Pediatric and adolescent mood disorders: An analysis of factors that influence inpatient presentation in the United States

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ABSTRACT

Background: Mental health is an essential aspect of health and wellbeing that the general population often overlooks. This study aims to utilize a nationwide sample [Healthcare Cost and Utilization Project (HCUP) Kid's Inpatient Database (KID)] to analyze the factors affecting inpatient mood disorder admissions in the United States.

Methods: A total of 295,472 cases ages 1—20 were identified to meet the criteria (Appendix A) for the selected mood disorders from the HCUP KID 2016 dataset. We conducted descriptive statistics of the individual diagnosis. We evaluated the relationships with variables such as age (grouped), sex, region, disposition, household income, race, rural-urban demographics, and mean charges. We also conducted association tests for the variables of interest.

Results: An average of six days LOS was observed for mood disorders compared to four days LOS for other pediatric inpatient admissions nationwide. The highest prevalence rate (per 100,000) of single (5050), recurrent (2284) episode MDD and bipolar disorder (2445) was observed among no charge (uninsured) populations. The native American population had the highest rate prevalence of single episode MDD (3274) and highest extreme and significant loss of function at presentation. The highest manic episode presentation rate was observed among Black (12) and Native American (9) populations. Manic episodes and bipolar disorder were higher among young adults (47 and 4554); teenagers (13—17) showed a higher presentation rate for all other mood disorders.

Conclusion: No charge (uninsured), teenagers (13—17), females, native Americans, and south and midwest regions showed a higher rate of mood disorder presentations among the population. Understanding these variances could play a vital role in highlighting the need for new innovative care approaches. Comprehensive mental health programs in collaboration with educational and community organizations and other stakeholders could be vital to addressing mood and mental health among these populations. This approach tackles several social influencers such as stigma and support to ensure effectiveness and sustainability.conclusion.

1. Introduction

Pediatric and adolescent mental and psychological health is an essential aspect of health and wellbeing that health-care providers and the general population have often overlooked. Global estimates from the World Health Organization indicate that roughly 10—20% of adolescents experience mental health conditions [1]. In the United States, mood disorders are among the leading causes of mortality and morbidity among pediatric and adolescent populations [2]. Additionally, mood disorders in children consist of some of the most debilitating categories of emotional and behavioral disturbances in youth, resulting in academic, social, and interpersonal relationship difficulties [3]. These trends necessitate careful evaluation and concerted effort with multiple stakeholders to address this problem. Several studies have established the

relationship between mood, psychological disorders, and other medical and health conditions [4,5]. These populations' medical and psychological changes are often exhibited by acting out and changes in behavior that directly or indirectly impact their well-being and health in general [6]. The presence of multiple risk factors has been shown to directly impact these presentations [7]. Factors such as conformity with peers, autonomy, sexual exploration, and ease of communication via social media and other technology directly impacts the outcomes of mood disorder presentations in these populations [3,8]. The likelihood of inpatient presentation and potential comorbidities directly or indirectly impacts these patients' socioeconomic outlook [9].

The prevalence of other psychiatric comorbidities, including family history and irritability, is likely to be observed for those presenting with manic episodes and other mood disorders [10]. The ability to effectively diagnose variances in performance and factors that impact such presentations needs to be adequately studied to develop effective approaches in addressing them. Persistent irritability and lack of adequate mitigation efforts often lead to violent outbursts with potentially dangerous consequences to patients and society [11]. Many studies have shown an increased rate of bipolar diagnosis in the pediatric and adolescent population [12—14]. Multiple factors show an impact in the prevalence of pediatric bipolar, including an increase in diagnosing and recognition, side effects of stimulant medications, and changes in diagnostic criteria [15]. The chronic nature of these conditions [16] makes it imperative for timely diagnosis and treatment.

An estimated 2—5% of children and adolescents experience significant depression [17]. The presence of a family history of emotional or psychological difficulties plays a significant factor in the prevalence of these psychiatric presentations [18]. The lack of active engagement and of a concerted effort to recognize and treat depression among this population risks escalating recurrence and worsening of other health problems. Given the full range of presentation of depression, a provider-educator-parent partnership must develop multifaceted strategies to encourage youth discussion and openness about their feelings and experiences. A significant percentage of those who experience a single episode are likely to have recurrent events in the future [6]. The interconnectivity between these psychiatric disorders necessitates a concerted effort to create a multifaceted support system for these populations. Adolescents diagnosed with Major Depression Disorders (MDD) have been found to have neurocognitive impairments as part of a varied range of health issues that arise or worsen due to this comorbidity [19]. Research has shown that individuals with persistent depression had frequent health-care resource utilization and increased care costs [20]. There has been consistency regarding the presence of depression and comorbidities; moreover, the lack of effective coordination between primary care and mental health services impacts health outcomes. These comorbidities have been shown to lead to "hidden prevalence, underdiagnosed, and undertreated depression, especially in the underserved populations" [21].

