ABSTRACT

OBJECTIVE: To examine the associations between mental and physical illness in hospitalized children.

METHODS: The data for this analysis came from the 2009 Kids’ Inpatient Database (KID). Any child with an International Classification of Diseases, Ninth Revision code indicative of depressive, anxiety, or bipolar disorders or a diagnosis of sickle cell disease, diabetes mellitus type 1 or 2, asthma, or attention-deficit/hyperactivity disorder (ADHD) were included. Using SAS software, we performed χ² tests and multivariable logistic regression to determine degrees of association.

RESULTS: Children discharged with sickle cell disease, asthma, diabetes mellitus type 1, diabetes mellitus type 2, and ADHD were 0.94, 2.76, 3.50, 6.37, and 38.39 times more likely to have a comorbid anxiety, depression, or bipolar disorder diagnosis than other hospitalized children, respectively.

CONCLUSIONS: Children with several chronic physical illnesses (asthma, diabetes mellitus type 1, diabetes mellitus type 2) and mental illnesses (ADHD) have higher odds of being discharged from the hospital with a comorbid mood or anxiety disorder compared with other children discharged from the hospital. It is therefore important to screen children hospitalized with chronic medical conditions for comorbid mental illness to ensure optimal clinical care, to improve overall health and long-term outcomes for these children.
Chronic childhood illnesses are becoming ever more common in the United States, with an estimated 7% of people <18 years old having a chronic medical condition in 2004, compared with 1.8% in 1980. As with adults, mental health conditions often co-occur with somatic health problems in children. However, although the literature examining the relationship between mental and somatic illnesses in adults is abundant, there are few studies looking at this issue in children. In the adult population, studies have shown that people with mental illness have higher rates of existing physical health problems, are at higher risk of developing physical health problems, and have a shorter life expectancy than those without mental illness. Adults who have comorbid mental illness are also less likely to seek and obtain appropriate care for their physical conditions or adhere to treatment regimens, which often leads to worsening of the condition. Similar large-scale studies examining health of children with comorbid mental and somatic illnesses are limited. This is a large gap in the literature, because mental illness is prevalent among children. According to the Centers for Disease Control, in any given year 13% to 20% of children meet criteria for a mental illness. Most of the studies that do exist are limited to specific populations. For example, previous studies have examined rates of comorbid physical illness among youth entering residential treatment programs and among children with anxiety disorders. Some studies have also assessed the rates of mental health conditions among children with physical and other health problems such as sickle cell disease, diabetes, and attention-deficit/hyperactivity disorder (ADHD) in the outpatient setting.

One group that is underrepresented in the literature is hospitalized pediatric patients. In 2009, >3.1 million US children ages 1 to 21 years (3.6 hospitalizations per 100 children) had an inpatient hospital stay. Respiratory illnesses such as asthma and pneumonia were the most common reason for hospitalization among children ages 1 to 9 years, and mental illness was the most common primary diagnosis among children age 10 to 14 years and the second most common primary diagnosis among those 15 to 21 years of age. Given the high proportion of mental health hospitalizations among older children and the strong connection between mental illness and some physical conditions found in adults, we thought an examination of mental and physical health comorbidity among hospitalized children was warranted. We hypothesized that children hospitalized for chronic physical ailments would have high rates of comorbid mental illness.

METHODS
This is a cross-sectional study of comorbid mental (depression, anxiety, or bipolar disorder) and somatic illness among US children hospitalized in 2009. Data came from the Kids’ Inpatient Database (KID), created by the Agency for Healthcare Research and Quality (AHRQ) as part of the Healthcare Cost and Utilization Project (HCUP). Subjects are drawn from a sampling of discharges from community nonrehabilitation hospitals (4121 hospitals in 44 states) in the United States that participate in HCUP. Eighty percent of pediatric discharges are randomly drawn from each frame hospital to build the database. The American Hospital Association universe is used as the standard to develop discharge weights so that the data can be used to determine national estimates. The database contains ~3.4 million unweighted discharges, representing a weighted total of 7,370,203 discharges for children ages 0 to 20 years.

