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Research paper

Trends in diagnosis of bipolar and disruptive mood dysregulation disorders in children and youth

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ABSTRACT

Objective: : Rates of pediatric bipolar disorders have increased and some are concerned about diagnostic accuracy. Disruptive mood dysregulation disorder (DMDD) was added to the DSM-5 in 2013. The purpose of this study was to assess diagnostic trends of bipolar disorders and DMDD and to identify predictors of receiving the DMDD diagnosis since implementation of DSM-5.

Method: : Kentucky Medicaid claims from 2012–2017 for children under 18 years (N = 814,919; 2012 n = 473,389; 2013 n = 470,918; 2014 n = 499,094; 2015 n = 517,199; 2016 n = 529,048; 2017 n = 535,814) were used. Logistic regression was used to identify predictors of a diagnosis of DMDD in 2015–2017 for a subsample (n = 5,071).

Results: : The use of DMDD rose after 2013 and mood disorder NOS decreased steadily through 2017. This decrease was seen when there was a diagnosis of bipolar and oppositional defiant disorder (ODD) combined with mood disorder NOS. A diagnosis of only mood disorder NOS in 2012 did not predict DMDD in 2015–2017, but the same diagnosis in 2013 was predictive (OR 2.14, p = 0.049). The reverse is true for a diagnosis of only ADHD in 2013, which did not predict DMDD in later years, but its presence in 2012 was predictive (OR 1.36, p = 0.010).

Conclusions: : DMDD increased after 2013, and this was associated with a diagnosis of mood disorder NOS, ADHD, as well as with bipolar disorders comorbid with ODD. Given the complexity of comorbid diagnoses, DMDD may be more accurate in classifying some children. Administrative claims data have limitations, which are discussed; and the data represent only children living in Kentucky.

1. Introduction

The diagnosis of pediatric bipolar disorder rose substantially for 20 years before stabilizing around 2010. Using data from the National Hospital Discharge Survey, Blader and Carlson found that the rate of hospital discharges of youth with a primary diagnosis of bipolar disorder increased nearly 300% for adolescents (14 to 18 years old) and more than 400% for children (5 to 13 years old) between 1996 and 2004 (Blader and Carlson, 2007). Similarly, Moreno and colleagues found that the percentage of outpatient psychiatric care visits that included a diagnosis of a bipolar disorder among youth aged 0 to 19 years increased from 0.42% to 6.67% between 1994 and 2003 (Moreno et al., 2007). The increase in rates of bipolar disorder in children has been controversial and it remains unclear whether this trend represented an increase in recognition, an increase in incidence, or a broadening of the application of the diagnostic criteria.

The Diagnostic and Statistical Manual (DSM) of Mental Disorders criteria for bipolar disorder requires at least one lifetime manic episode (bipolar 1) or both a hypomanic episode and a major depressive episode (bipolar II) (American Psychiatric Association DSM-5 Task Force, 2013). The most widely reported symptoms of pediatric bipolar disorder (PBD) include increased energy, irritable mood, and

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grandiosity. The increased prevalence of PBD may have occurred as a result of children receiving the diagnosis for mood irritability and behavioral outbursts. The DSM-5, released in 2013, attempted to address this diagnostic dilemma with the creation of disruptive mood dysregulation disorder (DMDD) (American Psychiatric Association DSM-5 Task Force, 2013). DMDD is characterized by severe, recurrent temper outbursts and chronically irritable mood that should not be diagnosed before the age of 6 and with symptoms present for at least 12 months. One of the primary differences between the two diagnoses is that PBD is episodic in nature with distinct intervals of worsening behavior, while DMDD has mood irritability as a chronic trait.

The community prevalence rates of DMDD in youth aged 2 to 17 years is estimated to be 0.8% to 8.2% (Copeland et al., 2013; Dougherty et al., 2014) with the highest comorbid diagnoses of depression and oppositional defiant disorder (ODD). DMDD at age 6 has been predicted by early diagnoses of ODD, attention deficit hyperactivity disorders (ADHD), and temperamental signs of dysregulation and negative emotional intensity (Dougherty et al., 2017, 2014). Common comorbidities include anxiety/mood problems and disruptive behaviors (Rao, 2014).

Rates of subthreshold mental health diagnoses increased dramatically between 1999–2002 and 2007–2010 and are felt to reflect practices of providers under time pressure to diagnose and treat mental health conditions (Safer et al., 2015). During this time, rates of diagnoses of mood disorder, not otherwise specified (NOS); and bipolar disorder NOS increased markedly. Trends in the diagnosis of pediatric bipolar disorders have not been re-examined since the implementation of the DSM-5 diagnostic criteria. The introduction of the diagnosis of DMDD may have an impact on the assignment of a bipolar diagnosis and mood disorder NOS in the pediatric population. There may also be a relationship between the use of other mood diagnoses and ODD.