It is estimated that over 43 billion dollars can be associated with the care for depression in the United States [22]. Mood disorder presentations with comorbidities such as mania and depression have been shown to present with a worse prognosis. Distinguishing between mood disorders and creating an effective plan for screening in a primary care setting is imperative in improving overall health outcomes in these populations. The impact of developmental factors plays a vital role in these mood disorders in the pediatric and adolescent population. Furthermore, these presentations often negatively affect their social, environmental, family, and academic activities [23]. Several approaches are effective in treatment for these populations [24]. A multifaceted

approach must be taken to ensure adequate resources to aid in addressing such a problem.

This research is focused on evaluating the inpatient rates of adolescent and pediatric mood presentations and factors that directly or indirectly impact these presentations. Understanding these factors will help implement innovative approaches to care that are targeted at this age group.

2. Methods

We included 295,472 cases that met the inclusion criteria based on ICD 10 codes for each of the mood disorders (Appendix 1) in the Kid's Inpatient Dataset (KID 2016). The KID 2016 includes only ICD-10 data elements for inpatient presentations. The dataset consists of 44 states, which makes up a significant majority of inpatient presentations across the country.

2.1. Study cohort

We included all patients with the diagnosis described in Appendix 1 and aged between 1 and 20 years with a primary or secondary diagnosis of the selected mood disorders.

2.2. Analysis

We conducted descriptive statistics of the individual diagnosis (Appendix A). We evaluated the relationships with variables such as age (grouped), sex, region, disposition, household income, race, rural-urban demographics, and mean charges. Disease severity and mortality for all patients grouped by age, race, location and income were further analyzed. We also conducted a logistic regression to evaluate the predictors of presentation for each diagnosis. All analyses were performed with weights per HCUP guidelines. All variable analysis was performed with IBM (IBM Corp., Armonk, NY) Statistical Package for Social Sciences (SPSS) Version 23. Power BI (2019; Microsoft Corporation, Redmond, WA) to calculate the rates of presentation and graphs.

3. Results

A total of 295,472 cases were identified as meeting the criteria for the selected mood disorders based on ICD-10 classification. Of the total included in this study, recurrent MDDs, Bipolar disorders, and single episodes of MDD comprised the highest numbers of cases, presenting with 22%, 19%, and 46% of the total number of cases, respectively. As shown in Fig. 1, young adults (18—20 years) and females had the highest bipolar presentation rates of 4555 and 1042 per 100000 hospitalizations, respectively. Teenagers within the 13-17-year group had the highest rates of a single (68275) and recurrent MDD (36035) and unspecified mood disorder (13548) diagnosis. Unspecified mood disorder presentations were similar among pre-teens and young adults, while the highest presentations were seen among teenagers (13—17) and men at a rate of 2678 and 459 per 100,000 presentations, respectively. Further analysis also indicated a statistically significant difference ($P < .001$) in Length of Stay (LOS) for mood disorder presentation (Pre-Teen = 7, Teenagers = 6, Young Adults = 6) compared to the general population (Pre-Teen = 4, Teenagers = 4, Young Adults = 4). Females showed the highest presentations in all categories, except with manic episodes and unspecified mood disorders, as shown in Fig. 1. Single and recurrent MDD presentations showed the highest variance in presentations between males and females.

