from what has been reported (Ghanizadeh, 2013).

Second, similar to other studies, we observed a substantial increase in both the prevalence rates of ADHD diagnosis and treatment among adult Medicaid beneficiaries (Holden et al., 2013; Knight et al., 2014; McCarthy et al., 2012; Montejano et al., 2011). In this study, we observed an approximately five fold relative increase in ADHD diagnosis and a seven fold relative increase in ADHD treatment in adult patients. This substantial increase in diagnosis of ADHD in adults could partially be explained by the fact that the prevalence of ADHD may have been influenced by modified diagnostic criteria among adults over time (Wender, Wolf, & Wasserstein, 2001). Furthermore, our findings reflect the increasing clinician and public recognition of ADHD as a serious medical condition for adults and

Figure 5. Annual prevalence of methylphenidate, mixed amphetamine salts, and atomoxetine preparations use.

Figure 6. Percentage of patients with ADHD medication after ADHD diagnosis and percentage of patients who had ADHD diagnosis before ADHD medication.

also raise concerns about the potential growth of the medical and economic burden related to ADHD in adults, especially in patients with low social economic status. In terms of prevalence of specific drug classes, mixed amphetamine salts had surpassed methylphenidate utilization at the end of the study period, where the prevalence of mixed amphetamine salts was one and a half times as large as the prevalence of methylphenidate. Atomoxetine use was on the decline across all 29 states with marginal prevalence rates in 2010. The fluctuation of the prevalence of atomoxetine

use corresponds with the box warning issued by the Food and Drug Administration (FDA) for the potential side effect related to suicidal behavior/ideation in September 2005.

Third, the growth of ADHD diagnosis and treatment occurred across both genders and all age groups over the 12-year study period. Compared with males, the prevalence of both diagnosis and treatment among females was lower, which were similar to what has been observed in children (Winterstein et al., 2008). However, the prevalence in females increased slightly faster than that in males. Compared with

older age groups, the highest prevalence in 18 to 25 age group can be explained by delayed diagnosis from childhood, persistence of ADHD from childhood, as well as the increased recognition and diagnosis of ADHD in the college-age population. Some argue that the lower prevalence in older age groups could also be explained by improvement of hyperactivity and impulsivity and increased compensation strategies over time (Biederman, Wilens, Spencer, & Adler, 2007; Jackson & Farrugia, 1997; Klein et al., 2012). However, according to survey-based studies using validated diagnostic tools, the prevalence of ADHD was estimated to be more than 3% among older adults (aged >55), which is much higher than the prevalence we observed (de Zwaan et al., 2012; Goodman, Mitchell, Rhodewalt, & Surman, 2016; Guldborg-Kjær & Johansson, 2009; Michielsen et al., 2012). This suggests the relative absence of diagnosis and treatment of ADHD in patients above age 55 is much likely a reflection of lack of clinician training, appropriate symptom definitions, and diagnostic tools for use among older adults in clinical practice.

Finally, the annual prevalence of ADHD treatment use surpassed the ADHD prevalence in the later study years. Following the observation, about half of the patients who had ADHD treatment did not have a service claim with a diagnosis of 314.xx within 6 months before the pharmacy to dispense claim, which could be explained by a few possible reasons. First, studies have shown that physicians may be reluctant to label adult patients with psychiatric disorders without confirming the condition (Mitchell, 2007). ADHD medications are likely to be prescribed when a clinician is unsure of the diagnosis and uses the medication response as a clinical indicator of the condition, which may result in treatment without ADHD diagnosis. In addition, with only two diagnoses that are documented with an outpatient visit claim, it is conceivable that more prominent or more acute diagnoses took precedence, and thus, ADHD may have been present but not documented. On the contrary, ADHD medications may be prescribed for narcolepsy or off-label indications such as treatment-refractory depression, cancer fatigue, obesity, or other conditions symptomatic with a lack of motivation and apathy (Greenhill et al., 2002; Jeffers & Benotsch, 2014; Trenque, Herlem, Abou Taam, & Drame, 2014). Given that previous studies reported prevalent non-medical use and misuse of prescription stimulants among young adults (Kaye & Darke, 2012; McCabe, Knight, Teter, & Wechsler, 2005; Wilens et al., 2008), future research should address what alternative indications or purposes for ADHD medication use exist in this population.

Limitation

Our study is subject to a few limitations. In this study, we used ICD-9-CM diagnosis codes to identify ADHD

diagnosis in medical encounter billing records, which has inherent limitations due to coding and billing errors. In addition, the accuracy of ADHD diagnosis depends on a number of factors, including clinician training and experience, time necessary for adequate evaluation of patients' condition, as well as outside informants to increase specificity and sensitivity of diagnosis (Asherson et al., 2010; Moncrieff & Timimi, 2010; Surman & Goodman, 2017). Thus, our prevalence estimate of ADHD diagnosis may not reflect the true prevalence among adults. Furthermore, we included patients from 29 states in the United States, representing the vast majority of patients enrolled in Medicaid FFS plans nationally. We did not examine the prevalence in individual states and given demonstrated variability of ADHD diagnoses and treatment across states in children (Visser et al., 2015; Visser et al., 2014), we caution against extrapolating our results to individual states. Of note, sample sizes dropped drastically in the year 2006 because of increasing Medicaid managed care penetration and decreased number of FFS enrollees (Centers for Medicare & Medicaid Services, 2013). In the present analysis, we restricted eligible beneficiaries to those in FFS or PCCM plans from 1999 to 2010 with no supplemental managed care plan other than dental because of concerns on completeness and quality of the encounter data of managed care plan. Thus, our results may have limited generalizability to Medicaid patients in other managed care plans.

Conclusion

In summary, this study reports the prevalence estimates of ADHD diagnosis and treatment using administrative data in Medicaid Analytic eXtract (MAX) billing records. The prevalence of adult ADHD diagnosis and medication use has increased substantially from 1999 to 2010 across both genders and all age groups. Approximately, half of the patients did not have a prescription claim within 6 months of the diagnosis whereas half of the patients on ADHD medications did not have a diagnosis 6 months before the treatment. These findings on ADHD diagnosis and treatment emphasize the need for studies that examine the treatment patterns of Adult ADHD and alternative diagnosis and purpose of ADHD medication use.

Authors' Note

The results in this study have been presented at the 31st International Conference on Pharmacoepidemiology & Therapeutic Risk Management in Boston, 2015. The second author, Dr. Liu, is currently an employee of the U.S. Food and Drug Administration (FDA). Dr. Liu was involved in this study while he was a postdoctoral associate at the University of Florida. The views expressed in this article are those of the authors and not necessarily those of the FDA.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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