Inclusion Criteria
All nonneonate hospitalizations from the 2009 KID were included in the analysis. Then, any hospitalization with an International Classification of Diseases, Ninth Revision (ICD-9) primary or secondary diagnostic code indicative of depression, anxiety, or bipolar disorder was included in the analysis as a mental health diagnosis. Additionally, all hospitalizations for physical illnesses as indicated by the following primary or secondary ICD-9 diagnostic codes were identified: sickle cell disease, diabetes mellitus types 1 and 2 (DM1, DM2), asthma, and ADHD. These diagnoses were specifically chosen because they are common, they affect children of all races, ages, and socioeconomic statuses, and when severe they often lead to hospitalization. A complete list of all ICD-9 codes used can be found in the Appendix.

Data Analysis
We determined the proportion of children hospitalized for physical health diagnoses who had comorbid mental health diagnoses and the number of children hospitalized primarily for mental health diagnoses who had comorbid physical health diagnoses. The primary diagnosis was the one listed first among all the ICD-9 codes attached to a discharge. Our denominator for both of these calculations was the total number of discharges with both a physical and a mental health diagnosis. These results were weighted to the US population of hospitalized children according to KID specifications.

All statistical analyses were conducted in SAS (SAS Institute, Inc, Cary, NC) software with the weighting system devised by HCUP and distributed with the data set. A P value of ≤.05 was used to determine statistical significance. The research was exempted from full institutional review board review by the University of Maryland Human Protections Research Office based on the exclusive use of deidentified data.

RESULTS
Male children made up 47.4% of all 2009 hospital discharges. White children made up 51.1% of hospitalizations, black children made up 16.0%, and Hispanic children 21.8%. Medicaid was the primary payer for 48.5% of discharges, and private insurance (including health maintenance organizations) covered 42.5% of children (Table 1). The total number of discharges including both mental and somatic illness ICD-9 codes was 108,058. This was the primary cohort from which the following entries were identified for the analysis. Several different chronic childhood illnesses were examined in relationship with mental illness; these were sickle cell disease, DM1, DM2, asthma, and ADHD (Table 2, percentages of comorbid diagnoses, Table 3, odds ratios[ORs]). Children with sickle cell
Children with DM1, DM2, asthma, or ADHD had higher odds of receiving a diagnosis of comorbid anxiety, depression, or bipolar disorder compared with children without these childhood illnesses. Children with sickle cell disease had lower odds of receiving a diagnosis of anxiety or bipolar disorder than children without sickle cell disease and higher odds of receiving a diagnosis of depression. These findings are in general agreement with previous studies that have shown a relationship between chronic childhood illness and mental illness.17–19 However, 2 findings stand out. First, children with ADHD have much higher odds of receiving a diagnosis of mental illness compared with children with any of the other childhood illnesses examined. Previous studies have suggested ADHD is comorbid with other mental illnesses in children at the following rates: depression between 9% and 38%, anxiety between 5% and 15%, and bipolar disorder 16%.20,21 The very high rates of comorbid ADHD and mental illness are probably the result of at least 3 phenomena. First, ADHD is a behavioral and emotional disorder, as are mental illnesses; therefore, there may be some

higher than for any of the other diagnoses (OR = 38.39; 95% CI, 37.89–38.89; P = .0001).

**DISCUSSION**

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common pathways that exist for both diseases. Family and population studies have shown that there is a familial link between ADHD and depression and between ADHD and bipolar disorder.20 Also, there have been several studies examining the shared pathologic pathways between ADHD and anxiety disorders; for example, 1 study examining ADHD and obsessive–compulsive disorder found that there were subtle abnormalities in the basal ganglia common to both illnesses.21 Second, patients with ADHD often have difficulty with academic performance, social relationships, and family interactions that could contribute to the patient developing depression or anxiety. However, the majority of studies conclude that it is a combination of increased heritability and social stressors that makes children more likely to have comorbid ADHD and depression or anxiety.20,21 Finally, children with a diagnosis of ADHD are often treated by a pediatric mental health specialist, and these practitioners may be more sensitive to identification of other mental illness and therefore more likely to diagnose them.

