



Original Research

Increasing rate of diagnosed childhood mental illness in the United States: Incidence, prevalence and costs

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ABSTRACT

Objective: This study examined the rate and economic burden of pediatric mental illness from 2012 to 2018.

Study design: Observational, retrospective analysis of administrative healthcare data.

Methods: This retrospective study of the MarketScan Commercial Research Database included calendar year-based samples (2012-2018) of children aged 4-17 with continuous medical, pharmacy, and mental health/substance abuse coverage for the year of interest and prior year. Incidence and prevalence rates of overall and specific mental illness diagnoses were calculated based on the appearance of diagnosis codes on claims: alcohol/substance abuse, depression, anxiety, eating disorders, bipolar, schizophrenia, developmental disorders, attention deficit/hyperactivity, and conduct disorders. Annual direct medical costs were compared between children with any mental illness and a matched non-mental illness control population.

Results: Between 2.4 and 4.1 million children qualified for each calendar year sample. From 2012 to 2018, there was a 34.6% increase in the prevalence of mental illness. Attention deficit/hyperactivity, conduct disorders, anxiety, and depression were the most common conditions, while eating disorders, anxiety, and depression presented the greatest increases at 96%, 95%, and 73% respectively. Children with a mental illness incurred significantly greater medical costs compared to matched controls in all years assessed (2018 comparison: \$6,055±\$27,198 vs. \$1,629±\$7,274; $p < 0.001$).

Conclusions: Childhood mental illness diagnoses have increased substantially in the United States from 2012 to 2018. In addition to patient impacts, mental health diagnoses also place a notable burden on the healthcare system via increased medical costs. As mental illness is known to be underdiagnosed, the true rate of mental illnesses among children is likely even greater.

Over the past decades there has been increasing awareness of mental illness in the United States (US), which has been underscored by the passage of legislation such as the Mental Health Parity Act and provisions in the Affordable Care Act, as well as an increased number of mental health patient advocacy groups [1–3]. Despite these efforts, mental illness is still associated with long-held stigmas, which can manifest in treatment delays and negative health and social consequences [4–6]. This issue is of particular concern among the pediatric population, as nearly half of all US children with a diagnosable mental illness go untreated [7].

The Centers for Disease Control and Prevention estimate that between 13% and 20% of American children and adolescents aged 3 through 17 have a diagnosable mental, emotional, or behavioral disorder [8]. This has resulted in a considerable burden on a healthcare

system that already presents significant access issues to mental health services for various segments of the population [9–11]. From 2012 to 2016, there was a 55% increase in mental health emergency room visits among pediatric patients [12], while hospitalizations for mood disorders among juveniles increased 80% from 1997 to 2010 [13]. Further, suicide recently surpassed homicide as the second leading cause of death among teenagers aged 15-19, trailing only accidents [14]. As such, numerous researchers and practitioners have begun referencing the current state of mental health among US children as a crisis [15–17].

Addressing the increasing demands of a potential public health crisis requires accurate and timely estimates of the full scope and burden of pediatric mental illness from a real-world perspective. These data may assist in estimating the amount of mental healthcare-related resources needed at a nationwide level, and stimulate government and other

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organizations to implement strategies to further promote increased mental health awareness. The purpose of this study was to assess the incidence and prevalence of pediatric mental illness in the US from 2012 to 2018 using administrative claims data. As these data include a full record of healthcare costs, the economic burden associated with pediatric mental illness was also estimated.

1. Methods

1.1. Study Design and data source

This observational, retrospective study used de-identified healthcare claims from the MarketScan Commercial Claims and Encounters Database spanning the period of January 1, 2011, through December 31st, 2018. Although the calendar year-based cohorts begin in 2012, inclusion of the 2011 calendar year was necessary to provide a one-year pre-period for the 2012 calendar year sample (see Sample Selection and Cohort Assignment below). The MarketScan database includes inpatient medical, outpatient medical, and outpatient pharmacy claims data, along with enrollment and demographic information from employees and their dependents insured via >300 large, self-insured US employers and >25 US health plans. All database records are statistically de-identified and certified to be fully compliant with US patient confidentiality requirements set forth in the Health Insurance Portability and Accountability Act of 1996. As this study used only de-identified patient records and did not involve the collection, use, or transmittal of individually identifiable data, Institutional Review Board approval was not necessary.

