Correlating Psychotropic Use to Major Depressive Disorder and ADHD Research Diagnoses:

Trends in a Prospective Pediatric Cohort From Ages 3 to 21

Miranda U. Liang, BS[a,*]; Natchanan Charatcharungkiat, MD[b]; Rebecca Tillman, MA[b]; Hetal M. Patel, MD[b]; Alecia C. Vogel, MD, PhD[b]; and Joan L. Luby, MD[b]

ABSTRACT

Objective: To examine the associations of psychotropic usage to clinical characteristics in a pediatric research cohort with research diagnoses and severity scores.

Methods: The cohort (N = 348) was enriched for children with mood and externalizing symptoms. Prospective longitudinal data were collected from ages 3 to 21 (September 2003–December 2019). At up to 10 time points, data on psychotropic medication use were collected by caregiver- and self-report from the MacArthur Health and Behavior Questionnaire, Parent Version and as part of the diagnostic interview, and research diagnoses (*DSM-IV* and *DSM-5*) and disease severity scores were acquired using an age-appropriate standardized research interview (Preschool Age Psychiatric Assessment, Child and Adolescent Psychiatric Assessment, Kiddie-Schedule for Affective Disorders and Schizophrenia).

Results: The percentage of children with attention-deficit/hyperactivity disorder (ADHD) taking ADHD medications was preschool, 20.7%; school-age, 65.4%; and adolescence/early adulthood, 84.0%. The percentage with major depressive disorder (MDD) who were taking antidepressants was preschool, 0%; school-age, 21.6%; and adolescence/early adulthood, 42.6%. Antipsychotic use in children with research diagnoses of ADHD or MDD peaked in school-age: ADHD, 30.8%, and MDD, 21.6%. Children who were taking an antipsychotic concurrently with an ADHD medication or antidepressant had more comorbid conditions and higher disease severity than those taking ADHD medications or antidepressants without concurrent antipsychotics. Black children with MDD used antidepressants significantly less than White children with MDD (Black = 12.1%, White = 31.9%, FDR $P = .0495$).

Conclusions: Concordance between research diagnosis and psychotropic use increased with age. Antipsychotic use was quite high, though more frequent in children with higher disease severity. Both findings suggest that psychotropic use is less tied to discrete diagnoses at earlier ages and that antipsychotic medication use may be motivated by severity/impairment rather than diagnosis.

J Clin Psychiatry 2022;83(6):21m14331

To cite: Liang MU, Charatcharungkiat N, Tillman R, et al. Correlating psychotropic use to major depressive disorder and ADHD research diagnoses: trends in a prospective pediatric cohort from ages 3 to 21. *J Clin Psychiatry.* 2022;83(6):21m14331.

To share: https://doi.org/10.4088/JCP.21m14331

[a]Washington University School of Medicine, St. Louis, Missouri

[b]Department of Psychiatry, Washington University School of Medicine, St. Louis, Missouri

**Corresponding author:* Miranda U. Liang, BS, Washington University School of Medicine, 4444 Forest Park Ave, Ste 2100, St. Louis, MO 63108 (miranda.liang@wustl.edu).

Over the past two decades, many studies have investigated the trends of psychotropic prescribing and usage among children.[1–6] Antidepressant and attention-deficit/hyperactivity disorder (ADHD) medication usage has increased overall, mostly in adolescents.[1–4] In contrast, antipsychotic prescriptions peaked around 2008–2009 and declined afterward coincident with public concern about overuse.[5–7] Psychotropic polypharmacy in pediatric patients has trended upward, with a rate of 27.3% among pediatric Medicaid beneficiaries receiving at least 1 psychotropic prescription in 2009.[8] Furthermore, there has been interest in disparities in prescriptions for and use of psychotropics as a function of racial and ethnic characteristics. Notably, data have suggested that Black and Hispanic children tend to be prescribed and/or use psychotropics less often than White children.[9,10]

Psychotropic use in younger children is of particular concern, due to the lack of safety and efficacy data for most psychotropic medications in early childhood when the brain is rapidly developing. One study[11] observed a 0.8% rate of psychotropic prescriptions in preschoolers overall, while another[10] observed a 1.19% rate of psychotropic prescriptions in preschoolers on Medicaid. Regarding polypharmacy, Soria Saucedo et al[8] looked at preschool Medicaid beneficiaries receiving psychotropic prescriptions in 2009 and found that 4.5% had prescriptions for at least 2 psychotropics.

Despite recent overall decreases in antipsychotic prescriptions in children, the rate of antipsychotic prescriptions in preschool and school-age children remains of concern.[6,10,12] Antipsychotic use in children under 12 is US Food and Drug Administration (FDA)-approved for schizophrenia, bipolar disorder, irritability associated with autism, and Tourette's syndrome.[13,14] However, according to studies using insurance claims data, many children who are receiving antipsychotics do not have a diagnosis for which use of an antipsychotic would be FDA-approved.[5,6] Past studies have pointed to ADHD and major depressive disorder (MDD) diagnoses as possible drivers of antipsychotic prescriptions.[5,6,15]

Pediatric pharmacoepidemiologic studies done to date have been limited by data that were obtained from insurance claims—the diagnoses associated with each prescription were based on clinical judgment, and not validated by standardized psychiatric interviews. In addition, disease severity of patients receiving psychotropics was unknown, so there is little information on what clinical features of these

Clinical Points

- Antipsychotics may be overprescribed in school-aged children, particularly in children with diagnoses of major depressive disorder and ADHD.
- Clinicians should aim to do a thorough diagnostic evaluation of the patient, start with the appropriate first-line medication for treatment, and exercise caution in antipsychotic prescription without diagnostic clarification, given the significant longitudinal side effects of these medications.

patients are driving the usage of psychotropics (specifically antipsychotics).

To begin filling this gap in the literature, we have analyzed data on psychotropic usage from the Preschool Depression Study, a 17-year prospective longitudinal follow-up, conducted at the Washington University School of Medicine Early Emotional Development Program (WUSM EEDP) in St. Louis. With these data, we investigated whether psychotropic type was associated with research diagnosis and/or disease severity, allowing us to make inferences about the drivers of medication use in this study population.

METHODS

Enrolling Participants

The Preschool Depression Study (details of methods previously described in Luby et al,[16] Gaffrey et al,[17] and Whalen et al[18]) was conducted at the WUSM EEDP between September 2003 and December 2019. Preschoolers ages 3.0–5.11 years (N = 306) were recruited between 2003–2005 from preschools, daycare centers, and pediatrician offices in the St. Louis metropolitan area. Caregivers and children were compensated for their time and participation. The study cohort oversampled for children with depressive and/or externalizing symptoms by using the Preschool Feelings Checklist.[19] Healthy children were included as controls. Participants with developmental delay, pervasive developmental disorders, severe medical illness, or neurologic disorders were excluded. Forty-two age-matched children were secondarily recruited at the fifth follow-up assessment from the ages of 8.0–12.11 to increase the numbers of healthy controls. All study procedures were approved in advance by the WUSM institutional review board. All parents gave written informed consent to the study, and all children assented to the study prior to all study procedures.