The second finding of interest is related to sickle cell disease, in which the odds of receiving a diagnosis of anxiety or bipolar disorder is lower than for children without the disease, and the odds of receiving a diagnosis of comorbid depression are higher. Despite having a higher odds of receiving a diagnosis of depression in the study presented here, it was significantly less than the odds of receiving a diagnosis of depression if a child had 1 of the other illnesses examined. One possible explanation for the lower odds of receiving a diagnosis of anxiety or bipolar disorder, as well as the only slightly elevated risk of receiving a diagnosis of depression, if a child has sickle cell disease is that most children with sickle cell disease are black. Because many studies have demonstrated that black children are less likely to receive a diagnosis of a mental health condition or use mental health services than white children, race may be a confounding variable in the relationship between sickle cell and the diagnosis of mental illness, with mental health diagnoses being missed in more black children than in children of another race or ethnicity.22

### TABLE 3 ORs for Childhood Diseases and Mental Illness, Children Ages 0–20

<table>
<thead>
<tr>
<th>Childhood Illness</th>
<th>Anxiety, Depression, or Bipolar Disorder Diagnosis</th>
<th>Anxiety Diagnosis Only</th>
<th>Depression Diagnosis Only</th>
<th>Bipolar Disorder Diagnosis Only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>CI</td>
<td>OR</td>
<td>CI</td>
</tr>
<tr>
<td>Sickle cell disease</td>
<td>0.94*</td>
<td>0.89–0.99</td>
<td>0.87**</td>
<td>0.79–0.95</td>
</tr>
<tr>
<td>DM1</td>
<td>3.50</td>
<td>3.42–3.59</td>
<td>2.08</td>
<td>1.97–2.20</td>
</tr>
<tr>
<td>Asthma</td>
<td>2.76</td>
<td>2.73–2.79</td>
<td>3.05</td>
<td>2.98–3.10</td>
</tr>
</tbody>
</table>

* *P* = .0123, **P** = .0038; all other odds ratios have *P* < .0001.

### STRENGTHS AND LIMITATIONS

The studies included in this report have several strengths, many of which were related to the KID. First, the KID is a large database with >3 million individual discharges. Additionally, HCUP has created a weighting system so that these discharges could be used to estimate all discharges of children ages 0 to 20 years in the United States in general inpatient settings. This large size allows focused statistical analysis with small *P* values and confidence intervals. Data for inclusion in the KID were acquired through probability-based sampling, thus minimizing bias. Despite the many positive aspects of the KID, there are also some limitations. One of the major drawbacks is that it is not possible to know whether each of the discharges represents a different patient or whether they represent the same patient who was discharged from the hospital more than once in the course of the year. Thus, the estimates of prevalence, especially those relating to relationships between childhood illness and mental illness, could be overstated. Additionally, there could be some misclassifications of discharge diagnoses, because of either human error or hospital coding, which may lead to inaccurate prevalence data. The database also did not include inpatient stays that occurred in psychiatric hospitals or rehabilitation hospitals and centers. The latter could lead to an underestimate of the frequency of mental health hospitalizations. Also, there were some hospitals that did not report race; this limitation could lead to bias if there was a relationship between this demographic factor and mental illness in these particular hospitals. However, given the extremely large size of the KID, it is unlikely that this lack of data had a significant impact on the validity of the findings. Finally, the cross-sectional nature of the database makes it impossible to determine the temporal relationship between the childhood illnesses and the mental illnesses. This would be valuable information for creation of screening programs. Because we know so little about comorbid physical and mental health in children, it is necessary to first look at frequency in an analysis such as described in this article; then, cohort or case–control studies can follow to examine temporality.

### CONCLUSIONS

Overall, investigations relating to chronic childhood illnesses and their relationship to mental illness are important because they can inform clinicians that certain groups of children are more at risk for having or developing mental illness than others. Through these findings, new screening programs or changes in the way care is delivered can be explored, and eventually screening for all children may become standard practice in hospital settings. Identifying mental illness in children who come to the hospital for physical illnesses can lead to lowering the morbidity from both diseases in the long run, because patients who receive appropriate care for their mental illness tend to take better care of their physical illnesses. Additionally, it could lead to improved health in adulthood.
Acknowledgments

Dr Jessica Brown and Dr Diane Marie St George, both of the Department of Epidemiology and Public Health, University of Maryland School of Medicine, reviewed this project and helped guide the investigation.