1.2. Sample Selection and Cohort Assignment

The full study population included seven calendar year-based (2012 to 2018) samples of children aged 4-17. Eligible children were required to be aged between 4 and 17 on January 1 of the year of interest and exhibit continuous medical, pharmacy, and mental health/substance abuse coverage for the calendar year of interest and the year prior; the additional inclusion of mental health/substance abuse coverage ensured that all mental health claims were captured in the data (e.g., patients did not have carve-out mental health coverage) to ensure accurate assessment of outcomes. These seven calendar year-based samples represented all eligible patients regardless of whether they had a mental health diagnosis or not and served as the denominator for prevalence calculations. Within the full samples, patients with mental illness diagnoses were identified via the presence of specific ICD-9/ICD-10-CM diagnostic codes including: alcohol abuse, substance abuse, depression, anxiety, eating disorders, bipolar disorder, schizophrenia, developmental disorders, attention deficit/hyperactivity disorder, and conduct disorders (for full list of diagnostic codes utilized, see [Appendix A](#)). Patients who presented ≥ 1 non-diagnostic claim were considered to have a mental health condition and included in the mental illness sample (an algorithm developed and refined over the years was utilized to exclude certain types of diagnostic claims when identifying eligible patients for the study; therefore, any claim with a Current Procedural Terminology code for diagnostic procedures or visits such as emotional/behavioral/developmental/psychiatric assessments for diagnosis/evaluation/interview/testing/screening [90792; 96172; 90801; 96110; etc.] for example, were excluded from the patient identification algorithm). Patients who did not evidence any mental health claims or who only evidenced non-diagnostic claims, indicative of procedures used to initially make or rule out a specific diagnosis, were considered to be non-mental illness patients.

1.3. Measures

Patient demographic characteristics were assessed on January 1 of each calendar year (2012-2018) for each of the seven annual samples

and included age, age category (early childhood [4-8], middle childhood [9-11], and adolescence [12-17]), gender, and geographic region of residence as defined by the US Census Bureau [18] (northeast, north-central, south, west, and unknown). The incidence and prevalence of childhood mental illness was assessed within each calendar year-based sample. Period prevalence rates were calculated among the full sample of children eligible for each calendar year cohort by dividing the total number of patients in the mental illness sample by the full eligible calendar year sample. Incidence proportion calculations used the same approach as prevalence calculations but excluded children who evidenced any mental illness diagnosis in the prior year from both the numerator and denominators.

Annual all-cause direct medical costs were calculated based on paid amounts of adjudicated claims, including both insurer and patient paid components. All costs were reported as per-person per-timeframe (i.e., annual costs), and were inflated to 2019 US dollars using the medical care component of the Consumer Price Index [19]. Annual all-cause direct medical costs were compared between a random 5% subset of prevalent patients with at least one mental illness claim, and a randomly selected subset of directly age- and gender-matched children during each calendar year.

1.4. Statistical analysis

Descriptive statistics were reported for demographics, incidence and prevalence rates of mental illness diagnoses, and total medical costs. Incidence and prevalence rates of any mental illness, along with the presence of individual conditions, were calculated for each of the calendar year cohorts. Overall mental illness prevalence rates, in addition to the prevalence of individual conditions, were presented via gender and age groups over each of the seven calendar years. Nonparametric tests of proportional inequality were conducted to examine group differences.

For medical cost analyses, a random 5% subset of each of the annual samples were directly matched on age and gender to a comparator group of children without a mental illness diagnosis during the same time-period (year of interest and prior year). Annualized medical costs were compared between mental illness and matched non-mental illness cohorts using student's t-tests. For all analyses, continuous variables were summarized using means and standard deviations (SD), while categorical variables were reported using frequencies and proportions. MarketScan data were accessed using Treatment Pathways 4.0, and all analyses were conducted with SPSS v.25.0 (IBM, Armonk, NY).

2. Results

Approximately 2.4 to 4.1 million children were included in each of the seven-calendar year-based samples ([Table 1](#)). Demographic characteristics of the mental illness samples were similar across calendar years ([Table 1](#)). Adolescent patients (12-17 years) accounted for >50% of the prevalent mental illness population in all years; patients in early (4-7 years) and middle (8-11 years) childhood each comprised ~20% of the samples respectively ($p < 0.001$). The most common prevalent conditions were attention deficit/hyperactivity disorder, anxiety, depression, and developmental disorders; all other disorders had prevalence rates of less than 2%.

