PEER-REVIEWED ARTICLE

# The Administration of Psychotropic Medication to Children Ages 0–4 in North Carolina: An Exploratory Analysis

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## Abstract

***Background:*** *The increasing use of psychotropic medication among preschool children raises concern because there are insufficient clinical guidelines and possible disparities.*

***Methods:*** *This study explored published administrative data (2001-2006) on the receipt of psychotropic medication by North Carolina Medicaid enrollees ages 0-4 by mental health catchment area. Quarterly prevalence statistics were examined and potential predictors of receipt were identified for future study.*

***Results:*** *During the study period the state's quarterly prevalence ranged from 2.3 to 3.0 recipients per 1,000 enrollees (range in catchment areas: 0.5 to 9.8). The state rate peaked at 3.0 in the third quarter of 2002 and at 2.9 in the third quarter of 2004.*

***Limitations:*** *The data are aggregated to a large area level and limited to Medicaid enrollees. The small number of catchment areas (36) limits the utility of statistical associations.*

***Conclusions:*** *Prevalence rates are high enough to deserve further exploration. Geographic variation exists. Psychotropic medication prescriptions for preschool children should be included as the state's mental health practitioners, policymakers, and planners discuss the service system and the mental health of children in our communities.*


***Keywords:*** *psychotropic drugs; child; preschool; catchment areas (health); regression analysis; mental health services*

Psychotropic medication is part of the standard of care for many mental disorders, but its increasing use among preschool children in the United States[1,2] has raised concern because of insufficient clinical guidelines and possible racial and economic disparities. Often the medication is a stimulant prescribed for attention deficit/hyperactivity disorder (ADHD) or related symptoms.[1,3-5] In examining Medicaid claims, Zito and colleagues found that between 1991 and 1995 the annual prevalence of stimulant prescriptions per 1,000 children ages 2-4 had increased from 4.1 to 12.3 in one state and from 4.9 to 8.9 in another.[2] Smaller but substantial increases were found in prescriptions for other psychotropic medications as well.

These trends are troubling for several reasons. Although ADHD screening instruments do exist for children as young as age 3,[6,7] not all preschool children who receive stimulants actually have a diagnosis of ADHD[5] and, among those who do, treatment varies widely.[3,4] Psychiatric diagnosis is difficult in this population,[9] especially for other disorders such as depression and psychosis. Most psychotropic drugs are not approved by the Food and Drug Administration (FDA) for use in people younger than age 6 (i.e., much of the current use is off-label). Especially in the case of antipsychotics and mood stabilizers, there is insufficient evidence of safety and effectiveness for preschool children, who may be particularly vulnerable to medication side effects.[1,8] Additional areas of concern include polypharmacy,[9,10] the use of psychotropic medication in the absence of well-child care or psychosocial services,[3,9] and the prescribing physician's level of preparation.[9] Most psychotropic medications taken by preschoolers are prescribed by pediatricians and general practitioners rather than by specialists in psychiatry.[1,5]

Regardless of whether increased psychotropic medication use among preschool children is mostly beneficial or mostly harmful, it is important to understand the factors associated with prescribing. Several studies have explored possible racial disparities in prescribing, with mixed results. In a study of 223 Michigan Medicaid recipients ages 0-4 with ADHD, Rappley and colleagues found no association between race and receipt of psychotropic medication.[4] Khandker and Simoni-Wastila found that African American children enrolled in the Georgia Medicaid program received

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significantly fewer prescriptions of any kind than did white enrollees.[11] In several studies, mostly using data from individual states or counties, investigators have found less psychotropic medication use among African American and/or Hispanic youths than among white youths.[12-15] However, Kelleher and colleagues found no such difference.[16] Zito and colleagues found greater racial disparities among economically disadvantaged youths.[15]

To the author's knowledge, no published study has examined the use of psychotropic medication among children in North Carolina. This exploratory, descriptive study takes advantage of a limited set of published secondary North Carolina Medicaid data for 2001-2006.[17] The study reports the prevalence of psychotropic medication prescriptions among North Carolina Medicaid enrollees ages 0-4, describes temporal variation, and identifies demographic and geographic predictors that could be included in future analyses of more detailed data. The importance of identifying relevant levels of analysis and including predictors at all levels is highlighted.

## Methods

### Data and Measures

From July 2001 through December 2006, the North Carolina Division of Medical Assistance[17] published reports covering resource use in each of the state's 36 mental health catchment areas,[a] known as Local Management Entities (LMEs). For 15 calendar quarters during this period, the LME data included the number and proportion of Medicaid enrollees ages 0-4 who received psychotropic medication. This formed the basis for the dependent variable: number of psychotropic drug recipients per 1,000 enrollees.