Measures

Participants were evaluated at baseline and up to 9 follow-up time points. They were assigned research diagnoses based on their responses to a standardized diagnostic interview. Research diagnoses were made using *DSM-IV* criteria prior to 2015, then *DSM-5* criteria after 2015. From ages 3.0–7.11, the Preschool Age Psychiatric Assessment (PAPA)[20] was administered to parents only; from ages 8.0–8.11, the Child and Adolescent Psychiatric Assessment (CAPA)[21] was administered to parents only; from age 9.0 and up prior to the last 2 time points, the CAPA was administered separately to parents and children; and at the final 2 time points, the Kiddie-Schedule for Affective Disorders and Schizophrenia (K-SADS)[22] was administered separately to parents and children, regardless of age. Research assessments when both child and parent report were obtained were combined by taking the most severe rating, as is standard in affective disorders research.[23] Disease severity scores were obtained by summing the number of symptoms of a specific disease endorsed during the PAPA/CAPA/K-SADS.

Raters were trained to reliability before being allowed to independently administer an interview. Interviews were recorded, and 20% were reviewed by a master coder. Discrepancies were resolved by consulting a senior child psychiatrist. Raters were blind to past diagnostic history and medication use, but it was not possible to blind to current diagnosis or medication use.

The MacArthur Health and Behavior Questionnaire for Middle Childhood (4–8 years) Parent Form version 1.0 and for Late Childhood and Adolescence (9–18 years) Parent Form version 2.1[24] (HBQ-P) were used to obtain prescription data. The HBQ-P was completed by caregivers prior to diagnostic assessments. The HBQ-P defines "regular" medication use as "taken daily for at least 1 month." Medication data were also collected by self-report or caregiver-report on the interviewer-administrated PAPA/CAPA/K-SADS. Children were able to self-report medication use starting during the last 2 time points, when the K-SADS was administered. If a medication was reported on either the HBQ-P or the diagnostic assessment (or both), it was included in the dataset. For a complete list of which medications were considered psychotropics and how they were classified (eg, antidepressant, antipsychotic), see Supplementary Table 1.

Child functioning was assessed by using the Preschool Early Childhood Functional Assessment Scale[25] (PECFAS) or the Child and Adolescent Functional Assessment Scale[26] (CAFAS). The PECFAS was used from ages 3–6, and the CAFAS was used after age 7, but it was not completed at the last 2 time points. The PECFAS and CAFAS are semistructured scales used to rate child functioning over multiple contexts (home, school, community).

Income-to-needs ratio was calculated by dividing the total family income by federal poverty level based on family size for that year. Caregiver-reported race data about themselves and the child were collected at baseline assessments.

Data Analysis

Assessments occurring when children were age 3.0–5.11 years were considered preschool, age 6.0–12.11 were considered school-age, and age 13.0 and older were considered adolescent/early adult. Subjects could have completed more than 1 assessment during each developmental period. If a diagnosis or medication was

Table 1. Summary Characteristics of Subjects With Preschool, School-Age, and Adolescent/Early Adult Assessments

	Preschool (N = 302)[a]			School-age (N = 316)			Adolescent/ early adult (N = 196)		
Characteristics	Total	Mean	SD	Total	Mean	SD	Total	Mean	SD
Age at first assessment, y	302	4.45	0.80	316	5.28	2.14	196	5.59	2.45
Income-to-needs ratio	294	2.03	1.14	312	1.91	0.93	185	1.90	0.72
	Total	%	N	Total	%	N	Total	%	N
Female sex	302	48.0	145	316	47.8	151	196	50.5	99
Baseline healthy control	302	48.3	146	316	54.1	171	196	54.6	107
Race	302			316			196		
White		54.3	164		54.1	171		53.6	105
Black		32.5	98		33.9	107		35.2	69
Other		13.2	40		12.0	38		11.2	22
Research diagnoses									
No diagnosis	302	39.1	118	316	36.7	116	195	42.6	83
MDD	302	31.5	95	316	35.1	111	195	24.1	47
ADHD	302	19.2	58	315	24.8	78	195	12.8	25
ODD	302	28.5	86	315	22.2	70	184	8.2	15
CD	302	17.9	54	315	14.9	47	195	4.6	9
GAD	302	12.3	37	316	18.7	59	195	39.0	76
PTSD	302	2.7	8	315	1.9	6	195	5.1	10
SAD	302	21.5	65	316	15.5	49	185	1.1	2
OCD[b]	0	…	…	294	12.6	37	195	4.1	8
Panic disorder	0	…	…	294	3.4	10	195	3.6	7
Agoraphobia	0	…	…	294	1.7	5	195	1.0	2
Social anxiety disorder	0	…	…	294	22.1	65	195	17.4	34
Treatments									
Any psychotropic	302	9.3	28	316	26.0	82	196	32.1	63
2+ psychotropic classes at same time[c]	302	2.3	7	316	13.3	42	196	13.3	26
Non-pharmacologic therapy	301	24.9	75	316	50.0	158	195	50.3	98

[a]A total of 306 participants were recruited at preschool age. However, 4 participants had unreliable diagnostic data and were excluded from the preschool time point. Data from these 4 participants were included in later time points.
[b]Twenty-two school-age participants only had school-age assessments prior to age 8 and were therefore administered the PAPA instead of the CAPA. For this reason, they were not evaluated for OCD, panic disorder, agoraphobia, and social anxiety disorder during school-age. Data from these subjects were excluded when looking specifically at anxiety disorders and/or anxiolytics.
[c]Psychotropic classes were α-agonist, antianxiety, antidepressant, antimanic, antipsychotic, stimulant, and atomoxetine.
Abbreviations: ADHD = attention-deficit/hyperactivity disorder, CAPA = Child and Adolescent Psychiatric Assessment, CD = conduct disorder, GAD = generalized anxiety disorder, MDD = major depressive disorder, OCD = obsessive-compulsive disorder, ODD = oppositional defiant disorder, PAPA = Preschool Age Psychiatric Assessment, PTSD = posttraumatic stress disorder, SAD = separation anxiety disorder, SD = standard deviation.

endorsed at any assessment during a developmental period, it was considered present during that period. Diagnostic severity in each developmental period was defined as the most severe rating (maximum score) during the period.

Group comparisons of continuous variables were made using *t* tests (for 2 groups) or general linear models with pairwise contrasts (for 3 groups), and comparisons of categorical variables were made using χ^2 tests (for 2 groups) or logistic regression models with pairwise contrasts (for 3 groups). Multiple comparisons were accounted for using false discovery rate (FDR) correction within each set of analyses.

We used generalized estimating equations to investigate the probability of psychotropic medication use over the course of the study (see Supplementary Appendix 1 Methods).

Analyses were conducted in SAS version 9.4 (released 2013).

RESULTS

Baseline Characteristics of Study Population

Our cohort contained 348 participants in total (Table 1). The mean baseline income-to-needs ratio was 2.03 (SD = 1.15), indicating our cohort was of generally lower socioeconomic class. Our cohort was 52.9% White, 34.5% Black, and 12.6% "other." The prevalence of MDD and ADHD in our cohort (which was enriched for children with mood and externalizing symptoms) ranged from 24.1%–35.1% and 12.8%–24.8%, respectively, over the course of the study.

We obtained data from 157 participants at all 3 time periods (preschool, school-age, adolescence/early adulthood), from 152 participants at only 2 time periods, and 39 participants at only 1 time period (Supplementary Table 2). These groups were different in regard to age at first assessment, due to the healthy controls who entered the study at school-age. There were no significant differences in race, gender, or baseline income-to-needs ratio between these groups.