Steady increases in rates of overall pediatric mental illness were observed over the study period, with increases of 29.4% and 34.6% in incidence and prevalence rates respectively ([Fig. 1](#)). In the prevalent population, males accounted for a greater proportion of the sample in all calendar year cohorts; a decrease in the difference between genders was observed towards the end of the study period (59.2% in 2012 to 54.9% in 2018; $p < 0.001$). Within specific conditions, increases were also observed in the prevalence of depression (73.2% increase), anxiety (94.7%), attention deficit/hyperactivity disorders (20.0%), and developmental disorders (65.1%; [Fig. 2](#)). Gender differences emerged across

Table 1
Mental illness prevalence rates and patient characteristics for children with a mental illness calendar during each calendar year.

	Calendar Year 2012		Calendar Year 2013		Calendar Year 2014		Calendar Year 2015		Calendar Year 2016		Calendar Year 2017		Calendar Year 2018	
	Mental Illness Sample		Mental Illness Sample		Mental Illness Sample		Mental Illness Sample		Mental Illness Sample		Mental Illness Sample		Mental Illness Sample	
	N=448,414		N=374,853		N=400,320		N=360,813		N=368,228		N=359,836		N=361,088	
	Mean/SD/No.	%	Mean/SD/No.	%	Mean/SD/No.	%	Mean/SD/No.	%	Mean/SD/No.	%	Mean/SD/No.	%	Mean/SD/No.	%
Demographics														
Age	11.8	3.8	11.8	3.7	11.9	3.7	11.9	3.7	12.0	3.7	12.0	3.7	12.0	3.7
Age Category														
Early Childhood (4-8)	103,677	23.1%	84,641	22.6%	87,745	21.9%	77,652	21.5%	77,658	21.1%	74,992	20.8%	74,589	20.7%
Middle Childhood (9-11)	98,048	21.9%	81,384	21.7%	87,377	21.8%	77,306	21.4%	78,158	21.2%	75,579	21.0%	74,474	20.6%
Adolescence (12-17)	246,689	55.0%	208,828	55.7%	225,198	56.3%	205,855	57.1%	212,412	57.7%	209,265	58.2%	212,025	58.7%
Gender														
Female	182,734	40.8%	155,929	41.6%	169,546	42.4%	154,686	42.9%	160,414	43.6%	159,550	44.3%	162,942	45.1%
Male	265,680	59.2%	218,924	58.4%	230,774	57.6%	206,127	57.1%	207,814	56.4%	200,286	55.7%	198,146	54.9%
Geographic Region														
Northeast	98,825	22.0%	75,528	20.1%	80,526	20.1%	68,609	19.0%	71,549	19.4%	69,448	19.3%	73,099	20.2%
North Central	121,661	27.1%	94,521	25.2%	102,825	25.7%	77,150	21.4%	82,455	22.4%	83,328	23.2%	93,002	25.8%
South	159,201	35.5%	136,259	36.3%	160,659	40.1%	161,565	44.8%	161,929	44.0%	160,027	44.5%	144,915	40.1%
West	63,821	14.2%	65,293	17.4%	52,022	13.0%	50,791	14.1%	50,426	13.7%	45,086	12.5%	48,101	13.3%
Missing	4,906	1.1%	3,252	0.9%	4,288	1.1%	2,698	0.7%	1,869	0.5%	1,947	0.5%	1,971	0.5%
Mental Illness Diagnoses: Rates and Prevalence^a														
	Calendar Year 2012 Population N = 4,078,558		Calendar Year 2013 Population N = 3,221,265		Calendar Year 2014 Population N = 3,159,229		Calendar Year 2015 Population N = 2,747,918		Calendar Year 2016 Population N = 2,835,504		Calendar Year 2017 Population N = 2,590,314		Calendar Year 2018 Population N = 2,439,906	
Alcohol Abuse	6,661	0.2%	4,999	0.2%	4,873	0.2%	4,357	0.2%	4,677	0.2%	4,059	0.2%	3,625	0.1%
Substance Abuse/Dependence	17,797	0.4%	13,150	0.4%	13,767	0.4%	11,199	0.4%	8,761	0.3%	8,405	0.3%	8,219	0.3%
Depression	73,470	1.8%	65,383	2.0%	71,558	2.3%	66,549	2.4%	67,273	2.4%	70,183	2.7%	76,104	3.1%
Anxiety	150,266	3.7%	135,153	4.2%	154,722	4.9%	146,516	5.3%	158,719	5.6%	164,280	6.3%	175,051	7.2%
Bipolar Disorder	12,633	0.3%	9,583	0.3%	9,657	0.3%	8,775	0.3%	7,946	0.3%	7,190	0.3%	6,447	0.3%
Eating Disorder	4,803	0.1%	4,383	0.1%	4,637	0.1%	4,420	0.2%	4,199	0.1%	4,843	0.2%	5,617	0.2%
Attention Deficit/Hyperactivity Disorder	232,197	5.7%	191,467	5.9%	207,068	6.6%	186,950	6.8%	187,250	6.6%	174,819	6.7%	166,746	6.8%
Conduct Disorder	35,920	0.9%	29,499	0.9%	31,086	1.0%	33,351	1.2%	38,945	1.4%	37,684	1.5%	37,651	1.5%
Schizophrenia	540	0.00%	434	0.01%	418	0.01%	404	0.01%	457	0.02%	367	0.01%	435	0.00%
Developmental Disorder	56,369	1.4%	48,494	1.5%	56,232	1.8%	54,170	2.0%	54,123	1.9%	54,474	2.1%	55,660	2.3%