The analyses described here are ecological in that they examine only the state and LME levels and (because of data limitations) not the county, provider, or individual levels. The LME is an appropriate unit of analysis only to the extent to which Medicaid mental health services within a catchment area are uniformly affected by LME policies and practices or by regional resources or demographic characteristics. This issue is addressed further in the Discussion section.

In order to check data accuracy, the author calculated Medicaid enrollment (ages 0-4) by LME and ensured that these counts were consistent with the two LME mergers (both in January 2003) documented in North Carolina legislative and Division of Medical Assistance reports. As an additional consistency check, enrollment was plotted over time by LME. All LMEs had similar trajectories, with small increases at most time points. In the first quarter of 2003 the denominator increased by 31% at the state level, with larger percent increases in some LMEs than in others. This sudden increase is likely due to the addition of NC Health Choice enrollees ages 0-4.[b] The study data and actual Medicaid and Health Choice enrollment counts are consistent with this explanation. A small decrease in prevalence accompanied the denominator change (see Figure 1). The statistical model controls for such changes between time points (see details below). The term "Medicaid enrollees," used in reference to the study population, includes Health Choice enrollees beginning with 2003 Quarter 1.

One error was identified: for the last nine quarters the Johnston County LME was absent from the data file, and there were two entries for Guilford County. In each case one Guilford entry was assigned to Johnston County based on calculated LME enrollment.

Four categories of independent variables—race and ethnicity, socioeconomic status (SES), population-related measures, and provider availability—were identified based on expected associations with access to care and/or quality of care, and therefore with the dependent variable. Year 2000 Census-based data on race and ethnicity (percent white non-Hispanic), SES (per capita income, percent in poverty, percent high school graduates among people age 25 and older, percent of children under age 18 who are uninsured), and population-related measures (population density [population per square mile], metropolitan statistical area [MSA] status, 2003 Rural-Urban Continuum Code) were obtained from the US Census Bureau and the US Department of Agriculture.[18-22] Provider availability was measured in two ways: (1) the number of psychiatrists per 10,000 population (for the year 2000) was calculated using data from the North Carolina Health Professions Data System[23] and (2) the number of primary care providers per 10,000 population (for 1998, adjusted for county-level indicators of high need) was calculated from data provided by the Cecil G. Sheps Center for Health Services Research at the University of North Carolina at Chapel Hill.[24] Because the dependent variable was measured only at the LME level, and because each LME serves one or more whole counties, each independent variable was aggregated from the county level to the LME level. For this purpose, each county was associated with the LME to which it belonged as of July 1, 2003. This was consistent with the data structure and ensured the comparability of measurements over time by holding geographic areas constant. MSA status was aggregated by creating a variable to indicate whether more than 50% of an LME's population lived in a MSA.

a. There were 39 Area Mental Health Programs at the beginning of the study period, each serving one or more of North Carolina's 100 counties. In July 2003, mergers decreased this number to the 36 areas represented in the study data. As of July 2008, additional mergers had decreased the number of catchment areas to 24 and the Area Program designation had been changed to Local Management Entity (LME). The latter term will be used throughout the current paper to refer to a local mental health authority or to its service region.

b. NC Health Choice is the state's insurance program for uninsured children.

The University of North Carolina's Public Health and Nursing Institutional Review Board determined that Board approval was not required for this study.

## Statistical Analyses

Quarterly statistics were calculated to describe the proportion of enrollees ages 0-4 who received psychotropic medication. Potential area-level predictors of psychotropic medication receipt were assessed in two ways: (1) correlations with the dependent variable were calculated, and (2) single-predictor hierarchical linear models (HLMs) were constructed using the MIXED procedure in the statistical software program SAS.[25] The HLMs provided a stronger measure of association by utilizing the 15 repeated measures for each LME while controlling for the clustering of observations within LMEs. In order to control for policy or practice changes over time, the 15 calendar quarters were represented by 14 dummy variables. Because this study is exploratory and the number of LMEs is small, multivariate models and parameter estimates are not presented; only the direction and strength of each association is reported. Percentage of variance explained is calculated according to the formula given by Snijders and Bosker.[26]