The current study aimed to assess the trends in the use of bipolar disorders and DMDD in a population of children and adolescents in Kentucky covered by Medicaid. Additionally, we wished to evaluate whether prior diagnoses of bipolar disorders, mood disorder (NOS), ADHD, or ODD predicted a diagnosis of DMDD following the implementation of DSM-5 diagnostic criteria.

2. Methods

2.1. Data source and sample

Kentucky Medicaid claims records from 2012–2017 were used to build a cohort of children under the age of 18 (N = 814,919; 2012: n = 473,389; 2013: n = 470,918; 2014: n = 499,094; 2015: n = 517,199; 2016: n = 529,048; 2017: n = 535,814). These data include all health services billed through Kentucky Medicaid insurance with the service date, type of visit, location of residence, provider, and associated International Classification of Diseases (ICD-9 and ICD-10 codes). In addition to health service information, the data contain patient demographic information such as date of birth, gender, self-identified race and ethnicity, and postal code for the child's place of residence for all pediatric enrollees.

The data set included children under 18 years of age who were diagnosed with at least one of the following diagnoses: bipolar disorder, mood disorder NOS, ODD, or DMDD during the time period between 2012–2017 (n = 68,655; 8.4%). We did not exclude any children from the study sample based on the length of enrollment in Medicaid with the understanding that this may lead to biased estimates, since shorter enrollment periods provide less time to accumulate a claim for DMDD. Our primary outcome of interest was the appearance of DMDD after it was defined in the DSM-5 in May of 2013. Specifically, we hypothesized that many of the children diagnosed in 2012 and 2013 with bipolar disorder, ODD, ADHD, and mood disorder NOS were children for whom the diagnosis would later be revised as DMDD. Annual trends were assessed using cross-sectional data from children included in the study sample within each year 2012 through 2017. In addition to studying the trends in the above diagnoses, we looked at the trends in comorbid ADHD from 2012 through 2017. In order to determine whether these diagnoses in 2012 and 2013 were predictive of a diagnosis of DMDD in the following years between 2015–2017, a logistic regression model was used to analyze a sub-sample of children who had at least one of the diagnoses, were not missing any of the relevant demographic information, and were present in the claims data each year from 2012–2017 (n = 5071). In addition to diagnostic history of the patient, we looked at possible demographic predictors within the regression, including location of residence, age, and race/ethnicity. We identified psychiatric diagnoses using ICD-9 coding for claims occurring prior to October 1, 2015 and ICD-10 coding for claims after and including October 1, 2015. We did not give priority to a primary diagnostic variable but, rather, included the record if the diagnosis code was present in any of the four available diagnostic code columns. The ICD-9 and ICD-10 codes used were, respectively, 296.99 and F34.8 for DMDD, 313.81 and F91.3 for ODD, 296.90 and F06.3, F39 for mood disorder NOS, 314.XX and F90.X for ADHD. Bipolar and related disorders required a relatively large series of ICD-9 (296.00-296.10, 296.40-296.89, and 301.13) and ICD-10 (F30.10-F30.4, F30.8, F30.9, F31.0-F31.9, F34.0) codes. A full list of ICD codes that were used is available upon request. Additionally, we studied these diagnoses in groups within each given year to look at how these diagnoses trended in relationship to each other over time.

3. Covariates

Demographic covariates were obtained from yearly enrollment data files for Kentucky Medicaid. Diagnostic data came from the medical claim. In the cross-sectional, descriptive analysis the child's age and foster care status would be listed as that in each year's enrollment file. However, in our logistic regression analysis, the age, location of residence (metropolitan or non-metropolitan) and foster care status at entry into the cohort during the 2012 calendar year were chosen as predictors. We determined the geographic status using each individual's zip code and county information, as indicated in the medical claims records. Geographic status was generated using 2013 Rural Urban Continuum Codes (RUCC), with metropolitan defined as RUCC 1 to 3, and non-metropolitan defined as RUCC 4 to 9. Gender and race/ethnicity were taken directly from the enrollment file, with race/ethnicity being further categorized into white (non-Hispanic), black (non-Hispanic), other (non-Hispanic), Hispanic, and not provided.

3.1. Statistical analyses

Descriptive analyses were performed to summarize the demographic and diagnostic characteristics of our cohort of children who were diagnosed with at least one of bipolar disorder, mood disorder NOS, ADHD, ODD, or DMDD during the time period between 2012 and 2017 and assess the annual diagnostic trends over those years. A comparison between children diagnosed with DMDD and those that were not, was performed for the 2017 calendar year. A chi-squared test for difference in proportions was performed and p-values reported. In order to account for various commonly occurring comorbidities among this group of behavioral diagnoses, we looked at the yearly trends in proportions of children with both mood NOS and bipolar disorder, or ODD, along with bipolar disorder and ODD, and separately, ADHD combined with each of ODD, mood disorder NOS, bipolar disorder, and the rest of the anxiety and trauma category. Cochran Armitage tests for trends were performed.