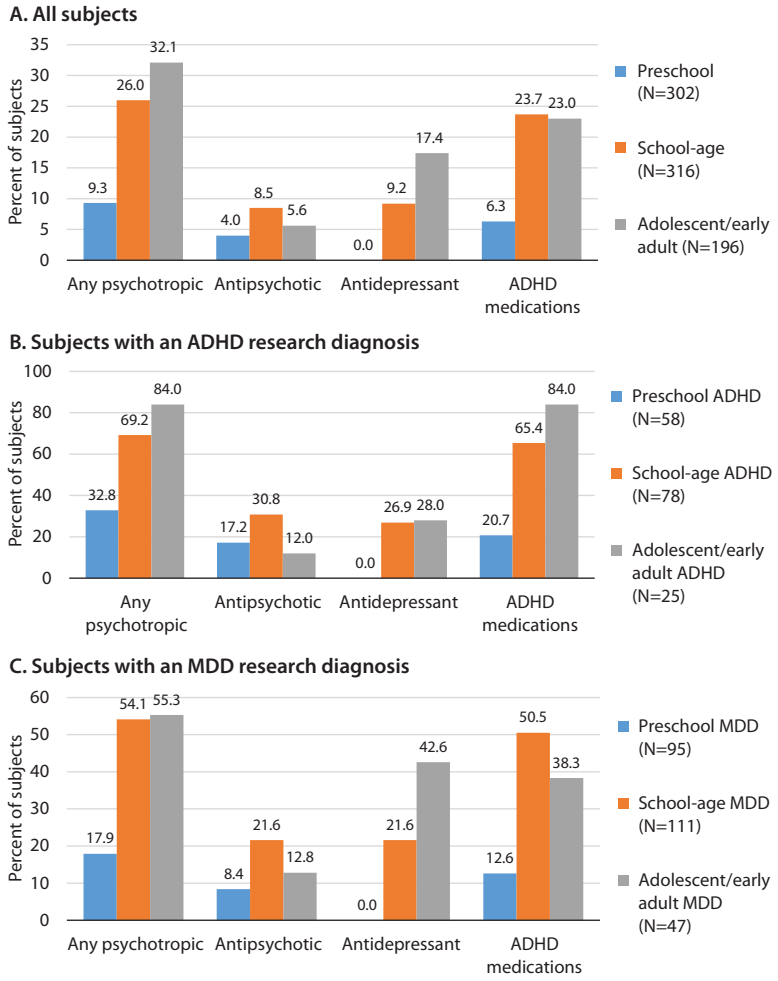
Psychotropic Use by Age Group and Research Diagnosis

In our cohort, 9.3% of preschoolers, 26.0% of school-age children, and 32.1% of adolescents/early adults used at least 1 psychotropic during the respective developmental time period (Table 1). To see a complete breakdown of psychotropics observed in the cohort, see Supplementary Table 3. 2.3% of preschoolers, 13.3% of school-age children, and 13.3% of adolescents/early adults were taking psychotropics from at least 2 different psychotropic classes concurrently (Table 1). Between 79.4%–96.3% of children who were on a psychotropic during an age period also received non-pharmacologic therapy (ie, counseling, psychotherapy, behavioral coaching) in the same age period (Supplementary Table 4).

ADHD medication use increased from 6.3% in preschool, to 23.7% in school-age, and 23.0% in adolescence/early adulthood (Figure 1). Antidepressant use increased from 0% in preschool, to 9.2% in school-age, and then doubled to 17.4% in adolescence/early adulthood. Antipsychotic use peaked in school-age at 8.5% of children, then decreased to 5.6% of adolescents/early adults.

Looking specifically at participants with a psychiatric diagnosis on the PAPA/CAPA/K-SADS, antipsychotic use is notable (Figure 1). In preschoolers with MDD, 8.4% were taking antipsychotics, while 0% were taking

Figure 1. Rates of Psychotropic Medication Use by Age Group



Abbreviations: ADHD = attention-deficit/hyperactivity disorder, MDD = major depressive disorder.

antidepressants. In preschoolers with ADHD, 17.2% were taking antipsychotics, while 20.7% were taking ADHD medications.

Antipsychotic use continued to be common into school-age. School-age children with MDD used antipsychotics and antidepressants at the same rate: 21.6%. In school-age children with ADHD, 30.8% were taking antipsychotics, and 65.4% were taking ADHD medications.

Upon entering adolescence/early adulthood, antipsychotic prescriptions became less common. For adolescents/early adults with ADHD, only 12.0% were taking antipsychotics, while 84.0% were taking ADHD medications. For adolescents/early adults with MDD, 12.8% were taking antipsychotics, while 42.6% were taking antidepressants.

Psychotropic Use Without a Corresponding Research Diagnosis

In our cohort, we observed some children using ADHD medications or antidepressants without a corresponding research diagnosis (Supplementary Table 5). The rates were lowest in preschool, with 0% of children without MDD or anxiety using antidepressants and 2.9% of children without ADHD using ADHD medications. For school-age children and adolescents/early adults, we took into account prior research diagnoses of ADHD and MDD/anxiety to determine whether these were children who did not meet criteria due to effective treatment. Of the children without current or prior diagnoses of MDD or anxiety, 0% used antidepressants in school-age and 2.4% used antidepressants in adolescence/early adulthood. Of the children without current or prior diagnoses of ADHD, 8.7% used ADHD medications in school-age and 9.3% used ADHD medications in adolescence/early adulthood. In school-age and adolescence/early adulthood, the children who were using ADHD medications without a corresponding ADHD diagnosis had significantly higher (though still subthreshold) ADHD severity scores than the children without an ADHD diagnosis and without ADHD medications (Supplementary Table 6).

Disease Severity and Psychotropic Use

Children had a greater likelihood of being prescribed any psychotropic when they had greater functional impairment, as measured by their PECFAS/CAFAS score (Supplementary

Table 2. Diagnostic Characteristics of School-Age Subjects With ADHD Taking Antipsychotics vs ADHD Medications Without Antipsychotics and School-Age Subjects With MDD Taking Antipsychotics vs Antidepressants Without Antipsychotics

Subjects with ADHD

	On antipsychotics (N = 24)[a]		On ADHD medications, no antipsychotics (N = 28)		Comparison		
School-age diagnoses	%	N	%	N	χ^2	*P*	FDR *P*[b]
ADHD	100.0	24	100.0	28	…	…	…
MDD	91.7	22	71.4	20	FE	.0855	.0855
ODD	75.0	18	35.7	10	8.03	.0046	**.0096**
CD	62.5	15	25.0	7	7.45	.0064	**.0096**
School-age severity	Mean	SD	Mean	SD	*t*	*P*	FDR *P*
ADHD severity	14.04	3.28	11.89	3.33	2.34	.0234	**.0312**
MDD severity	6.33	1.34	5.46	1.57	2.12	.0387	**.0387**
ODD severity	5.08	1.82	3.32	2.07	3.23	.0022	**.0088**
CD severity	3.29	1.83	1.89	1.77	2.80	.0073	**.0146**
CAFAS score	81.67	29.44	54.29	28.47	3.40	.0013	**.0055**