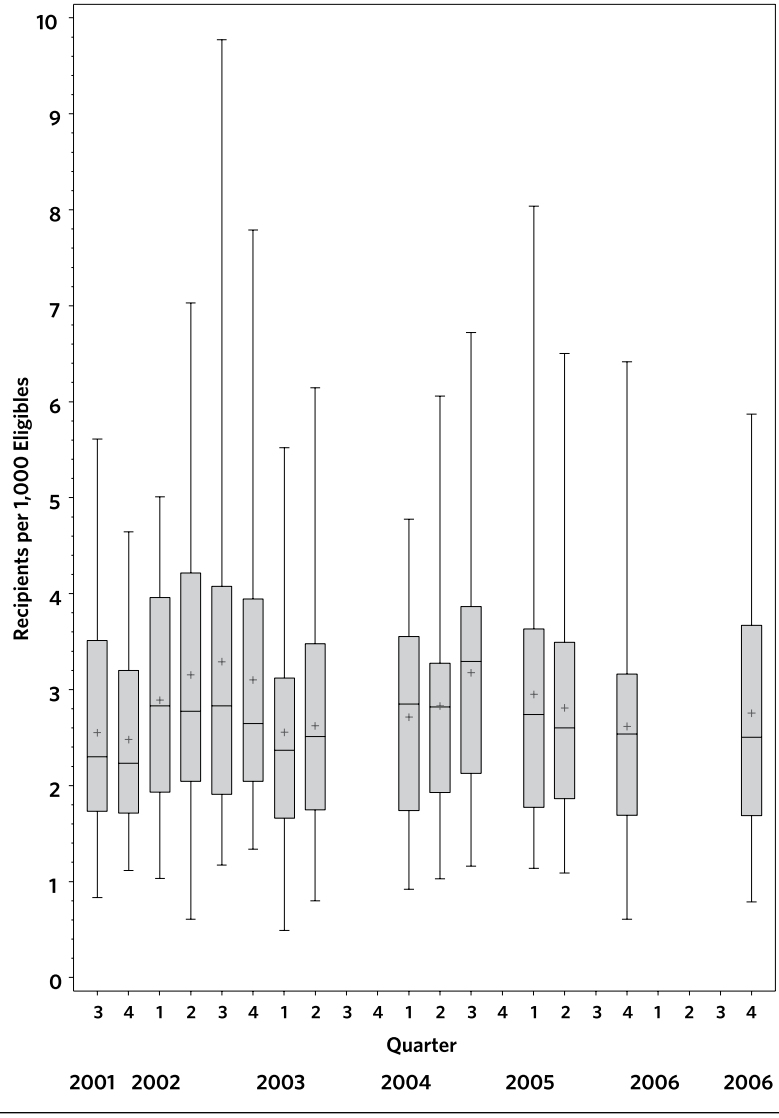
Because it had a skewed distribution, the dependent variable—which is exactly 1,000 times a child's probability (*p*) of receiving psychotropic drugs in a given catchment area and quarter—was transformed for correlation and HLM analyses by calculating log ($p/(1-p)$), the log odds of receipt. This variable had a normal distribution.

## Results

Quarterly administrative files, published alongside the catchment area data, list the psychotropic drugs received by Medicaid enrollees ages 0-4. Most of the drugs listed were antidepressants (20), antipsychotics or mood stabilizers (12), stimulants (7), or anxiolytics (7). One was a combination antipsychotic/antidepressant.[c] Figure 1 shows the variation in receipt of psychotropic medication per 1,000 Medicaid enrollees in this age range, both among LMEs and over time. The mean rate ranged from 2.5 to 3.3 per 1,000 (median 2.2 to 3.3, standard deviation 1.1 to 1.8), with peaks in 2002 Quarter 3 and 2004 Quarter 3. Most LMEs had their highest rates near these two time points (not shown). The minimum LME rate per 1,000 was 0.5 and the maximum was 9.8. The state rate per 1,000 ranged from 2.3 to 3.0 over the same time period, with a mean of 2.6. Similar to the LME rates, the state rate peaked at 3.0 in 2002 Quarter 3 and at 2.9 in 2004 Quarter 3.

Table 1 (page 12) shows the mean LME-level correlation (across the 15 calendar quarters) between each predictor and the log odds of receiving psychotropic medication.

**Figure 1.**
**Psychotropic Drug Recipients Per 1,000 Medicaid Eligibles Ages 0-4 in 36 Mental Health Catchment Areas, 2001-2006**




c. A 24-hour nicotine patch appeared on the drug list for 2005 Quarter 1 only. This is assumed to be a data error but is mentioned here for completeness. The one-time error should have little effect on the results.