In order to determine whether the afore mentioned diagnoses in 2012 and 2013 were predictive of a diagnosis of DMDD sometime during 2015–2017, a generalized linear model with a logit link and binomial distribution was used to analyze the possible variables associated with receiving a DMDD diagnosis. We tested for significant

Table 1
Diagnosis rates and demographic characteristics of the overall medicaid population by year.

2012		2013	2014	2015	2016	2017
Total number of children	473,389	470,918	499,094	517,199	529,048	535,814
Demographic Variables	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**
Age group: 0–5 years	185,466 (39.18%)	180,336 (38.29%)	186,502 (37.37%)	190,187 (36.77%)	192,272 (36.34%)	192,893 (36.00%)
Age group: 6–11 years	156,516 (33.06%)	158,809 (33.72%)	170,198 (34.10%)	177,606 (34.34%)	182,708 (34.54%)	184,584 (34.45%)
Age group: 12–17 years	131,407 (27.76%)	131,773 (27.98%)	142,394 (28.53%)	149,406 (28.89%)	154,068 (29.12%)	158,337 (29.55%)
Race/Ethnicity: White-NH	320,909 (67.79%)	319,408 (67.83%)	327,500 (65.62%)	333,787 (64.54%)	345,721 (65.35%)	357,808 (66.78%)
Race/Ethnicity: Black-NH	57,397 (12.12%)	56,341 (11.96%)	59,129 (11.85%)	60,860 (11.77%)	63,703 (12.04%)	66,852 (12.48%)
Race/Ethnicity: Hispanic	23,226 (4.91%)	24,319 (5.16%)	25,575 (5.12%)	26,411 (5.11%)	28,335 (5.36%)	30,729 (5.74%)
Race/Ethnicity: Other	17,432 (3.68%)	17,822 (3.78%)	23,900 (4.79%)	17,748 (3.43%)	11,487 (2.17%)	13,963 (2.61%)
Race/Ethnicity: Not Provided	54,425 (11.50%)	53,028 (11.26%)	62,990 (12.62%)	78,393 (15.16%)	79,802 (15.08%)	66,462 (12.40%)
Gender: Female	230,297 (48.65%)	228,768 (48.58%)	242,656 (48.62%)	251,988 (48.72%)	257,557 (48.68%)	260,881 (48.69%)
Gender: Male	243,092 (51.35%)	242,150 (51.42%)	256,438 (51.38%)	265,211 (51.28%)	271,487 (51.32%)	274,928 (51.31%)
Residence: Metro	199,204 (42.08%)	196,134 (41.65%)	209,838 (42.04%)	217,888 (42.13%)	271,468 (51.31%)	277,432 (51.78%)
Residence: Non-metro	274,185 (57.92%)	274,784 (58.35%)	289,256 (57.96%)	299,311 (57.87%)	257,580 (48.69%)	258,382 (48.22%)
Foster care	9836 (2.08%)	10,376 (2.20%)	10,730 (2.15%)	10,982 (2.12%)	11,245 (2.13%)	9512 (1.78%)
Not foster care	463,553 (97.92%)	460,542 (97.80%)	488,364 (97.85%)	506,217 (97.88%)	517,803 (97.87%)	526,302 (98.22%)
Diagnostic Variables	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**
At least one of DMDD, Bipolar, ODD, Mood NOS	21,780 (4.60%)	20,974 (4.45%)	22,592 (4.53%)	25,746 (4.98%)	24,773 (4.68%)	25,421 (4.74%)
DMDD alone	305 (0.06%)	359 (0.08%)	497 (0.10%)	1205 (0.23%)	2723 (0.51%)	3604 (0.67%)
Bipolar alone	1629 (0.34%)	1500 (0.32%)	1314 (0.26%)	1270 (0.25%)	1370 (0.26%)	1259 (0.23%)
ODD alone	8700 (1.84%)	8244 (1.75%)	8710 (1.75%)	10,344 (2.00%)	10,956 (2.07%)	11,487 (2.14%)
Mood NOS alone	5896 (1.25%)	6073 (1.29%)	6790 (1.36%)	5930 (1.15%)	3545 (0.67%)	2973 (0.55%)
Mood NOS + Bipolar	798 (0.17%)	791 (0.17%)	816 (0.16%)	724 (0.14%)	352 (0.07%)	340 (0.06%)
Mood NOS + ODD	2190 (0.46%)	2131 (0.45%)	2342 (0.47%)	2237 (0.43%)	1591 (0.30%)	1130 (0.21%)
Bipolar + ODD	657 (0.14%)	492 (0.10%)	555 (0.11%)	604 (0.12%)	611 (0.12%)	512 (0.10%)
ADHD alone	31,621 (6.68%)	31,174 (6.62%)	32,349 (6.48%)	32,007 (6.19%)	32,510 (6.15%)	31,582 (5.89%)
ADHD + ODD	4422 (0.93%)	4144 (0.88%)	4268 (0.86%)	4989 (0.96%)	5089 (0.96%)	5124 (0.96%)
ADHD + Mood NOS	2045 (0.43%)	2187 (0.46%)	2251 (0.45%)	1973 (0.38%)	1156 (0.22%)	924 (0.17%)
ADHD + Bipolar	781 (0.16%)	723 (0.15%)	566 (0.11%)	522 (0.10%)	469 (0.09%)	412 (0.08%)
ADHD + PTSD	456 (0.10%)	468 (0.10%)	544 (0.11%)	683 (0.13%)	947 (0.18%)	1024 (0.19%)
ADHD + Anxiety	2481 (0.52%)	2548 (0.54%)	3116 (0.62%)	4222 (0.82%)	5572 (1.05%)	6612 (1.23%)