Subjects with MDD

	On antipsychotics (N = 24)[c]		On antidepressants, no antipsychotics (N = 10)		Comparison		
School-age diagnoses	%	N	%	N	χ^2	*P*	FDR *P*
ADHD	91.7	22	50.0	5	FE	.0139	**.0359**
MDD	100.0	24	100.0	10	…	…	…
ODD	70.8	17	80.0	8	FE	.6921	.6921
CD	62.5	15	20.0	2	5.10	.0239	**.0359**
School-age severity	Mean	SD	Mean	SD	*t*	*P*	FDR *P*
ADHD severity	13.42	4.13	8.90	6.52	2.44	.0205	.0562
MDD severity	6.42	1.25	6.40	1.17	0.04	.9715	.9715
ODD severity	4.88	2.15	4.40	2.01	0.60	.5547	.7396
CD severity	3.25	1.89	1.70	1.49	2.30	.0281	.0562
CAFAS score	82.08	27.97	62.00	33.60	1.80	.0815	.1358

[a]Subjects taking both antipsychotics and ADHD medications (N = 23) are included in the antipsychotic group.
[b]Differences were considered significant if FDR $P < .05$ (shown in bold).
[c]Subjects taking both antipsychotics and antidepressants (N = 14) are included in the antipsychotic group.
Abbreviations: ADHD = attention-deficit/hyperactivity disorder, CAFAS = Child and Adolescent Functional Assessment Scale, CD = conduct disorder, FDR = false discovery rate, FE = Fisher exact test, MDD = major depressive disorder, ODD = oppositional defiant disorder.

Figure 1). This pattern continues when looking at each class of medication separately; likelihood of ADHD medication, antidepressant, and antipsychotic prescription increases with greater functional impairment (Supplementary Figure 1).

Furthermore, children with research diagnoses who were taking antipsychotics tended to be more clinically complex, with higher rates of comorbidity and higher severity of disease and more impairment than those who were not (Table 2). For children with ADHD, those who took antipsychotics (with or without ADHD medications) had significantly more comorbid diagnoses of oppositional defiant disorder (ODD) and conduct disorder (CD); more symptoms of ADHD, MDD, ODD, and CD; and higher impairment levels (CAFAS) when compared to children who took ADHD medication without antipsychotics. For children with MDD, the children who took antipsychotics (with or without antidepressants) had significantly more comorbid diagnoses of ADHD and CD, but no statistically significant difference in ADHD, MDD, ODD, and CD symptom severity or in impairment level (CAFAS) compared to children who took antidepressants without antipsychotics.

Associations Between Race and Psychotropic Use

When looking at the rate of psychotropic usage throughout the length of the study, there was no statistically significant effect of income-to-needs ratio when looking at all psychotropics together nor when looking at each class of medication separately. Furthermore, our study found no statistically significant difference in rates of psychotropic medication use between White and Black participants in any age group after correcting for multiple comparisons.

However, when specifically looking at participants with a diagnosis of MDD at any point during the study, Black participants were significantly less likely to use any psychotropic medication than White participants (Table 3). Looking at medication subgroups, Black participants with MDD were less likely to use antidepressants but not antipsychotics. There was no statistically significant difference in maximum MDD severity score over the course of the study between White and Black participants (4.07 [SD = 2.12] White vs 4.04 [SD = 2.13] Black, $t = 0.12$, $P = .91$).

In patients with a diagnosis of ADHD at any point during the study, Black participants were significantly less likely to

Table 3. Rates of Lifetime Psychotropic Medication Use by Race in Subjects With Lifetime MDD or ADHD

Medication	%	N	%	N	%	N	Black vs other *P* (FDR *P*)[a]	White vs other *P* (FDR *P*)	Black vs White *P* (FDR *P*)
MDD diagnosis during study	White (N = 91)		Black (N = 58)		Other (N = 30)				
Any psychotropic	56.0	51	34.5	20	53.3	16	.0909 (.2054)	.7957 (.8952)	.0110 **(.0495)**
Antidepressant	31.9	29	12.1	7	26.7	8	.0913 (.2054)	.5923 (.7615)	.0079 **(.0495)**
Antipsychotic	24.2	22	13.8	8	13.3	4	.9525 (.9525)	.2170 (.3255)	.1277 (.2299)
ADHD diagnosis during study	White (N = 52)		Black (N = 44)		Other (N = 18)				
Any psychotropic	80.8	42	47.7	21	72.2	13	.0845 (.1901)	.4487 (.5769)	.0010 **(.0090)**
ADHD medications	65.4	34	47.7	21	61.1	11	.3408 (.5112)	.7445 (.7445)	.0832 (.1901)
Antipsychotic	36.5	19	18.2	8	22.2	4	.7151 (.7445)	.2705 (.4869)	.0499 (.1901)

[a]Differences were considered significant if FDR $P < .05$ (shown in bold).
Abbreviations: ADHD = attention-deficit/hyperactivity disorder, FDR = false discovery rate, MDD = major depressive disorder.

use any psychotropic medication throughout their lifetime than White participants (Table 3). However, medication subgroup analyses did not reveal any statistically significant difference between the two groups for lifetime ADHD medication or antipsychotic use.

DISCUSSION

The current study investigated the rates of psychotropic use as reported by parents and children in a longitudinal sample followed naturalistically and correlated these with research diagnoses based on standardized clinical interviews during 3 developmental periods. During the preschool and school-age periods, the research diagnosis showed a lower correspondence than expected with the type of psychotropic taken based on standard indications.

Those with a research diagnosis of ADHD were using agents designed and tested for ADHD treatment less frequently than expected and were using antipsychotics (which are not specifically indicated for ADHD treatment) more frequently than expected. Past studies have raised concerns about the level of pediatric antipsychotic prescriptions, particularly for off-label uses.[5,6,27,28] Given the potential for metabolic and other serious side effects,[29,30] antipsychotics should only be used judiciously in children, and our findings suggest they may be used in lieu of safer medications indicated for the treatment of ADHD.

One study[31] found that 2.6% of youth with a new ADHD diagnosis were prescribed antipsychotics in the year following their diagnosis, and 47.9% of those youth were not prescribed a stimulant between ADHD diagnosis and antipsychotic initiation. Our study showed a similar concerning trend—preschoolers with ADHD were taking antipsychotics almost as frequently as ADHD medications. This trend improves in school-age, where 65.4% of children with ADHD were taking ADHD medications; however, almost a third of children with ADHD were still taking antipsychotics. Antipsychotics are not FDA-approved for ADHD, and there is little to no evidence of their efficacy for treatment of ADHD.[32]

In adolescence/early adulthood, the rate of children with ADHD taking antipsychotics decreases to 12.0%. This decrease could be because, as ADHD children age, inattentive symptoms tend to persist, while hyperactive/externalizing symptoms tend to decrease,[33] which could lead to a decrease in the need for an antipsychotic. This decrease could also reflect the general nationwide downward trend in pediatric antipsychotic prescription[5,6] that was observed following public concerns of overuse in 2008–2009,[7] as our cohort would have entered adolescence in 2011 or afterward.

Past pharmacoepidemiologic studies have relied on insurance claims data and have not had access to clinical severity ratings of the children who are receiving antipsychotic prescriptions. Our results suggest, however, that antipsychotics are generally reserved for the children who are the most impaired, with the highest comorbidity rates and the highest disease severity. While it is encouraging to see that antipsychotics are not being used indiscriminately, it remains unclear whether antipsychotics are the best choice of medication for these children with a primary diagnosis of MDD or ADHD.