^a Specific mental illness prevalence rates are based on full calendar year denominators; sample sizes of the calendar year population reflect the total number of eligible patients included in the analyses regardless of mental illness status.

the four most diagnosed conditions (Fig. 3). Males were more likely to be diagnosed with attention deficit/hyperactivity over the study period (7.8% to 9.2% from 2012 to 2018) and developmental disorders (2.0% to 3.3%), while females were more likely to be diagnosed with depression (2.2% to 4.0%) and anxiety (4.7% to 8.5%). These gender differences persisted across some of the less common conditions, with females being more likely to be diagnosed with bipolar disorder (3.3-5.7-fold) and males being more likely to be diagnosed with substance abuse (1.4-1.5-fold) or schizophrenia (1.2-1.5-fold).

In all calendar years assessed, the presence of a mental illness was associated with annual direct medical costs that were nearly triple that of the control population and ranged from \$5,254±\$18,801 to \$6,258±\$83,157 for the mental illness cohort across years, to \$1,554±\$8,912 to \$1,825±\$15,881 for the matched, non-mental illness cohort across years (ps < 0.001 for all years; Fig. 4). For the most recent calendar year (2018), children with a mental illness presented a mean annual medical cost of \$6,226±\$27,967, while those without a mental illness diagnosis incurred \$1,674±\$7,480 in medical costs (t(26,976) = 18.3, p < 0.001, 95% CI of the difference [\$4,062, \$5,039]).

3. Discussion

Results of this study demonstrate increases in the rate of diagnosed mental illnesses within the pediatric population from 2012 to 2018. Further, children with mental illness diagnoses incurred significantly increased annual direct medical costs compared to children without such diagnoses. Adolescents (aged 12-17) presented the greatest risk of mental illness. Gender differences were identified across conditions, with males being more likely to exhibit attention deficit/hyperactivity and developmental disorders, and females more likely to present with anxiety and depression. This study provides one of the most up to date, real-world estimates of the changing prevalence and economic burden of diagnosed mental illness among the pediatric population in the US and provides further insight into age- and gender-specific trends underlying these estimates.

Although this study indicates a change in the underlying mental health of American children, there have been alterations in social and legislative constructs over the study period that could be partially responsible for the surge in mental illness diagnoses observed here. Increases in the ability and comfort level in assigning mental illness diagnoses to younger individuals have been reported over time, indicating a decrease in the stigma towards mental illness [20,21]. These changing