REFERENCES

APPENDIX: ICD-9 CODES USED

Depression ICD-9 Codes

293.83: Organic Affective Syndrome
296.20: Depressive Affective Disorders—Unspecified
296.21: Depressive Affective Disorder—Mild
296.22: Depressive Affective Disorder—Moderate
296.23: Depressive Affective Disorder—Severe Without Psychotic Behavior
296.24: Depressive Affective Disorder—Severe With Psychotic Behavior
296.25: Depressive Affective Disorder—Partial Remission
296.26: Depressive Affective Disorder—Full Remission
296.30: Recurrent Depressive Disorder—Unspecified
296.31: Recurrent Depressive Disorder—Mild
296.32: Recurrent Depressive Disorder—Moderate
296.33: Recurrent Depressive Disorder—Severe
296.34: Recurrent Depressive Disorder—Severe With Psychotic Behavior
296.35: Recurrent Depressive Disorder—Partial Remission
296.36: Recurrent Depressive Disorder—Full Remission
311: Depressive Disorder Not Elsewhere Classified
300.4: Dysthymic Disorder

Anxiety ICD-9 Codes

300.00: Anxiety State—Unspecified
300.01: Panic Disorder—No Agoraphobia
300.02: Generalized Anxiety Disorder
300.09: Other Anxiety States
300.10: Hysteria—Unspecified
300.11: Conversion Disorder
300.12: Dissociative Amnesia
300.13: Dissociative Fugue
300.14: Dissociative Identity Disorder
300.15: Dissociative Disorder or Reaction—Unspecified
300.20: Phobia—Unspecified
300.21: Agoraphobia With Panic
300.22: Agoraphobia Without Mention of Panic Attacks
300.23: Social Phobia
300.29: Other Isolated or Specific Phobias
300.3: Obsessive Compulsive Disorder
309.81: Posttraumatic Stress Disorder

Bipolar Disorder

296.00: Bipolar I Disorder, Single Manic Episode, Unspecified
296.01: Bipolar I Disorder, Single Manic Episode, Mild
296.02: Bipolar I Disorder, Single Manic Episode, Moderate
296.03: Bipolar I Disorder, Single Manic Episode, Severe, Without Mention of Psychotic Behavior
296.04: Bipolar I Disorder, Single manic Episode, Severe, Specified as With Psychotic Behavior
296.05: Bipolar I Disorder, Single manic Episode, in Partial or Unspecified Remission
296.06: Bipolar I Disorder, Single manic Episode, in Full Remission
296.10: Manic Affective Disorder, Recurrent Episode, Unspecified
296.11: Manic Affective Disorder, Recurrent Episode, Mild
296.12: Manic Affective Disorder, Recurrent Episode, Moderate
296.13: Manic Affective Disorder, Recurrent Episode, Severe, Without Mention of Psychotic Behavior
296.14: Manic Affective Disorder, Recurrent Episode, Severe, Specified as With Psychotic Behavior
296.15: Manic Affective Disorder, Recurrent Episode, in Partial or Unspecified Remission
296.16: Manic Affective Disorder, Recurrent Episode, in Full Remission
296.40: Bipolar I Disorder, Most Recent Episode (or Current) Manic, Unspecified
296.41: Bipolar I Disorder, Most Recent Episode (or Current) Manic, Mild
296.42: Bipolar I Disorder, Most Recent Episode (or Current) Manic, Moderate
296.43: Bipolar I Disorder, Most Recent Episode (or Current) Manic, Severe, Without Mention of Psychotic Behavior
296.44: Bipolar I Disorder, Most Recent Episode (or Current) Manic, Severe, Specified as With Psychotic Behavior
296.45: Bipolar I Disorder, Most Recent Episode (or Current) Manic, in Partial or Unspecified Remission
296.46: Bipolar I Disorder, Most Recent Episode (or Current) Manic, in Full Remission
296.50: Bipolar I Disorder, Most Recent Episode (or Current) Depressed, Unspecified
296.51: Bipolar I Disorder, Most Recent Episode (or Current) Depressed, Mild
296.52: Bipolar I Disorder, Most Recent Episode (or Current) Depressed, Moderate
296.53: Bipolar I Disorder, Most Recent Episode (or Current) Depressed, Severe, Without Mention of Psychotic Behavior
296.54: Bipolar I Disorder, Most Recent Episode (or Current) Depressed, Severe, Specified as With Psychotic Behavior
296.55: Bipolar I Disorder, Most Recent Episode (or Current) Depressed, in Partial or Unspecified Remission
296.56: Bipolar I Disorder, Most Recent Episode (or Current) Depressed, in Full Remission
296.60: Bipolar I Disorder, Most Recent Episode (or Current) Mixed, Unspecified
296.61: Bipolar I Disorder, Most Recent Episode (or Current) Mixed, Mild
296.62: Bipolar I Disorder, Most Recent Episode (or Current) Mixed, Moderate
296.63: Bipolar I Disorder, Most Recent Episode (or Current) Mixed, Severe, Without Mention of Psychotic Behavior
296.64: Bipolar I Disorder, Most Recent Episode (or Current) Mixed, Severe, Specified as With Psychotic Behavior
296.65: Bipolar I Disorder, Most Recent Episode (or Current) Mixed, in Partial or Unspecified Remission
296.66: Bipolar I Disorder, Most Recent Episode (or Current) Mixed, in Full Remission
296.7: Bipolar I Disorder, Most Recent Episode (or Current) Unspecified
296.80: Bipolar Disorder, Unspecified
296.81: Atypical Manic Disorder
296.82: Atypical Depressive Disorder
296.89: Other Bipolar Disorders
296.90: Unspecified Episodic Mood Disorder
296.99: Other Specified Episodic Mood Disorder