Evaluation of patient disposition showed that most of the patients were discharged routinely after receiving inpatient medical care. A significant percentage also discharged themselves against
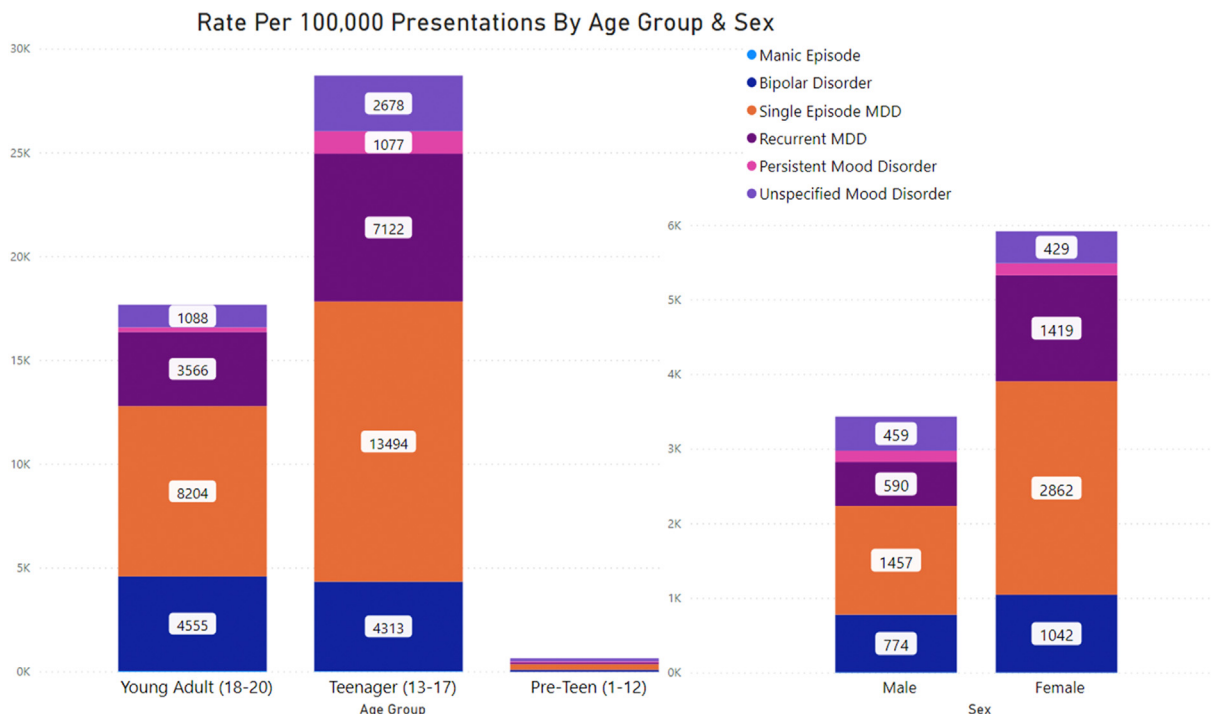
Fig. 1. Rate per 100,000 presentations by age group & sex.

medical advice. Table 1 shows that the highest mortality was observed among patients with a single episode of MDD and bipolar disorder with 238 and 66 cases, respectively. Table 1 also shows higher mortality and discharges against medical advice rates among single episode major depression and bipolar compared to other diagnoses. Individuals diagnosed with depression were more likely to be transferred compared to other mood disorders.

3.1. Income by zip code

The presentation rate was generally evenly distributed across income demographics, as depicted in Fig. 2. Single, recurrent MDD and bipolar disorders had the highest rates across all income groups. The lowest income groups showed a higher presentation of bipolar disorder with a rate of 920 and 930 compared to 885 and 887 per 100000 hospitalizations among high-income groups. Recurrent MDD prevalence was ubiquitous across income classification, with about 16000 cases in every income category. An average of 6 days LOS was observed for mood disorders compared to 4 days LOS for other pediatric inpatient admissions nationwide. Payer demographics also differed significantly ($P < .001$) compared

to the general population with Medicaid (47%), private insurance (45%), other (4%), and self-pay (3%), among mood disorder presentations. As shown in Fig. 2, the highest rates of presentations for all mood disorders were among the population without health insurance categorized as no charge, followed by Medicare recipients.

3.2. Race

As shown in Table 2, the race demographics indicate a higher single and recurrent MDD presentation rate among native Americans and Whites, followed by Blacks, Hispanics, and Other and Asians. The rate of bipolar and manic episodes among the population was significantly higher among White and Black populations than other racial demographics. Further analysis shows a higher LOS (days) for Native Americans (9), Asians, and Pacific Islanders (7) compared to other races with an average LOS of 6 days. The rate of severity presentation varied considerably by race and region. The Native American population shows a higher rate of severity presentation relative to population size with extreme loss of function and significant function loss. Extreme mortality risk was observed

Table 1
Patient disposition by mood disorder.