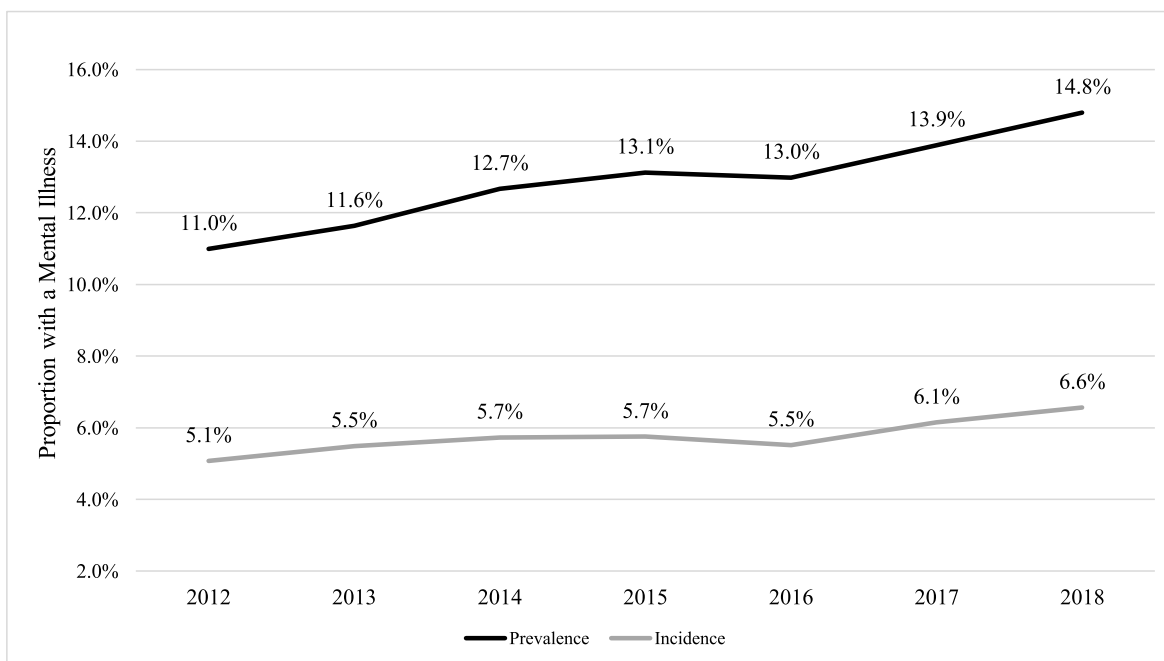


Fig. 1. Mental illness rates in children aged 4-17.

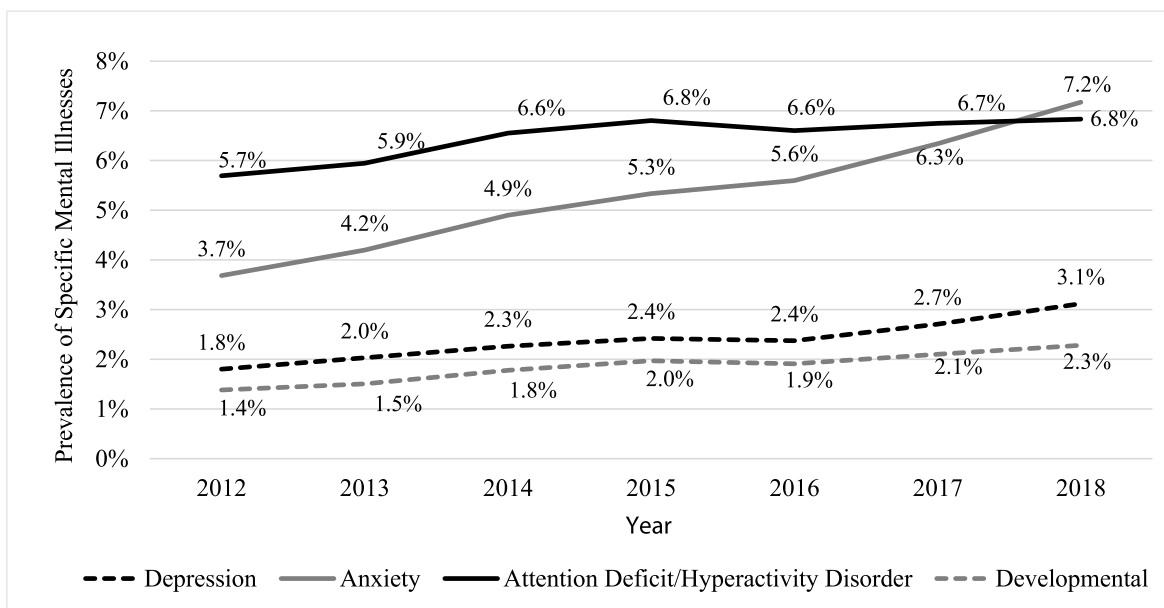


Fig. 2. Trends in specific mental illnesses over time.