NOTE: ADHD + Anxiety = Anxiety diagnosis other than PTSD (See Methods); Abbreviations: DMDD, disruptive mood dysregulation disorder; NH, Non-Hispanic; NOS, not otherwise specified; ODD, oppositional defiant disorder; ADHD, attention deficit hyperactivity disorders; PTSD, Post-traumatic stress disorder.

predictors and report odds ratios (OR) with a 95% confidence interval (CI) and 2-sided *p*-values for the model. We performed data preparation and analyses using R statistical software, version 3.5.1 (7/02/2018).

The study was approved by the Institutional Review Board at the [BLINDED]. Data were obtained from and approved for use by the Kentucky Department of Medicaid Services.

4. Results

The rate of DMDD diagnoses has increased with every year among children in Kentucky Medicaid since it has been defined in the DSM-5 (Table 1; Fig. 1). While there is some evidence of the ICD codes being used prior to May 2013, the use increased over time to a maximum number of 3604 children in 2017 (0.67%). At the same time, bipolar disorder and mood disorder NOS decreased through the years from 0.34% and 1.25% in 2012 to 0.23% and 0.55% in 2017, respectively ($p < 0.001$). Similarly, the percent of children diagnosed with both a mood disorder NOS and either bipolar disorder or ODD decreased from during the same time period.

The population of children with DMDD in Kentucky Medicaid had significantly different demographic characteristics than the population of children without DMDD in 2017 (Table 2). Children with DMDD tended to be older, and a larger proportion of children with DMDD were male. A higher proportion of children with DMDD lived in a metropolitan area and were in the foster care system. A higher proportion of children without DMDD were Hispanic, while a higher proportion of children with DMDD were Black (not Hispanic).

A multivariable logistic model was created to investigate the predictive value of receiving a bipolar disorder, mood NOS, ADHD, or ODD diagnoses on a DMDD diagnosis beginning in 2015 when adjusted for demographic characteristics (Table 3; Fig. 2). While a diagnosis of mood disorder NOS alone in 2012 was not a significant predictor of a diagnosis of DMDD in 2015–2017 (*OR* 1.16, $p = 0.324$), the same diagnosis in 2013 was predictive (*OR* 2.14, $p = 0.049$). In contrast, the reverse is true for a diagnosis of ADHD alone. In 2013, ADHD did not predict DMDD in later years (*OR* 1.11, $p = 0.652$), but its presence in 2012 was a significant predictor (*OR* 1.36, $p = 0.010$). An interaction between ODD and ADHD in 2012 made it less likely for a revised diagnosis later (*OR* 0.69, $p = 0.034$), however, having ODD and bipolar disorder in 2012, increased the odds of revising the diagnosis to DMDD (*OR* 1.53, $p = 0.046$). A child that was older in 2012 had significantly lower odds of receiving a DMDD diagnosis later on. For each year increase in age during 2012, the child was less likely to have their diagnosis revised (*OR* = 0.88, $p < 0.001$). Boys were less likely among children that had received at least one of the predictive diagnoses to receive a diagnosis of DMDD later (*OR* = 0.79, $p = 0.002$). Neither foster care nor race in 2012 were significant predictors of DMDD after 2014.

5. Discussion

The current study provides new insights into diagnosing patterns related to mood disorders, ADHD, and DMDD. This large epidemiological study examines data from a statewide sample of children and youth receiving Kentucky Medicaid. Descriptive data were used to identify trends. Logistic regression models were used to identify early predictors of receiving a diagnosis of DMDD between 2015 and 2017.