Patient disposition	Manic episode	Bipolar disorder	Single episode major depressive disorder	Recurrent major depressive disorder	Persistent mood disorder	Unspecified mood disorder
Routine	449	49459	116003	57306	8979	24826
Transfer to short-term hospital	11	836	2152	676	98	376
Against medical advice (AMA)	64	5221	13938	4899	556	2061
Home health care	3	507	2294	237	46	174
Against medical advice (AMA)	6	948	1792	476	86	262
Died	0	66	238	11	1	15
Discharge alive, destination unknown	0	0	3	1	0	0

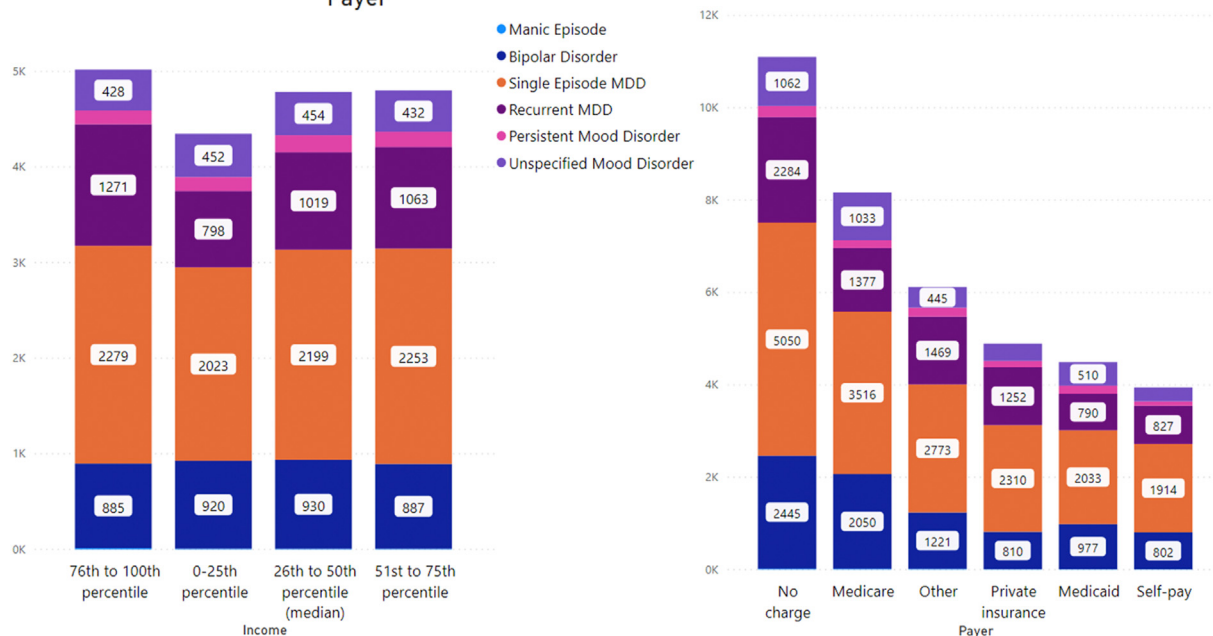Rate Per 100,000 Presentations By Median Household Income & Payer

Fig. 2. Rate per 100,000 presentations by median household income & payer.

Table 2
Race by mood disorder.

Race	Manic episode	Bipolar disorder	Single episode major depressive disorder	Recurrent major depressive disorder	Persistent mood disorder	Unspecified mood disorder
White	260	33756	77089	39344	5399	15064
Black	108	10487	19550	6620	1859	5428
Hispanic	61	5992	18140	6816	982	3179
Asian or Pacific Islander	13	735	2440	1199	130	308
Native American	4	317	1572	616	94	175
Others	33	2160	5059	2247	339	1138

among Native Americans and the White population.

3.3. Region & Rural-Urban Classification

Mood disorder presentation varied by region, with the highest rate presentation in all diagnostic categories found in the Midwest, as shown in Fig. 3. Average of LOS (Days) also varied with Northeast (7), Midwest (5), South (6), and West (6) for patients with mood disorders and an average of 4 LOS (days) for non-mood disorder hospitalization. Extreme loss of function rate was high in the Midwest, West, Northeast, and South. Presentation by region varied considerably, with a higher presentation of single and recurrent depression in the Midwest, Northeast, South, and West. The Northeast witnessed a higher manic episode and was the third highest in both single and repetitive MDD presentation. The Western part of the country had the lowest inpatient presentation in every mood disorder diagnosis, as observed in Fig. 3.