attitudes may contribute to observed trends to some degree. Additionally, legislation passed in the period preceding the current study measurement window, including the Mental Health Parity and Addiction Equity Act of 2008 and the Affordable Care Act (2010, with major provisions enacted by 2014), have served to improve and expand mental health insurance coverage in the US. Although our analyses were limited to individuals with mental health insurance coverage, one cannot rule out that changes in mental health insurance coverage (reduced out of pocket payments, increased in-network providers, increased awareness of benefits, etc.) could have occurred even within this insured population. Therefore, present findings may also reflect an increase in the identification and diagnosis of these disorders; however, the continued upward trajectory throughout the study period, and beyond the initial period of expanded coverage via the Affordable Care Act, suggests that

multiple factors contribute to the trend of increased mental illness diagnoses. Further analyses are warranted to investigate trends in the rate of these diagnoses within the pediatric population. This is especially critical given the recent disruptions to normal daily activities due to the COVID-19 pandemic, as research has demonstrated increased rates of depression and anxiety among children who have been socially isolated [22]. Additionally, investigations in individuals with Medicaid or other non-commercial insurance are warranted and may elucidate the potential impacts of insurance coverage on mental illness diagnosis rates.

The current study estimated a prevalence of diagnosed pediatric mental illness of 11.0%-14.8% from 2012 to 2018; these results are generally comparable to previously published nation-wide estimates [7, 8,23]. Of particular public health concern are the observed increases in both the incidence (+29.4%) and prevalence (+34.6%) of diagnosed

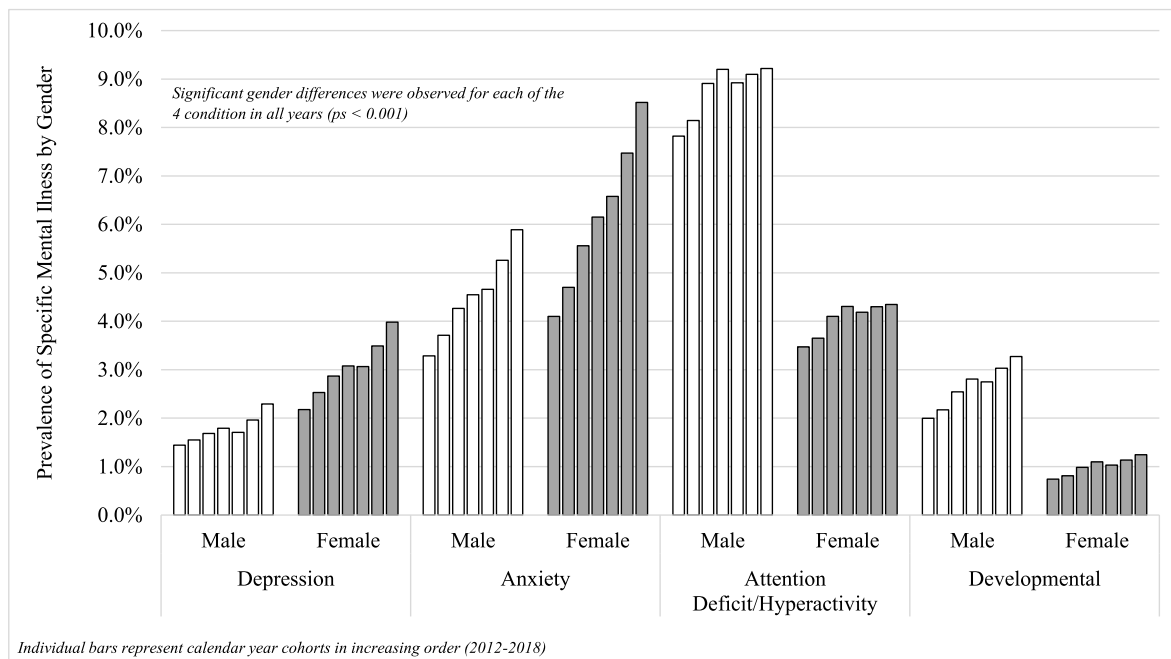


Fig. 3. Gender differences across specific mental illnesses.