The longitudinal nature of our data allowed for trends to be identified as DMDD was introduced. Over the years of our study, more children receiving Kentucky Medicaid were diagnosed with DMDD while rates of mood disorder NOS and bipolar disorder decreased. The demographic findings of our study suggest children diagnosed with DMDD are more likely to be older, black, male, and living in rural areas.

Having a diagnosis of ADHD alone in 2012 and a diagnosis of mood

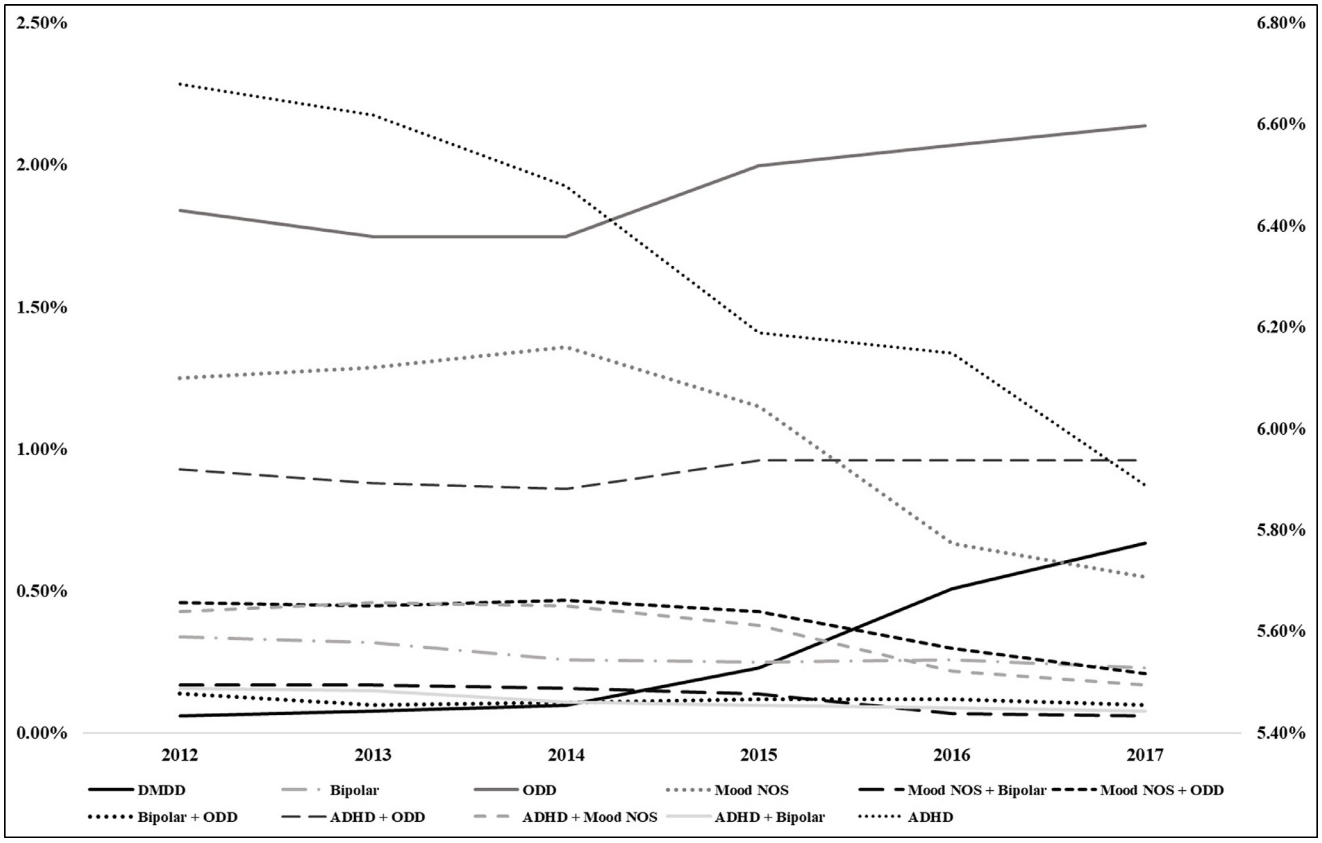

Fig. 1. Percent of children in kentucky medicaid diagnosed with DMDD and related disorders. Note. ADHD is represented on the secondary axis.

disorder NOS in 2013 was a significant predictor of a diagnosis of DMDD beginning in 2015. Additionally, we found that ODD in combination with bipolar disorder in 2012 was predictive of a later diagnosis of DMDD, while ODD in combination with ADHD was more likely to remain the diagnosis without a switch to DMDD. Finally, females and children living in a non-rural area in 2012 were more likely to be reclassified with a diagnosis of DMDD.