Juvenile Arthritis ICD-9 Codes
714.30: Polyarticular Juvenile Rheumatoid Arthritis, Chronic or Unspecified
714.31: Polyarticular Juvenile Rheumatoid Arthritis, Acute
714.32: Pauciarticular Juvenile Rheumatoid Arthritis
714.33: Monoarticular Juvenile Rheumatoid Arthritis
Sickle Cell Disease ICD-9 Codes
282.60: Sickle-Cell Disease Unspecified
282.61: Sickle-Cell Disease Hb-SS Disease Without Crisis
282.62: Sickle-Cell Disease Hb-SS Disease With Crisis
282.63: Sickle-Cell/Hb-C Disease Without Crisis
282.64: Sickle-Cell/Hb-C Disease With Crisis
282.68: Other Sickle-Cell Disease Without Crisis
282.69: Other Sickle-Cell Disease With Crisis

Diabetes Mellitus Type I ICD-9 Codes
250.01: Diabetes Mellitus Without Mention of Complication—Type I [Juvenile Type], Not Stated as Uncontrolled
250.03: Diabetes Mellitus Without Mention of Complication—Type I [Juvenile Type], Uncontrolled
250.11: Diabetes With Ketoacidosis—Type I [Juvenile Type], Not Stated as Uncontrolled
250.13: Diabetes With Ketoacidosis—Type I [Juvenile Type], Uncontrolled
250.21: Diabetes With Hyperosmolarity—Type I [Juvenile Type], Not Stated as Uncontrolled
250.23: Diabetes With Hyperosmolarity—Type I [Juvenile Type], Uncontrolled
250.31: Diabetes With Other Coma—Type I [Juvenile Type], Not Stated as Uncontrolled
250.33: Diabetes With Other Coma—Type I [Juvenile Type], Uncontrolled
250.41: Diabetes With Renal Manifestations—Type I [Juvenile Type], Not Stated as Uncontrolled
250.43: Diabetes With Renal Manifestations—Type I [Juvenile Type], Uncontrolled
250.51: Diabetes With Ophthalmic Manifestations—Type I [Juvenile Type], Not Stated as Uncontrolled
250.53: Diabetes With Ophthalmic Manifestations—Type I [Juvenile Type], Uncontrolled
250.61: Diabetes With Neurologic Manifestations—Type I [Juvenile Type], Not Stated as Uncontrolled
250.63: Diabetes With Neurologic Manifestations—Type I [Juvenile Type], Uncontrolled
250.71: Diabetes With Peripheral Circulatory Disorders—Type I [Juvenile Type], Not Stated as Uncontrolled
250.73: Diabetes With Peripheral Circulatory Disorders—Type I [Juvenile Type], Uncontrolled
250.81: Diabetes With Other Specified Manifestations—Type I [Juvenile Type], Not Stated as Uncontrolled
250.83: Diabetes With Other Specified Manifestations—Type I [Juvenile Type], Uncontrolled
250.91: Diabetes With Unspecified Complication—Type I [Juvenile Type], Not Stated as Uncontrolled
250.93: Diabetes With Unspecified Complication—Type I [Juvenile Type], Uncontrolled