Fig. 4 provides an overview of presentations in a rural-urban setting. The rate of manic episodes among the population was primarily the same across the classification areas. Metropolitan areas with 50,000—250,000 population size had a higher presentation of single and recurrent MDD and the second-highest bipolar disorder rate (1030 per 100,000) presentations. Higher mortality and severity risk at presentation were observed among smaller

micropolitan and rural areas than large urban centers. Most of the population presented with a moderate and significant loss of function, as shown in Fig. 5. The rate of major and extreme loss of function was high among White (7266 & 5174) and Native Americans (6594 & 4952). Further analysis of severity at presentation shows a higher rate of major and significant loss of function among the highest income demographics (51st to 75th & 76th to 100th income percentiles).

Table 3 shows a higher charge for patients with manic episodes of single MDD presentations with $39,287 and $31,182, compared to the general pediatric population. There are minor differences in the charges (bipolar, persistent & unspecified mood disorders) for other diagnoses compared to the general population given the very small percentage of mood disorders. These charges associated with presentations are much higher than the most frequent reasons for pediatric inpatient presentations, as shown by other studies [25—27].

4. Discussions

Understanding the prevalence of mood disorders in children and adolescents is imperative in developing effective strategies for providing quality care to these patient populations. Given that the highest prevalence is observed among teenagers (13—17 years) and
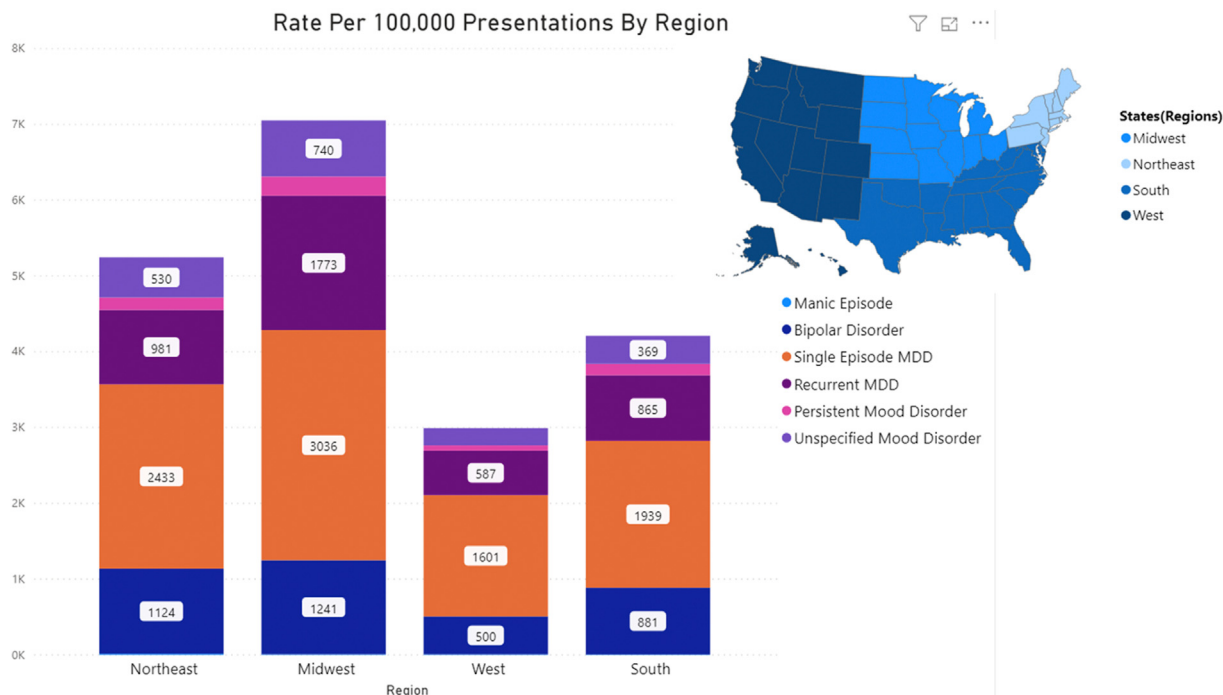
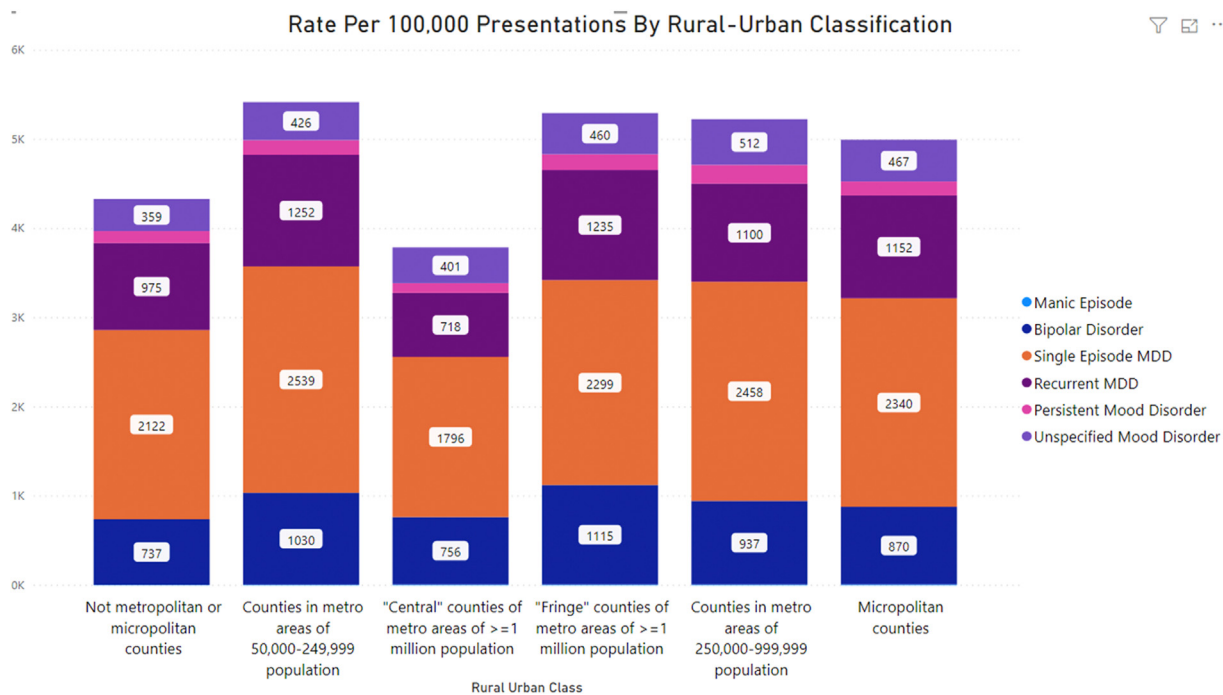**Fig. 3.** Rate per 100,000 presentations by region.