Our findings that an earlier diagnosis of ADHD predicts a later diagnosis of DMDD is noteworthy because it supports previously published findings of this relationship. Our findings that ADHD with comorbid ODD does not predict a switch to DMDD may suggest appropriate use of the two diagnoses since neither contain criteria describing a significant mood component to their presentation, therefore, we would not necessarily expect DMDD to be used in later years.

Interestingly, an earlier diagnosis of mood disorder NOS in 2012 did not predict a later DMDD diagnosis, however, a diagnosis in 2013 was predictive of a switch in diagnosis to DMDD. The reasons for this finding are unclear but may be related to the practices of providers and their adaptability with using the DMDD diagnosis when it became available. The use of mood disorder NOS alone begins decreasing in 2015, and even more so by 2016, suggesting that some providers may have continued to use this diagnosis code for several years after the introduction of the DMDD diagnosis as a default diagnosis for children with non-specific mood complaints. In our analysis, a child would be considered to have a particular diagnosis for that year if one claim from any provider submitted the diagnosis. Knowing that most children who

Table 2
Comparison of demographic characteristics between children with and without DMDD in 2017.

Demographics	DMDD n (%)	No DMDD n (%)	p	% with DMDD of Overall Population
Overall	7447	528,367		1.39%
Age group: 0–5 years	225 (3.02%)	192,668 (36.46%)	< 0.001	0.12%
Age group: 6–11 years	3325 (44.65%)	181,259 (34.31%)	< 0.001	1.80%
Age group: 12–17 years	3897 (52.33%)	154,440 (29.23%)	< 0.001	2.46%
Race/Ethnicity: White-NH	4644 (62.36%)	353,164 (66.84%)	< 0.001	1.30%
Race/Ethnicity: Black-NH	1209 (16.23%)	65,643 (12.42%)	< 0.001	1.81%
Race/Ethnicity: Hispanic	148 (1.99%)	30,581 (5.79%)	< 0.001	0.48%
Race/Ethnicity: Other	148 (1.99%)	13,815 (2.61%)	0.001	1.06%
Race/Ethnicity: Not Provided	1298 (17.43%)	65,164 (12.33%)	< 0.001	1.95%
Gender: Female	2962 (39.77%)	257,919 (48.81%)	< 0.001	1.14%
Gender: Male	4485 (60.23%)	270,443 (51.18%)	< 0.001	1.63%
Metro residence	4557 (61.19%)	272,875 (51.64%)	< 0.001	1.64%
Non-metro residence	2890 (38.81%)	255,492 (48.36%)	< 0.001	1.12%
Foster care	892 (11.98%)	8620 (1.63%)	< 0.001	9.38%
Not in foster care	6555 (88.02%)	519,747 (98.37%)	< 0.001	1.25%

Abbreviations: DMDD, disruptive mood dysregulation disorder; NH, non-Hispanic.

Table 3
Binomial logistic regression predicting a DMDD diagnosis in 2015–2017.

Main Effects	OR	95% CI	p
Foster Care	0.99	(0.72, 1.34)	0.946
Gender: Female	***Reference***		
Gender: Male	**0.79**	**(0.68, 0.91)**	**0.002**
Residence Metro/Non-metro: Non-metro	1.14	(0.99, 1.32)	0.066
Age	**0.88**	**(0.86, 0.9)**	**< 0.001**
Race/Ethnicity: White-NH	***Reference***		
Race/Ethnicity: Black-NH	1.12	(0.91, 1.37)	0.290
Race/Ethnicity: Hispanic	0.93	(0.53, 1.56)	0.792
Race/Ethnicity: Other	0.66	(0.36, 1.15)	0.163
Bipolar Disorder (2012)	0.99	(0.54, 1.74)	0.963
Oppositional Defiant Disorder (2012)	1.11	(0.81, 1.52)	0.499
Mood Disorder NOS (2012)	1.16	(0.86, 1.55)	0.324
Attention Deficit Disorder (2012)	**1.36**	**(1.08, 1.73)**	**0.010**
Bipolar Disorder (2013)	1.16	(0.55, 2.42)	0.692
Oppositional Defiant Disorder (2013)	0.76	(0.35, 1.61)	0.475
Mood Disorder NOS (2013)	**2.14**	**(1, 4.53)**	**0.049**
Attention Deficit Disorder (2013)	1.11	(0.7, 1.76)	0.652
Interactions			
Bipolar Disorder (2012): Mood Disorder NOS (2012)	0.9	(0.59, 1.36)	0.611
Mood Disorder NOS (2012): Oppositional Defiant Disorder (2012)	1.04	(0.76, 1.43)	0.813
Bipolar Disorder (2012): Oppositional Defiant Disorder (2012)	**1.53**	**(1.01, 2.32)**	**0.046**
Bipolar Disorder (2012): Attention Deficit Disorder (2012)	1.19	(0.7, 2.09)	0.525
Oppositional Defiant Disorder (2012): Attention Deficit Disorder (2012)	**0.69**	**(0.49, 0.97)**	**0.034**
Mood Disorder NOS (2012): Attention Deficit Disorder (2012)	0.96	(0.69, 1.34)	0.811
Bipolar Disorder (2013): Mood Disorder NOS (2013)	1.02	(0.58, 1.84)	0.939
Mood Disorder NOS (2013): Oppositional Defiant Disorder (2013)	1.46	(0.74, 2.89)	0.278
Bipolar Disorder (2013): Oppositional Defiant Disorder (2013)	0.99	(0.61, 1.6)	0.969
Bipolar Disorder (2013): Attention Deficit Disorder (2013)	0.85	(0.53, 1.37)	0.496
Oppositional Defiant Disorder (2013): Attention Deficit Disorder (2013)	0.98	(0.66, 1.47)	0.913
Mood Disorder NOS (2013): Attention Deficit Disorder (2013)	1.01	(0.67, 1.51)	0.971