Diabetes Mellitus Type II ICD-9 Codes
250.00: Diabetes Mellitus Without Mention of Complication—Type II or Unspecified Type, Not Stated as Uncontrolled
250.02: Diabetes Mellitus Without Mention of Complication—Type II or Unspecified Type, Uncontrolled
250.10: Diabetes With Ketoacidosis—Type II or Unspecified Type, Not Stated as Uncontrolled
250.12: Diabetes With Ketoacidosis—Type II or Unspecified Type, Uncontrolled
250.20: Diabetes With Hyperosmolarity—Type II or Unspecified Type, Not Stated as Uncontrolled
250.22: Diabetes With Hyperosmolarity—Type II or Unspecified Type, Uncontrolled
250.30: Diabetes With Other Coma—Type II or Unspecified Type, Not Stated as Uncontrolled
250.32: Diabetes With Other Coma—Type II or Unspecified Type, Uncontrolled
250.40: Diabetes With Renal Manifestations—Type II or Unspecified Type, Not Stated as Uncontrolled
250.42: Diabetes With Renal Manifestations—Type II or Unspecified Type, Uncontrolled
250.50: Diabetes With Ophthalmic Manifestations—Type II or Unspecified Type, Not Stated as Uncontrolled
250.52: Diabetes With Ophthalmic Manifestations—Type II or Unspecified Type, Uncontrolled
250.60: Diabetes With Neurologic Manifestations—Type II or Unspecified Type, Not Stated as Uncontrolled
250.62: Diabetes With Neurologic Manifestations—Type II or Unspecified Type, Uncontrolled
250.70: Diabetes With Peripheral Circulatory Disorders—Type II or Unspecified Type, Not Stated as Uncontrolled
250.72: Diabetes With Peripheral Circulatory Disorders—Type II or Unspecified Type, Uncontrolled
250.80: Diabetes With Other Specified Manifestations—Type II or Unspecified Type, Not Stated as Uncontrolled
250.82: Diabetes With Other Specified Manifestations—Type II or Unspecified Type, Uncontrolled
250.90: Diabetes With Unspecified Complication—Type II or Unspecified Type, Not Stated as Uncontrolled
250.92: Diabetes With Unspecified Complication—Type II or Unspecified Type, Uncontrolled

**Asthma ICD-9 Codes**

493.00: Extrinsic Asthma Unspecified
493.01: Extrinsic Asthma With Status Asthmaticus
493.02: Extrinsic Asthma With (Acute) Exacerbation
493.10: Intrinsic Asthma Unspecified
493.11: Intrinsic Asthma With Status Asthmaticus Convert
493.12: Intrinsic Asthma With (Acute) Exacerbation Convert
493.20: Chronic Obstructive Asthma Unspecified Convert
493.21: Chronic Obstructive Asthma With Status Asthmaticus
493.22: Chronic Obstructive Asthma With (Acute) Exacerbation
493.81: Exercise Induced Bronchospasm
493.82: Cough Variant Asthma
493.90: Asthma, Unspecified Type, Unspecified
493.91: Asthma, Unspecified Type, With Status Asthmaticus
493.92: Asthma, Unspecified Type, With (Acute) Exacerbation

**Attention Deficit Disorder of Childhood**

314.00: Attention Deficit Disorder Without Mention of Hyperactivity
314.01: Attention Deficit Disorder With Hyperactivity
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