Fig. 4. Rate per 100,000 presentations by rural-urban classification.

females, a concerted public and population health are needed to ensure adequate education on the subject matter, as indicated by several researchers [3,28,29]. Teen targeted approaches are likely to aid in addressing self-care and better disease management to prevent inpatient hospitalizations. The relatively high number of individuals that discharge themselves against medical advice across all age groups supports the need for concerted local and national educational efforts on psychological disorders among the

pediatric population. Several studies have found a relationship between severity and increased re-admission likelihood in populations that discharge against medical advice [30,31]; this calls for a combined population and public health approach to improving education and understanding such decisions, especially in the pediatric and adolescent population. The mortality and morbidity rate stratified by race and income points to specific demographics disproportionately impacted [32–34].
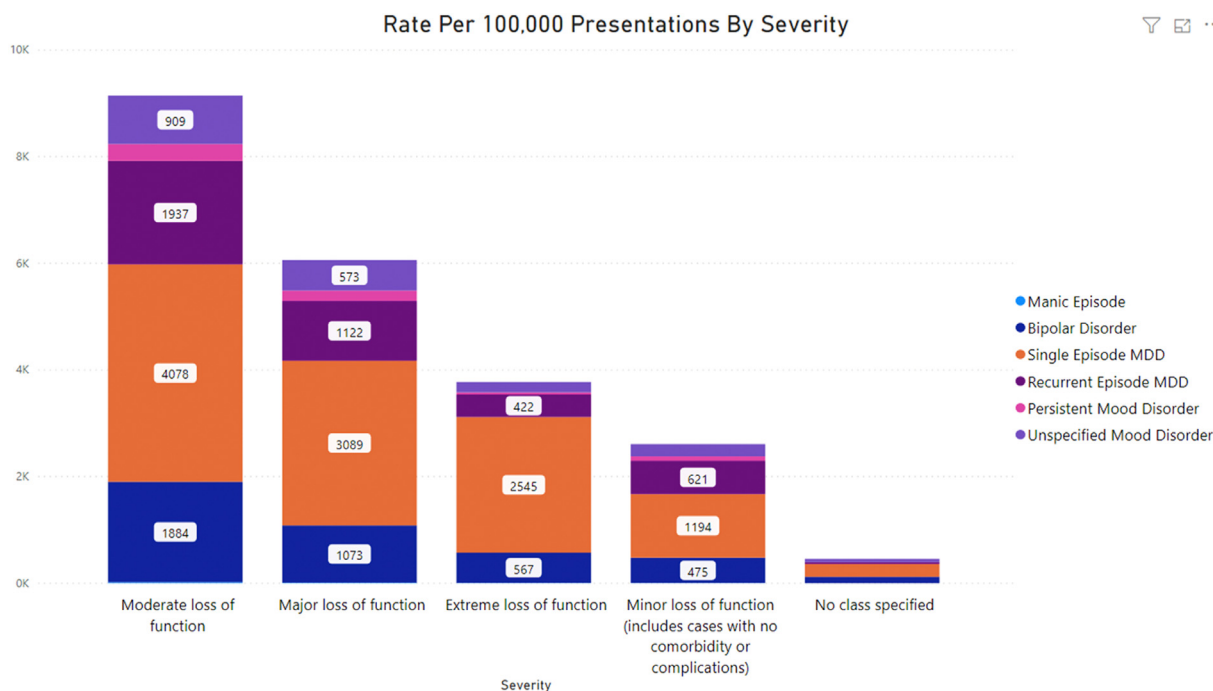
Fig. 5. Rate per 100,000 presentations by severity.