Abbreviation: DMDD, disruptive mood dysregulation disorder; OR, odds ratio; CI, confidence interval; NOS, not otherwise specified; ODD, oppositional defiant disorder.
NH, non-Hispanic.

have mental health diagnoses have multiple providers and provider types billing for their services, this lag may be associated with continued use of the mood disorder NOS diagnosis by some, but not all of the providers, for a particular child, thus skewing the predictive value for the later diagnosis of DMDD.

The opposite may be true when exploring reasons for the predictive value of ODD and comorbid bipolar disorder in 2012, but not in 2013, for DMDD. A child with this combination of diagnosis would have likely been a child with significant mood irritability along with the behavioral complaints associated with ODD, thus landing a bipolar disorder diagnosis, along with the ODD diagnosis. After years of exploring the significant increase in the use of bipolar diagnoses within our field, and the popular conclusion that the diagnostic criteria for bipolar disorder had been applied too broadly, it is possible that when the diagnosis of DMDD was made available, individuals working with children and adolescents with a bipolar diagnosis were more likely to reassess and use the DMDD diagnosis more quickly as a result of pressure in our field to be more judicious in our application of the criteria for bipolar diagnoses.

The predictive value of a prior diagnosis of ADHD, mood disorder NOS, and ODD that is comorbid with bipolar disorder for a later diagnosis of DMDD, as well as the negative predictive value of prior ODD with ADHD diagnoses suggests that behavioral and mood disorders are inter-related. DMDD may provide a more accurate description of the behavioral and mood problems demonstrated in these children. Predictably, there was a steady increase in DMDD after 2013, and this increase was associated with a prior diagnosis of mood disorder NOS as well as with bipolar disorders comorbid with ODD, which were common “default” diagnoses prior to 2013. The diagnosis of DMDD seemingly captures the apparent increased use of subthreshold diagnoses described by Safer et al. (2015). DMDD may provide a more accurate description of the inter-relational, behavioral, and mood problems demonstrated in children with a subthreshold diagnosis of mood disorders NOS or mood disorders comorbid with ODD.

While this study provides new knowledge, there are some limitations. Administrative claims data are known to have limitations (Research Data Assistance Center, 2018). We identified cases if a child had one medical claim with a diagnosis of interest. Using only a single claim could result in over-reporting due to coding errors or use of codes when ruling out the diagnosis. Race and ethnicity are optional fields in the Medicaid data allowing for some missing data (11.26% - 15.16%). Data from children with no race/ethnicity reported were excluded from the analyses, which could bias the findings. Additionally, claims data do not allow for validating the diagnosis as no medical records are available. Lastly, the data represent on children living in Kentucky and may or may not represent children living in other states or countries outside of the United States. Despite the limitations, the study has merit.

Given that the use of bipolar diagnoses has remained relatively stable since 2012, continued monitoring of the trend is important to clarify the questions related to providers’ previous surge in using the bipolar diagnosis. Future studies would benefit from methods that would allow for the validation of the DMDD diagnosis as well as to examine whether there are differences in the utilization of the DMDD diagnosis between types of providers caring for children and adolescents.