The pattern of antidepressant prescription was more complicated. There were no antidepressant prescriptions for depressed preschoolers—appropriate and likely related to the lack of studies regarding efficacy and safety of antidepressants in young children, as well as the lack of FDA approval for antidepressants in this age group. However, antidepressants continued to be less frequently used in school-age depression than in adolescence and less frequently used in Black children with MDD. The ongoing lack of clinical recognition of depression in younger and minority children quite likely plays a role in patterns of medication use.

Many providers are justifiably hesitant to prescribe pharmacotherapy in young children. However, we would expect more children with MDD to be taking antidepressants than antipsychotics. In our cohort, we observed the same percentage of school-age MDD patients taking antidepressants as antipsychotics (21.6%). This raises the concern that affective disorders are not being recognized

and instead may be misdiagnosed as disruptive behavioral problems. Notably, MDD in young children shows high rates of comorbidity with externalizing behaviors.[34,35] Additionally, in the *DSM-5*, irritability is a cardinal symptom for depression in children and adolescents.[36] In our cohort, we observed that school-age children taking antipsychotics (both with and without antidepressants) were more likely to have comorbid diagnoses of ADHD and CD than children taking antidepressants only, indicating that antipsychotics may have been intended to treat the disruptive behaviors that may arise alongside depression. However, while these medications may be effective at diminishing irritability and mood instability in certain populations, they are not indicated for the treatment of underlying depressed mood, and antidepressants alone, as well as stimulants, can improve irritability in children.[37,38]

Some children in our cohort were taking psychotropic medications without a current or prior corresponding research diagnosis. The number of children receiving antidepressants without a current or prior diagnosis of MDD or anxiety was very small. The number of children receiving ADHD medications without a current or prior ADHD diagnosis was higher; however, the children who used ADHD medications had significantly higher ADHD severity scores than those without, suggesting that their prescriptions had some clinical justification and that the clinicians were likely treating subclinical levels of ADHD symptoms. However, this is still a concerning finding, suggesting clinicians are quick to address subclinical symptoms with medication rather than pursuing nonpharmacologic forms of treatment.

Several prior studies have raised concerns about racial disparities in psychotropic prescriptions and have found that Black children tend to use psychotropics less often than White children.[9,10,39] While our study did not replicate these findings when looking at White and Black children overall, we found that Black children with a diagnosis of MDD or ADHD during the study were less likely to use psychotropic medications—specifically antidepressants—than White children. This observation is consistent with the literature on disparities in psychiatric care. While lack of access to mental health resources for minority groups partially contributes to the general racial disparity,[40] our study participants generally had access to mental health services. This suggests that even with access to care, biases in prescription of medications by providers and/or use of medications by patients may exist. Specifically, minority patients may have less trust in the medical system than White patients, given the history of racism in medicine, and may be more reluctant to accept pharmacotherapy.[41] However, Cohen et al[42] showed no differences between White and minority parents with regard to willingness to treat their children with psychotropic medications. Examining provider prescribing patterns further may help elucidate the barriers to mental health care equity.

Our study is limited in generalizability. Our cohort consists of participants from the St. Louis metropolitan area, and our results may not be generalizable to other states. Furthermore, our cohort was enriched for children with mood and externalizing symptoms arising in the preschool period, so any prevalence rates from our cohort should not be extrapolated to the general population. Another limitation is that our medication data were self- and caregiver-reported and may not be fully accurate, as this kind of data can be subject to recall error.[43] Furthermore, our sample sizes for some subgroup analyses were limited and may not have been enough to detect small differences between groups, specifically when looking only at children with ADHD or MDD diagnoses, or when looking at racial subgroups.

The results of our study demonstrate the need for future research on the topic of psychotropic safety and effectiveness in children, given how many children in our cohort were taking psychotropics. Particularly of interest are the safety and effectiveness of using antipsychotics combined with ADHD medications to treat ADHD. This further research could be accomplished using postmarketing surveillance studies.

In conclusion, we observed that the correspondence between research diagnosis and appropriate psychotropic use improved as children aged. A higher percentage of our cohort than expected was being treated with antipsychotics, an effect particularly noticeable in school-age. Antipsychotics were reserved for more clinically severe patients. However, younger children and Black children with research diagnoses of MDD were less likely to be taking antidepressants than older and White children, indicating possible misattribution of symptoms and increased misdiagnosis in these groups and suggesting that further education and guidance for practitioners are needed.

Submitted: November 18, 2021; accepted June 28, 2022.

Published online: Ocrober 31, 2022.

Relevant financial relationships: None.

Funding/support: This study utilized data from the Preschool Depression Study funded by National Institute of Mental Health, R01 MH090786 (principal investigators: Luby/Barch). Ms Liang's time was funded by Washington University School of Medicine's Dean Fellowship. Dr Patel's time was funded by the PRREP R25 grant (Fund #: 1R25MH112473-01A1).

Role of the sponsor: The funding sources had no further role in the design, analysis, interpretation, or publication of this study.

REFERENCES

1. Zito JM, Pennap D, Safer DJ. Antidepressant use in Medicaid-insured youth: trends, covariates, and future research needs. *Front Psychiatry*. 2020;11:113.
2. Mojtabai R, Olfson M, Han B. National trends in the prevalence and treatment of depression in adolescents and young adults. *Pediatrics*. 2016;138(6):e20161878.
3. Bachmann CJ, Aagaard L, Burcu M, et al. Trends and patterns of antidepressant use in children and adolescents from five western countries, 2005-2012. *Eur Neuropsychopharmacol*. 2016;26(3):411–419.
4. Raman SR, Man KKC, Bahmanyar S, et al. Trends in attention-deficit hyperactivity disorder medication use: a retrospective observational study using population-based databases. *Lancet Psychiatry*. 2018;5(10):824–835.
5. Edelsohn GA, Karpov I, Parthasarathy M, et al. Trends in antipsychotic prescribing in Medicaid-eligible youth. *J Am Acad Child Adolesc Psychiatry*. 2017;56(1):59–66.
6. Bushnell GA, Crystal S, Olfson M. Trends in antipsychotic medication use in young privately insured children. *J Am Acad Child Adolesc Psychiatry*. 2021;60(7):877–886.
7. Harris G. Use of Antipsychotics in Children Is Criticized. *The New York Times*. November 18, 2008.
8. Soria Saucedo R, Liu X, Hincapie-Castillo JM, et