HLM results are used to indicate the percentage of variance explained by each predictor and the significance of each association, controlling for the clustering of observations within LMEs. The results are consistent; the five HLMs with significant effects correspond to the five largest mean correlations, and the proportions of variance explained in the HLMs are approximately equal to the squares of the corresponding mean correlations. More rural LMEs and those with proportionally larger white non-Hispanic populations have higher prevalence rates. LMEs with high per capita income, high population density, and high psychiatrist availability have lower prevalence rates.

The HLM results indicated that two-thirds (66.4%) of the variation in the dependent variable reflected differences in prevalence between LMEs rather than change over time within LMEs or residual variation.

## Discussion

For North Carolina Medicaid enrollees ages 0-4 the quarterly rate of receipt of psychotropic medication, at the state level, ranged from 2.3 to 3.0 per 1,000 during the study period. Depending on the degree of overlap among groups of children who received psychotropic medication in different quarters during the same year, the annual rates may have been as low as 2.4 to 3.0 or as high as 9.9 to 11.1.[d] The latter rates are comparable to those reported in other studies of preschool-aged Medicaid enrollees after the dramatic increases of the early 1990s. For example, based on year 1996 claims, Zito and colleagues reported annual rates of 9.8 and 15.3 respectively for children ages 0-4 in a mid-Atlantic state and a Midwestern state.[27] Based on 1998-1999 Connecticut Medicaid claims, Martin and colleagues reported an annual rate of 11.2 for children ages 2-4.[28] (Because medication use increases with age, the rate should be somewhat higher for ages 2-4 than for ages 0-4.) Strikingly, the highest *quarterly* LME rate in the current study (9.8) is on the order of the *annual* state rates reported in the previous studies. Clearly the proportion of North Carolina's youngest Medicaid enrollees who receive psychotropic medication is sufficient to warrant further attention, certainly in some areas and probably statewide.

A few additional issues should be considered when interpreting the current results in the context of previous findings. Medicaid programs in different states may vary in policy, practice, or population served. Historical changes (such as policy or program implementation) may have occurred after the earlier studies were completed. There may also be differences in methods, particularly in the definition of "psychotropic." For example, the following drugs were absent in the administrative data used for

**Table 1.**
**Associations Between Predictors and Log Odds of Receiving Psychotropic Medication Among Children Ages 0-4 (N=36 Mental Health Catchment Areas)**

| Predictor Category | Predictor | Mean Correlation, 2001 Quarter 3-2006 Quarter 4 | Percent Variance Explained in HLM[a] |
|---|---|---|---|
| Race/Ethnicity | Percent white non-Hispanic | 0.41 | 22% |
| Socioeconomic Status | Per capita income | -0.35 | 15% |
| | Percent in poverty | 0.03 | |
| | Percent uninsured (under 18) | -0.04 | |
| | Percent high school graduates (age 25+) | -0.08 | |
| Population-Related | Population density | -0.42 | 23% |
| | Rural-Urban Continuum Code (2003)[b] | 0.29 | 9% |
| | >50% in metropolitan statistical areas | -0.24 | |
| Provider Availability | Psychiatrists per 10,000 population | -0.29 | 10% |
| | Primary care providers per 10,000 population | -0.26 | |

a. The hierarchical linear model (HLM) uses repeated observations over 15 calendar quarters, controls for the clustering of observations within Local Management Entities, and controls for change between time points in the mean of the dependent variable. Direction of effect and percent variance explained are shown only for effects significant at the 0.05 level. Percent variance explained is calculated according to the formula given by Snijders and Bosker.[26]
b. The Rural-Urban Continuum Code is scored from 1 (most urban) to 9 (most rural).

d. For each of the four complete fiscal years (July-June) in the study period, lower and upper bounds on the annual rate were estimated post-hoc. Within each fiscal year the lower bound is the maximum quarterly rate and the upper bound is the sum of the quarterly rates. Quarters with missing data were assigned the mean of the most recent past rate and the next available future rate.

the current study: alpha-adrenergic agonists (included in both previous studies), hydroxyzine hydrochloride (included by Zito and colleagues), and mood stabilizer anticonvulsants (included in both previous studies, at least for certain primary diagnoses).[27,28] In the current study, the medication lists included mood stabilizers such as lithium and aripiprazole and atypical antipsychotics (e.g., risperidone) that can be used in the treatment of bipolar disorder. Anticonvulsants that are sometimes used as mood stabilizers (e.g., carbamazepine, valproic acid, lamotrigine) were not included. Also, although some of the drugs classified as anxiolytics in the current study could also be classified as sedatives or hypnotics, it is possible that not all anxiolytics, sedatives, and hypnotics were included in generating the administrative data. Thus, the current study may be subject to a narrower definition of "psychotropic" than those used in previous studies.