Table 3
Mean charges by mood disorder.

Mood disorder	Mean ($)	N	Total N (%)
Manic episode			
Not selected	28,631	6113842	100.0
Selected	39,285	530	0.0
Bipolar disorder			
Not selected	28,647	6057595	99.1
Selected	27,093	56777	0.9
Single episode major depressive disorder			
Not selected	28,575	5978987	97.8
Selected	31,182	135385	2.2
Recurrent major depressive disorder			
Not selected	28,712	6051302	99.0
Selected	21,027	63070	1.0
Persistent mood disorder			
Not selected	28,639	6104652	99.8
Selected	24,238	9720	0.2
Unspecified mood disorder			
Not selected	28,648	6086780	99.5
Selected	25,159	27592	0.5

The variance in the rate of mood disorder presentation by race requires further studies to ascertain the influence of nature [35] (genetics) and nurture (social, environment) on disease prevalence [36,37]. Given the disproportionality of health resources availability across the United States [38], the creation of educational programs that educate and empower minority women and youth would be valuable in addressing mood disorders [39]. The longer LOS and higher severity observed among specific populations (such as Native Americans) supports the idea that more investment in such communities is needed to improve health outcomes [40]. Higher mortality and morbidity (severity) rates in small metropolitan and rural areas further support the notion of health-care inequities and their impact on patient outcomes [41]. The income gap observed in disease presentation also supports the relationship between social determinants of health and mental health [33].

The Payer demographics findings support the notion that governmental funds (Medicaid and Medicare) pay for a significant proportion of the disease burden [42]. The utilization of emergency medical services by region for such presentations shows the need for concerted efforts in certain parts of the country to provide preventive behavioral and psychological care to these populations. As shown in Table 3, the cost variance early indicates a higher cost burden for individuals with specific mood disorders than for the general population; this finding is supported by other studies on the increasing cost of mental health services in the United States [43]. It is imperative to develop local and national comprehensive pediatric and adolescent mental health educational programs [44–47]. Such programs should be directly related to school curricula to ensure adequate education and minimize stigma and shame associated with such medical conditions.

5. Conclusion

Several factors influence pediatric and adolescent mood disorders in inpatient admissions. Understanding these variances could play a vital role in highlighting the need for new innovative care approaches. The lack of sufficient programs tailored to provide care to children and adolescents directly impacts health-care outcomes and hence cost of care, as demonstrated by this study. Factors such as region, age, income, sex, rural-urban, payer, severity, mortality, and LOS play a role in the likelihood of inpatient presentation. Comprehensive mental health programs in collaboration with educational and community organizations and other stakeholders are vital to addressing mood and mental health among this study population. Such an approach should tackle several social influences such as stigma and support to ensure effectiveness and sustainability. Health policymakers need to note that about 50% of mood disorder presentations were identified through ER visits across all regions and rural-urban demographics. Such findings call for a reevaluation of current health-care policy on comprehensive care to the pediatric and adolescent population, especially regarding mental health. More work needs to be done on mental health for pediatric, adolescent, and early adult populations across

the country. Approaching such essential issues through a community and population health perspective could hold the key to providing quality care to these populations.

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Ethical approval

This article does not contain any studies involving human participants performed by any of the authors.