al. Prevalence, time trends, and utilization patterns of psychotropic polypharmacy among pediatric medicaid beneficiaries, 1999–2010. *Psychiatr Serv*. 2018;69(8):919–926.
9. Cook BL, Carson NJ, Kafali EN, et al. Examining psychotropic medication use among youth in the US by race/ethnicity and psychological impairment. *Gen Hosp Psychiatry*. 2017;45:32–39.
10. Garfield LD, Brown DS, Allaire BT, et al. Psychotropic drug use among preschool children in the Medicaid program from 36 states. *Am J Public Health*. 2015;105(3):524–529.
11. Sultan RS, Correll CU, Schoenbaum M, et al. National patterns of commonly prescribed psychotropic medications to young people. *J Child Adolesc Psychopharmacol*. 2018;28(3):158–165.
12. Burcu M, Zito JM, Ibe A, et al. Atypical antipsychotic use among Medicaid-insured children and adolescents: duration, safety, and monitoring implications. *J Child Adolesc Psychopharmacol*. 2014;24(3):112–119.
13. Christian R, Saavedra L, Gaynes BN, et al. Future research needs for first- and second-generation antipsychotics for children and young adults. 2012.
14. Atypical Antipsychotic Medications. Use in Pediatric Patients. CMS website. https://www.cms.gov/Medicare-Medicaid-Coordination/Fraud-Prevention/Medicaid-Integrity-Program/Education/Resource-Library/atypical-antipsychotics-pediatric-fact-sheet. 2015.
15. Olfson M, King M, Schoenbaum M. Treatment of young people with antipsychotic medications in the United States. *JAMA Psychiatry*. 2015;72(9):867–874.
16. Luby JL, Si X, Belden AC, et al. Preschool depression: homotypic continuity and course over 24 months. *Arch Gen Psychiatry*. 2009;66(8):897–905.
17. Gaffrey MS, Tillman R, Barch DM, et al. Continuity and stability of preschool depression from childhood through adolescence and following the onset of puberty. *Compr Psychiatry*. 2018;86(10):39–46.
18. Whalen DJ, Hennefield L, Elsayed NM, et al. Trajectories of suicidal thoughts and behaviors from preschool through late adolescence. *J Am Acad Child Adolesc Psychiatry*. 2022;61(5):676–685.
19. Luby JL, Heffelfinger A, Koenig-McNaught AL, et al. The Preschool Feelings Checklist: a brief and sensitive screening measure for depression in young children. *J Am Acad Child Adolesc Psychiatry*. 2004;43(6):708–717.
20. Egger HL, Erkanli A, Keeler G, et al. Test-Retest Reliability of the Preschool Age Psychiatric Assessment (PAPA). *J Am Acad Child Adolesc Psychiatry*. 2006;45(5):538–549.
21. Angold A, Costello EJ. The Child and Adolescent Psychiatric Assessment (CAPA). *J Am Acad Child Adolesc Psychiatry*. 2000;39(1):39–48.
22. Kaufman J, Birmaher B, Brent D, et al. Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version (K-SADS-PL): initial reliability and validity data. *J Am Acad Child Adolesc Psychiatry*. 1997;36(7):980–988.
23. Bird HR, Gould MS, Staghezza B. Aggregating data from multiple informants in child psychiatry epidemiological research. *J Am Acad Child Adolesc Psychiatry*. 1992;31(1):78–85.
24. Essex MJ, Boyce WT, Goldstein LH, et al; MacArthur Assessment Battery Working Group. The confluence of mental, physical, social, and academic difficulties in middle childhood. II: developing the MacArthur Health and Behavior Questionnaire. *J Am Acad Child Adolesc Psychiatry*. 2002;41(5):588–603.
25. Murphy JM, Pagano ME, Ramirez A, et al. Validation of the Preschool and Early Childhood Functional Assessment Scale (PECFAS). *J Child Fam Stud*. 1999;8(3):343–356.
26. Hodges K, Doucette-Gates A, Liao Q. The relationship between the Child and Adolescent Functional Assessment Scale (CAFAS) and indicators of functioning. *J Child Fam Stud*. 1999;8(1):109–122.
27. Huskamp HA, Horvitz-Lennon M, Berndt ER, et al. Patterns of antipsychotic prescribing by physicians to young children. *Psychiatr Serv*. 2016;67(12):1307–1314.
28. Olfson M, Crystal S, Huang C, et al. Trends in antipsychotic drug use by very young, privately insured children. *J Am Acad Child Adolesc Psychiatry*. 2010;49(1):13–23.
29. Galling B, Roldán A, Nielsen RE, et al. Type 2 diabetes mellitus in youth exposed to antipsychotics: a systematic review and meta-analysis. *JAMA Psychiatry*. 2016;73(3):247–259.
30. Libowitz MR, Nurmi EL. The burden of antipsychotic-induced weight gain and metabolic syndrome in children. *Front Psychiatry*. 2021;12:623681.
31. Sultan RS, Wang S, Crystal S, et al. Antipsychotic treatment among youths with attention-deficit/hyperactivity disorder. *JAMA Netw Open*. 2019;2(7):e197850.
32. Catalá-López F, Hutton B, Núñez-Beltrán A, et al. The pharmacological and non-pharmacological treatment of attention deficit hyperactivity disorder in children and adolescents: a systematic review with network meta-analyses of randomised trials. *PLoS One*. 2017;12(7):e0180355.
33. Franke B, Michelini G, Asherson P, et al. Live fast, die young? a review on the developmental trajectories of ADHD across the lifespan. *Eur Neuropsychopharmacol*. 2018;28(10):1059–1088.
34. Luby JL, Heffelfinger AK, Mrakotsky C, et al. Preschool major depressive disorder: preliminary validation for developmentally modified *DSM-IV* criteria. *J Am Acad Child Adolesc Psychiatry*. 2002;41(8):928–937.
35. Calles JL Jr. Depression in children and adolescents. *Prim Care*. 2007;34(2):243–258, abstract vi.
36. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. Fifth Edition. American Psychiatric Association; 2013.
37. Tao R, Emslie GJ, Mayes TL, et al. Symptom improvement and residual symptoms during acute antidepressant treatment in pediatric major depressive disorder. *J Child Adolesc Psychopharmacol*. 2010;20(5):423–430.
38. Fernández de la Cruz L, Simonoff E, McGough JJ, et al. Treatment of children with attention-deficit/hyperactivity disorder (ADHD) and irritability: results from the Multimodal Treatment Study of Children with ADHD (MTA). *J Am Acad Child Adolesc Psychiatry*. 2015;54(1):62–70.e3.
39. Chirdkiatgumchai V, Xiao H, Fredstrom BK, et al. National trends in psychotropic medication use in young children: 1994–2009. *Pediatrics*. 2013;132(4):615–623.
40. Lê Cook B, Barry CL, Busch SH. Racial/ethnic disparity trends in children's mental health care access and expenditures from 2002 to 2007. *Health Serv Res*. 2013;48(1):129–149.
41. Comer JS, Olfson M, Mojtabai R. National trends in child and adolescent psychotropic polypharmacy in office-based practice, 1996–2007. *J Am Acad Child Adolesc Psychiatry*. 2010;49(10):1001–1010.
42. Cohen D, Dillon FR, Gladwin H, et al. American parents' willingness to prescribe psychoactive drugs to children: a test of cultural mediators. *Soc Psychiatry Psychiatr Epidemiol*. 2013;48(12):1873–1887.
43. Klungel OH, de Boer A, Paes AH, et al. Influence of question structure on the recall of self-reported drug use. *J Clin Epidemiol*. 2000;53(3):273–277.

Editor's Note: We encourage authors to submit papers for consideration as a part of our Focus on Childhood and Adolescent Mental Health section. Please contact Karen D. Wagner, MD, PhD, at kwagner@psychiatrist.com.