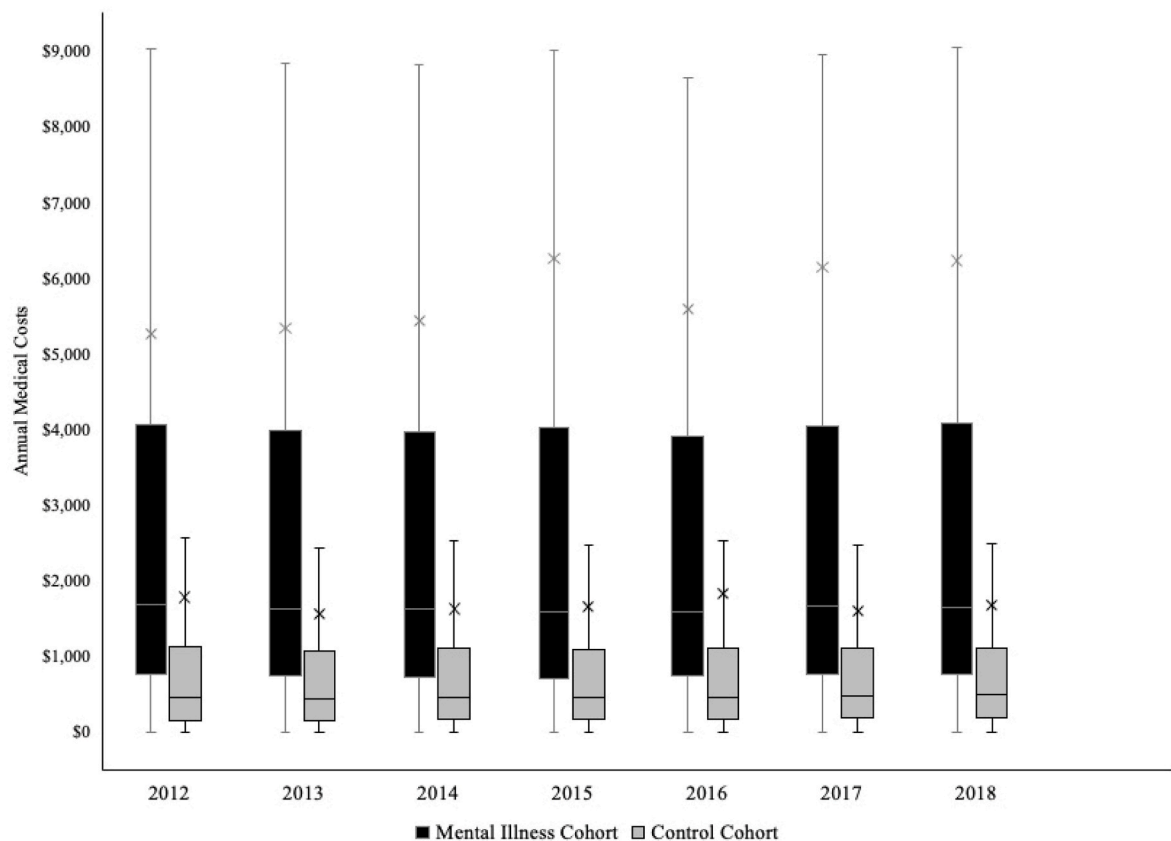


Fig. 4. Healthcare costs associated with mental illness

Line segmenting each bar represents median cost value, while “x” represents mean cost value.

1st and 3rd quartiles represented by the highest and lowest points in each bar.

The positive tail end of the whisker has been set to 1.5*IQR, as the cost distributions are skewed positive.

Data in Fig. 4 are derived from a 5% random sample of each mental illness calendar year sample directly matched on age and gender to a non-mental illness comparator group.

pediatric mental illnesses in this analysis. Other studies have also provided evidence that pediatric mood disorders have been on the rise for some time now. Results from the National Survey on Drug Use and Health found a 52% increase in depressive episodes from 2005 to 2017 [24]; similarly, the National Survey of Children's Health revealed childhood anxiety rates increasing from 3.5% in 2007 to 4.1% in 2012 [25]. The present analyses align with these trends, having demonstrated a 73% increase in the rate of depression and a 95% increase in anxiety from 2012 to 2018. Although dissimilarities in methodologies and data sources across investigations may account for variations in the magnitude of change in the rates of mental illness, the consistent trend of continued overall growth in the rate of mood disorders amongst children across sources suggests a legitimate mental health concern within this population, and warrants further exploration. Gender differences observed in the present study also replicate longer-standing trends. Results from the National Health and Nutrition Examination Survey study of the prevalence of mental disorders among children demonstrated that boys were more than twice as likely as girls to present attention-related disorders, whereas girls were more than twice as likely to present a mood disorder [26], patterns which were both observed in the present study.