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CRediT authorship contribution statement

Saanie Sulley: Conceptualization, Methodology, writing, and data, Formal analysis, Visualization. **Memory Ndanga:** Data, Formal analysis, Writing - review & editing. **Nana Mensah:** Data, Formal analysis, Writing - review & editing.

Declaration of competing interest

The authors declare no conflict of interest.

Appendix A. ICD 10 CM Inclusion Criteria

Description	ICD-10 Code
1. Manic episode without psychotic symptoms	F30.XX
2. Bipolar disorder	F31.XX
3. Major depressive disorder, single episode	F32.XX
4. Major depressive disorder, recurrent	F33.XX
5. Persistent mood [affective] disorders	F34.XX
6. Unspecified mood [affective] disorder	F35.XX

Appendix B. Chi-Square Results

Variables of Interest	Mood Disorder		P-value (Sig)
Inclusion (N-weighted)	Selected (%)	Not Selected (%)	
Manic Episode	533 (0)	6265752 (100)	
Bipolar Disorder	57119 (1)	6209166 (99)	
Single Episode MDD	136582 (2.2)	6129703 (97)	
Recurrent MDD	63685 (1)	6202600 (99)	
Persistent Mood Disorder	9779 (0.2)	6256506 (99)	
Unspecified Mood Disorder	27775(0.5)	6238509 (99)	
Mean Age (years)	16	4	<0.001
Disposition			<0.001
Sex (%)			
Female	2.9	49	
Male	1.6	47	<0.001
Race (%)			
White	2.8	48	

(continued)

Variables of Interest	Mood Disorder		P-value (Sig)
Inclusion (N-weighted)	Selected (%)	Not Selected (%)	
Black	0.7	16	
Hispanic	0.6	20.6	
Asian or Pacific Islander	0.1	4.8	<0.001
Native American	0.0	0.8	
Other	0.2	5.9	
ER Utilization (%)			
ER Code Present	2.2	17	
ER Code Not Present	2.3	79	<0.001
Hospital Region (%)			
Northeast	0.8	16	
Midwest	1.4	20	
South	1.6	38	
West	0.7	22	<0.001
Primary Payer (%)			
Medicare	0.0	0.4	
Medicaid	2.1	47	
Private Insurance	2	41	
Self-Pay	0.2	4	<0.001
No charge	0.0	0.1	
Other	0.2	3.1	
Rural Urban Code (%)			
"Central" counties of metro areas of ≥ 1 million population	1.2	32	
"Fringe" counties of metro areas of ≥ 1 million population	1.2	22	
Counties in metro areas of 250,000—999,999 population	1	20	
Counties in metro areas of 50,000—249,999 population	0.4	8	<0.001
Micropolitan counties	0.4	8	
Not metropolitan or micropolitan counties	0.2	5	
Median Household Income (%)			
0-25th percentile	1.3	29	
26th to 50th percentile (median)	1.1	24	
51st to 75th percentile	1.1	23	<0.001
76th to 100th percentile	1	20	
Severity Risk (%)			
No class specified	0.0	0.1	
Minor loss of function (includes cases with no comorbidity or complications)	1.5	60	
Moderate loss of function	2.3	24	
Major loss of function	0.6	9.3	<0.001
Extreme loss of function	0.1	2.2	
Mortality Risk (%)			
No class specified	0.0	0.1	
Minor likelihood of dying	4.1	87	
Moderate likelihood of dying	0.3	5.3	
Major likelihood of dying	0.1	2	
Extreme likelihood of dying	0.0	0.9	<0.001

Appendix C. Regression Results

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
1 (Constant)	.044	.000		89.478	.000	.043	.044
Disposition of patient (uniform)	.006	.000	.040	94.972	.000	.006	.006
Indicator of sex	.025	.000	.059	142.121	.000	.024	.025
HCUP Emergency Department service indicator	.031	.000	.115	272.953	.000	.031	.031
Region of hospital	-.012	.000	-.056	−132.775	.000	-.012	-.011
Primary expected payer (uniform)	.003	.000	.011	24.657	.000	.002	.003
Patient Location: NCHS Urban-Rural Code	.002	.000	.016	36.392	.000	.002	.002
Race (uniform)	-.007	.000	-.048	−111.298	.000	-.007	-.007
Median household income national quartile for patient ZIP Code	.002	.000	.012	27.029	.000	.002	.002

a. Dependent Variable: MOODDisorderALL

Visual abstract

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijpam.2021.01.002.

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