THE JOURNAL OF
CLINICAL PSYCHIATRY
THE OFFICIAL JOURNAL OF THE AMERICAN SOCIETY OF CLINICAL PSYCHOPHARMACOLOGY

Supplementary Material

Article Title: Correlating Psychotropic Use to Major Depressive Disorder and ADHD Research Diagnoses: Trends in a Prospective Pediatric Cohort From Ages 3 to 21

Authors: Miranda U. Liang, BS; Natchanan Charatcharungkiat, MD; Rebecca Tillman, MA; Hetal M. Patel, MD; Alecia C. Vogel, MD, PhD; and Joan L. Luby, MD

DOI Number: 10.4088/JCP.21m14331

List of Supplementary Material for the article

1. Appendix 1 Supplementary Methods and Results
2. Table 1 Complete List of Psychotropics Reported
3. Table 2 Baseline Subject Characteristics by Number of Age Groups With Assessments
4. Table 3 Rates of All Psychotropic Medication Use by Age Group
5. Table 4 Rates of Non-Pharmacologic Therapy by Age Group
6. Table 5 Psychotropic Use in Participants Without a Corresponding Research Diagnosis
7. Table 6 ADHD Severity Scores in Children Without a Research Diagnosis of ADHD by ADHD Medication Prescription Status
8. Figure 1 Generalized Estimating Equations of Psychotropic Medication Prescription by Age and Time-Varying PECFAS/CAFAS Score or Diagnosis Severity Score Covarying for Sex and Time-Varying Income-to-Needs Ratio

Disclaimer

This Supplementary Material has been provided by the author(s) as an enhancement to the published article. It has been approved by peer review; however, it has undergone neither editing nor formatting by in-house editorial staff. The material is presented in the manner supplied by the author.

Supplementary Material Appendix 1.

Supplementary Methods:

We used generalized estimating equations (GEE) to investigate the probability of psychotropic medication use over the course of the study. The GEE models had a binomial distribution with a logit link function and assumed an independent correlation matrix. GEE is ideal for dealing with repeated measurements and missing data. The dependent variables in these models were dichotomous variables indicating whether medication (any psychotropic, ADHD medication, antidepressants, and antipsychotics) was prescribed at each assessment. Independent variables were time-varying PECFAS/CAFAS score, ADHD severity, MDD severity, or ODD/CD severity. Age was the time variable, age squared was included if significant, and covariates were sex and time-varying income-to-needs ratio. The interaction between the independent variable and age was entered into the model but then removed if non-significant to obtain the final model. FDR correction was applied to the GEE models by correcting across all main effects of the independent variable and again across all age by independent variable interactions.

Supplementary Results:

We looked at the probability of psychotropic prescription over time as a function of impairment or disease severity (Supplementary Figure 1). In general, children with higher impairment levels had a significantly higher probability of receiving a psychotropic prescription. This pattern held true when looking at psychotropics separately: children with higher impairment levels also had a significantly higher probability of receiving ADHD medications, antidepressants, and antipsychotics. When looking at psychotropic prescription as a function of disease severity, we also observed some significant relationships. The probability of antidepressant prescription was significantly increased with increased MDD severity score, the probability of ADHD medication prescription was significantly increased with increased ADHD severity score, and the probability of antipsychotic prescription was significantly increased with increased ODD/CD severity score.

Supplementary Table 1. Complete list of psychotropics reported.

Antidepressants	Antipsychotics	ADHD Medications	Antimanic	Anti-Anxiety
Amitriptyline	Aripiprazole	Amphetamine	Carbamazepine	Buspirone
Bupropion	Chlorprothixene	Atomoxetine	Lamotrigine	Clonazepam
Citalopram	Clozapine	Clonidine	Lithium	
Clomipramine	Haloperidol	Dexmethylphenidate	Oxcarbazepine	
Desipramine	Lurasidone	Guanfacine	Valproic acid	
Doxepin	Mesoridazine	Lisdexamfetamine		
Duloxetine	Olanzapine	Methylphenidate		
Escitalopram	Paliperidone			
Fluoxetine	Prochlorperazine			
Imipramine	Quetiapine			
Mirtazapine	Risperidone			
Nortriptyline	Ziprasidone			
Paroxetine				
Sertraline				
Trazodone				
Venlafaxine				

Abbreviations: ADHD = attention-deficit/hyperactivity disorder.

Supplementary Table 2. Baseline subject characteristics by number of age groups with assessments.

	1 Age Group (N=39)		2 Age Groups (N=152)		3 Age Groups (N=157)		Omnibus Test	
Subject Characteristics	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**F**	**p***
Age at first wave	4.88	2.27	5.90	2.67	4.51	0.79	19.11	**<0.0001**
First income-to-needs ratio	1.78	1.15	2.05	1.11	2.06	1.18	0.96	0.3848
	%	**N**	**%**	**N**	**%**	**N**	χ^2	**p**
Female sex	51.3	20	45.4	69	50.3	79	0.91	0.6351
Race							0.46	0.7958
White	38.5	15	54.0	82	55.4	87		
Black	43.6	17	34.2	52	32.5	51		
Other	17.9	7	11.8	18	12.1	19		

*Differences were considered significant if $p < 0.05$ (shown in bold).
Abbreviations: SD = standard deviation.

Supplementary Table 3. Rates of All Psychotropic Medication Use by Age Group

	Preschool (N=302)		School-Age (N=316)		Adolescent (N=196)	
Medication	**%**	**N**	**%**	**N**	**%**	**N**
Any psychotropic	9.3	28	26.0	82	32.1	63
Antipsychotic	4.0	12	8.5	27	5.6	11
Antianxiety	0.0	0	1.0	3	4.6	9
Antidepressant	0.0	0	9.2	29	17.4	34
Non-antipsychotic mood stabilizer	0.7	2	4.1	13	3.6	7
ADHD medication	6.3	19	23.7	75	23.0	45
Alpha-agonist	1.7	5	7.0	22	2.0	4
Stimulant	4.3	13	23.1	73	22.5	44
Strattera	1.0	3	5.4	17	1.0	2

Abbreviations: ADHD = attention-deficit/hyperactivity disorder.

Supplementary Table 4. Rates of Non-Pharmacologic Therapy by Age Group.

	Non-Pharmacologic Therapy		
Preschool	**Total N**	**%**	**N**
All children	301	24.9	75
Any research diagnosis	184	35.3	65
MDD	95	43.2	41
ADHD	58	60.3	35
Any psychotropic mediation	28	89.3	25
Antidepressants	0	0.0	0
ADHD medication	19	89.5	17
Antipsychotics	12	100.0	12
	Non-Pharmacologic Therapy		
School-Age	**Total N**	**%**	**N**
All children	316	50.0	158
Any research diagnosis	200	65.0	130
MDD	111	76.6	85
ADHD	78	85.9	67
Any psychotropic mediation	82	96.3	79
Antidepressants	29	100.0	29
ADHD medication	75	97.3	73
Antipsychotics	27	100.0	27
	Non-Pharmacologic Therapy		
Adolescent/Early Adult	**Total N**	**%**	**N**
All children	195	50.3	98
Any research diagnosis	112	68.8	77
MDD	47	80.9	38
ADHD	25	80.0	20
Any psychotropic mediation	63	79.4	50
Antidepressants	34	91.2	31
ADHD medication	45	77.8	35
Antipsychotics	11	100.0	11

Abbreviations: MDD = major depressive disorder, ADHD = attention-deficit/hyperactivity disorder.