Although this study cannot address the underlying cause of the increasing prevalence of diagnosed mental illnesses in children observed here, numerous trends in behaviors associated with mental illnesses have been documented and may provide some context for the present findings. US culture is placing an increased value on extrinsic versus intrinsic motivations for achievement that is partially driven by ubiquitous social and electronic media. This extrinsic, validation-seeking focus has been associated with negative academic and psychological health consequences, and could be playing a role in mental health diagnosis rates [27–30]. Although the present study could not identify a causal role of social media, the societal trends which overlap with the time period of the current analyses are indicative of a potential relationship. Rates and duration of social media participation have notably increased over the study period, with estimates indicating the average teenager spending greater than 7 hours per day on their smartphone [31, 32]. Further, a number of reviews have reported mental health-related consequences associated with the overuse of social media including cyberbullying, depression, anxiety, and social isolation [33]. Future research should attempt to examine the relative contributions of each of the aforementioned risk factors, in addition to any possible interaction effects, as they relate to the onset of a mental illness, as this information may aid parents, teachers, and clinicians alike in identifying those children at the highest risk.

There are several limitations of note when interpreting results from the current study. First, this study was limited to individuals with commercial US health coverage; results may not be generalizable to children with mental illness with other types of insurance or without health insurance coverage altogether; thus, as previously mentioned, further analyses to investigate trends in mental illness diagnoses among children with non-commercial insurance coverage are warranted. Similarly, this study limited analyses to children who additionally had mental health and substance abuse coverage; thus, future studies should consider not just overall medical insurance, but also the status of these specific insurance benefits. Misclassification of patients and calculation of study outcomes was possible as patients were identified through administrative claims data instead of medical records; these data are subject to data coding limitations and data entry error. The current study employs a minimum period of 24 months of continuous enrollment. Patients who lose coverage or die will likely have a follow-up period less than 24 months and therefore will be excluded from the analysis. As such, a subset of the most severe patients (depressive patients with a history of hospitalizations from suicide attempts) may not be captured. Further, as cases in this study are based on billed diagnoses, it is likely that rates of mental illness presented here are still underestimates, as a significant proportion of children with a mental illness continue to go

untreated [7]. Finally, as stated earlier, given the increased comfort level in assigning mental illness diagnoses to younger individuals [20, 21], coupled with successful legislative efforts to expand mental health coverage in the early 2010s [34,35], it is difficult to identify precise drivers of the increasing rate of mental illness diagnoses among children. However, the continuation of this increasing trend in the years following the initial passage of the major legislation indicates trends may be more than a result of expanded coverage and warrants further investigation into specific causal factors.

This study utilized administrative claims to provide an up-to-date, real-world assessment of the incidence and prevalence of mental health diagnoses in children over time. Results of the present study demonstrate that mental illness diagnoses have been increasing among US children over the period from 2012 to 2018. In addition to the impact that mental illness can have on children's quality of life and social development, the increased healthcare costs incurred by these children place a notable burden on the healthcare system. The scope of this burden may be far greater than presented here. First, underdiagnosis of mental illnesses in the pediatric population has been reported; thus, the rate of mental illness defined here is likely an underestimate. Secondly, as this investigation focused on children, it is likely that the mental illness comorbidity burden established in childhood will influence their health status and interactions with the healthcare system for years to come. Due to the potentially wide reaching burden of mental illness in the US, continued efforts to understand physical, familial, and societal factors linked to mental illness are needed, along with continued awareness, improved identification and diagnosis, and enhanced management of these conditions. Each of these factors will be critical to managing this burgeoning pediatric public health crisis.

Contributor's statement

Joseph Tkacz and Brenna Brady conceptualized and designed the study, conducted the analyses, interpreted the results, and drafted/revised the manuscript. Joseph Tkacz and Brenna Brady approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Author statements

The authors received no funding for this research and report no conflicts of interest. As this study used only de-identified patient records and did not involve the collection, use, or transmittal of individually identifiable data, Institutional Review Board approval to conduct this study was not necessary.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.puhip.2021.100204>.

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