Although most of the variation in prevalence of psychotropic medication receipt occurs between LMEs, there is some variation over time, including noticeable peaks in 2002 Quarter 3 and 2004 Quarter 3, which appear in the data from individual LMEs (not shown) as well as in the summary statistics (see Figure 1, page 11). Although these trends may appear insignificant, the shift between 2001 Quarter 4 and 2002 Quarter 3 is a 28% increase, resulting in the receipt of psychotropic medication in 2002 Quarter 3 by 204 more children than would have received it had prevalence remained constant during that interval. These peaks appear to be both systematic and temporary, suggesting that they may be related to state or federal factors but were not caused by permanent shifts in policy or practice. It is possible that gradual, temporary increases in prevalence were caused in part by FDA approval of two drugs for the treatment of ADHD in children over 5: dexmethylphenidate hydrochloride on November 13, 2001 and atomoxetine hydrochloride on November 26, 2002. Seasonal variation in the use of psychotropic drugs may also be a contributing factor. An FDA black box warning on antidepressants was issued in 2004 Quarter 4 and may have contributed to the decline in prevalence during 2004-2005. A more definitive interpretation could be sought through quantitative analysis of claims data or through qualitative analysis of administrative and/or interview data from sources such as the state Medicaid and mental health divisions, individual LMEs, and treatment providers.

The variation in the outcome across LMEs is intriguing (see Figure 1, page 11). The difference between the minimum and maximum prevalence reached as high as 8.6 per 1,000 enrollees, and the ratio of maximum to minimum prevalence rates sometimes exceeded 10. This means that at some points in time there was a tenfold difference between the highest and lowest rates of use. This large amount of variation highlights the importance of examining and understanding differences in policy and practice among communities within a given state.

Only narrow and circumscribed inferences can be made about the relationships between LME-level variables and the receipt of psychotropic medication. The small number of LMEs in the state limits the utility of statistical associations. Further, although LMEs may influence the prescribing of psychotropic medication, county-level and practice-level information is important because some LMEs serve heterogeneous groups of counties and because there may be substantial variation among treatment providers. Individual-level information is also important because the relationships between socioeconomic variables and medication receipt may differ between the child level and the area level. The administrative data used for this study do not include information on child, provider, or even county characteristics, and ecological relationships observed at the LME level cannot be inferred to exist at other levels. Given these caveats, the associations observed here suggest only that rurality, race/ethnicity, per capita income, population density, and psychiatrist availability are good candidates for predictor variables in future studies of more detailed data.

In addition to the limitations discussed in the previous paragraph, the current study focuses on Medicaid and NC Health Choice enrollees, so the findings cannot be generalized to the treatment of the uninsured or of those with private health insurance. However, despite these limitations, two important conclusions can be drawn. First, the administration of psychotropic medication to preschool-aged Medicaid enrollees in North Carolina is common enough to deserve further careful examination. Second, there is substantial geographic variation in prevalence within the state, making it important to consider contextual information in studying the administration of psychotropic medication to this population.

## Implications for Research

This investigation should be complemented by both qualitative and quantitative studies. The former should include the perspectives of stakeholders such as providers, caregivers, patients (where possible), and state regulators. The latter should include all relevant levels of analysis (e.g., county, provider, individual) and should use appropriate methods to control for the dependence among observations. Studying North Carolina's 100 counties and a large number of individuals would allow stronger conclusions to be drawn, especially about the relationships between socioeconomic variables and medication receipt. Additionally, studies of larger data sets may be able to examine subgroups such as children in foster care and issues such as polypharmacy.

## Implications for Policy and Practice

For much of the past decade North Carolina has been struggling to reform its mental health system.[29,30] Although children with mental illness are a target population for public mental health spending, they are also in a system with insufficient community resources, especially for rural and low-income citizens.[30] The current findings provide an opportunity

for mental health practitioners, policymakers, and planners to enhance children's mental health care by examining prescribing practices, supporting further development of clinical guidelines, exploring how non-clinical factors (e.g., area-level resources) may influence prescribing practices, and ensuring that policies and practices match the best available evidence. Psychotropic medication prescriptions for preschool children should be part of the ongoing conversation in North Carolina about how the service system should function and what supports are needed for the mental health of children in our communities. **NCMJ**

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