Supplementary Table 5. Psychotropic use in participants without a corresponding research diagnosis

		No ADHD Meds		ADHD Meds	
	Total N	N	%	N	%
No Preschool ADHD	244	237	97.1	7	2.9
		No Antidepressants		**Antidepressants**	
	Total N	N	%	N	%
No Preschool MDD or Anxiety	161	161	100%	0	0%
		No ADHD Meds		**ADHD Meds**	
	Total N	N	%	N	%
No School-Age ADHD	237	214	90.3	23	9.7
No School-Age or Prior ADHD	218	199	91.3	19	8.7
		No Antidepressants		**Antidepressants**	
	Total N	N	%	N	%
No School-Age MDD or Anxiety	152	151	99.3	1	0.7
No School-Age or Prior MDD or Anxiety	115	115	100.0	0	0.0
		No ADHD Meds		**ADHD Meds**	
	Total N	N	%	N	%
No Adolescent/Early Adult ADHD	170	146	85.9	24	14.1
No Adolescent/Early Adult or Prior ADHD	129	117	90.7	12	9.3
		No Antidepressants		**Antidepressants**	
	Total N	N	%	N	%
No Adolescent/Early Adult MDD or Anxiety	92	87	94.6	5	5.4
No Adolescent/Early Adult or Prior MDD or Anxiety	42	41	97.6	1	2.4

Abbreviations: ADHD = attention-deficit/hyperactivity disorder, MDD = major depressive disorder.

Supplementary Table 6. ADHD severity scores in children without a research diagnosis of ADHD by ADHD medication prescription status

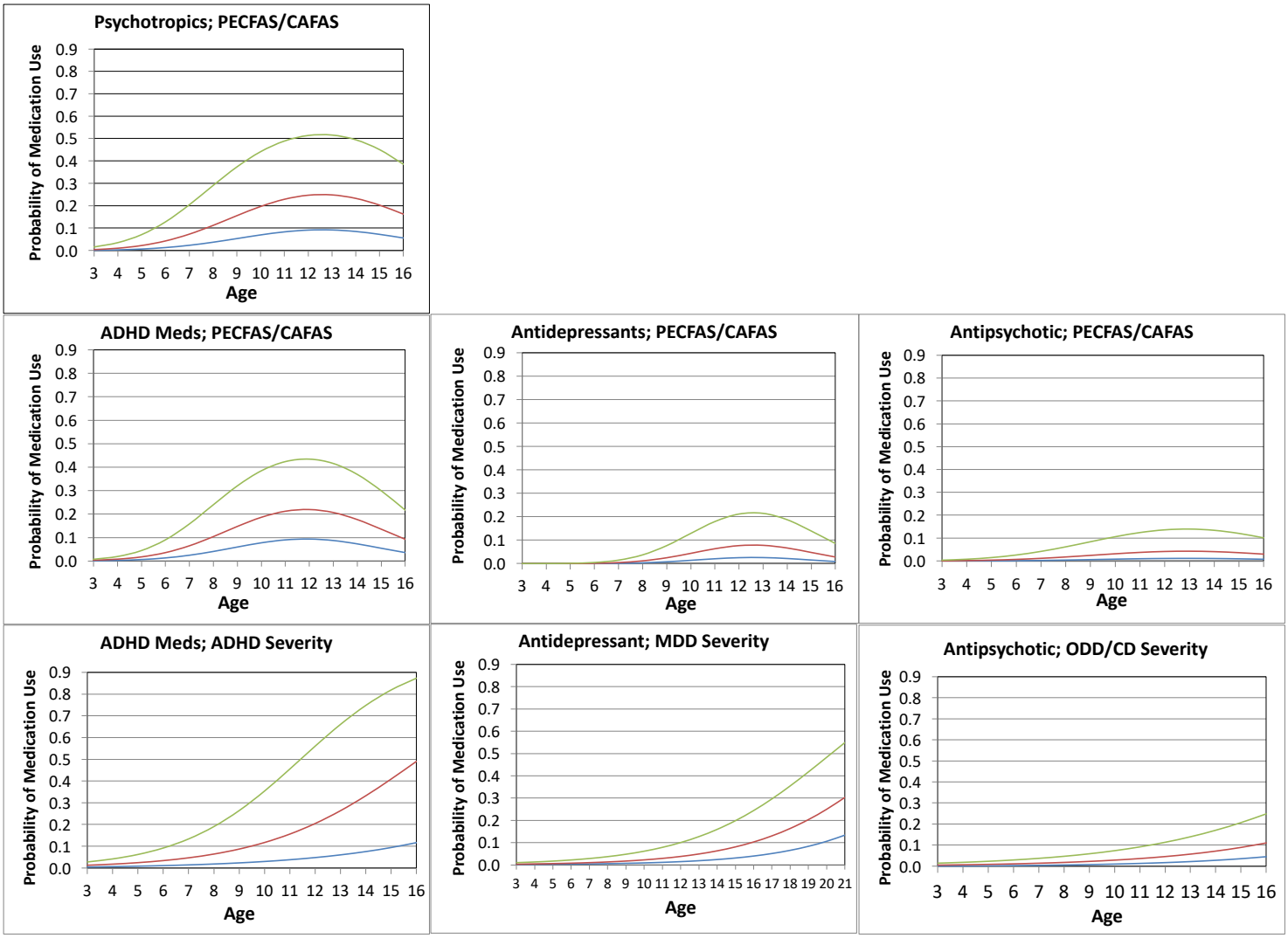
	No Preschool ADHD; No Preschool ADHD Meds			No Preschool ADHD; Preschool ADHD Meds			No ADHD Meds vs. ADHD Meds	
	N	**Mean**	**SD**	**N**	**Mean**	**SD**	**t**	**p**
ADHD severity	237	3.00	3.02	7	4.86	2.54	-1.61	0.1090
	No School-Age ADHD; No School-Age ADHD Meds			**No School-Age ADHD; School-Age ADHD Meds**				
	N	**Mean**	**SD**	**N**	**Mean**	**SD**	**t**	**P**
ADHD severity	214	2.19	2.37	23	5.35	3.04	-5.90	**<0.0001**
	No Adolescent/Early Adult ADHD; No Adolescent/Early Adult ADHD Meds			**No Adolescent/Early Adult ADHD; Adolescent/Early Adult ADHD Meds**				
	N	**Mean**	**SD**	**N**	**Mean**	**SD**	**t**	**P**
ADHD severity	59[a]	0.49	1.18	8	2.75	2.19	-2.86	**0.0223**

*Differences were considered significant if $p < 0.05$ (shown in bold).

[a]ADHD scores not available for all adolescent participants due to the format of the K-SADS.

Abbreviations: SD = standard deviation, ADHD = attention-deficit/hyperactivity disorder, K-SADS = Kiddie-Schedule for Affective Disorders and Schizophrenia.

Supplementary Figure 1. Generalized Estimating Equations of Psychotropic Medication Prescription by Age and Time-Varying PECFAS/CAFAS Score or Diagnosis Severity Score Covarying for Sex and Time-Varying Income-to-Needs Ratio



Footnote: X-axis = age; Y-axis = probability of medication use; Blue line = mean – 1 SD value of independent variable; Red line = mean value of independent variable; Green line = mean + 1 SD value of independent variable. The main effect of the independent variable was significant at $p<0.0001$ for all models.

Abbreviations: ADHD = attention-deficit/hyperactivity disorder, MDD = major depressive disorder, ODD = oppositional defiant disorder, CD = conduct disorder, PECFAS = Preschool and Early Childhood Functional Assessment Scale, CAFAS = Child and Adolescent Functional Assessment Scale, SD = standard deviation.