5.1. Limitations

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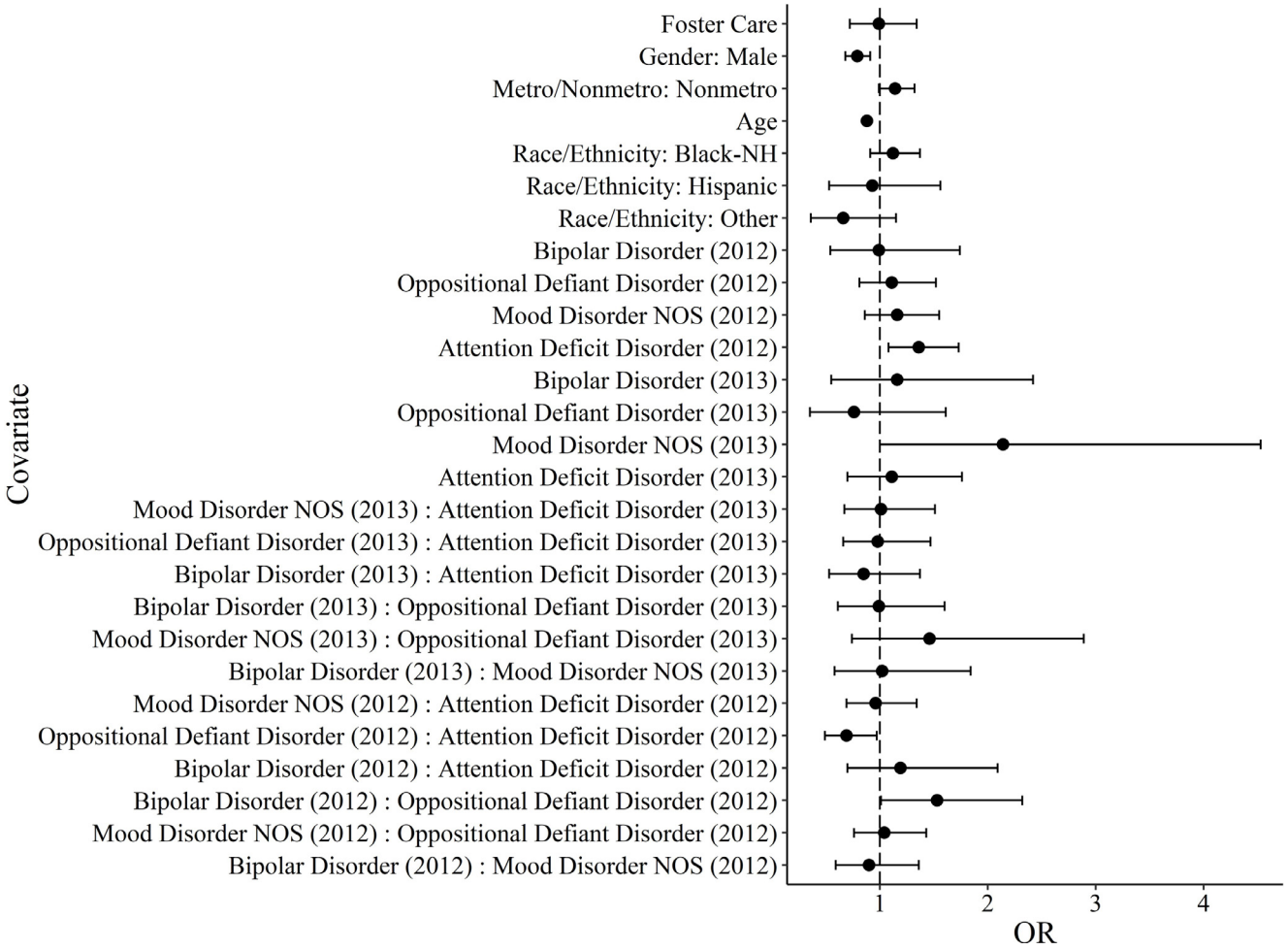

Fig. 2. Odds ratios predicting DMDD among children in Kentucky Medicaid after 2015.

the Medicaid data allowing for some missing data (11.26%–15.16%). Data from children with no race/ethnicity reported were excluded from the analyses, which could bias the findings. Additionally, claims data do not allow for validating the diagnosis as no medical records are available. Lastly, the data represent on children living in Kentucky and may or may not represent children living in other states or countries outside of the United States. Despite the limitations, the study has merit.

5.2. Human subjects

The study was approved by the Institutional Review Board at the University of Louisville. Data were obtained from and approved for use by the Kentucky Department of Medicaid Services.

CRediT authorship contribution statement

Jennifer Le: Conceptualization, Writing - review & editing. **Yana Feygin:** Data curation, Formal analysis, Writing - review & editing. **Liza Creel:** Supervision, Formal analysis, Writing - review & editing. **W. David Lohr:** Conceptualization, Writing - review & editing. **V. Faye Jones:** Writing - review & editing. **P. Gail Williams:** Writing - review & editing. **John A. Myers:** Supervision, Formal analysis, Writing - review & editing. **Natalie Pasquenza:** Writing - review & editing. **Deborah Winders Davis:** Writing - original draft, Writing - review & editing.

Declaration of Competing Interest

None.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jad.2019.12.018.

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