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ARTICLE

Prevalence of Developmental and Behavioral Disorders in a Pediatric Hospital

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What's Known on This Subject

This is the first prospective study of the prevalence of DDs in children admitted to a pediatric hospital for acute care.

What This Study Adds

This study shows that children who were admitted for acute care had a high prevalence of DDs. Many of the developmental problems had not been identified before the hospitalization.

ABSTRACT

OBJECTIVE. The objective of this study was to estimate the prevalence of developmental and behavioral disorders in a convenience sample of children in an acute care pediatric hospital setting. We hypothesized that hospitalized children would have a higher prevalence of developmental and behavioral disorders than the general population.

METHODS. Data for this cross-sectional study were collected during interviews with primary caregivers of 325 children from infancy throughout childhood who were admitted to a general pediatric service. Screening tests included the Child Development Inventory (3 months to 6 years), Parents' Evaluation of Developmental Status (0–8 years), Pediatric Symptom Checklist (4–18 years), and Vanderbilt Attention-Deficit/Hyperactivity Disorder Parent Rating Scale (6–18 years). Children were classified as having a known developmental and behavioral disorder, a suspected developmental and behavioral disorder, or no developmental and behavioral disorder.

RESULTS. The prevalence of developmental and behavioral disorders among the hospitalized children 6 months to 17 years of age was 33.5%. A total of 72 children (22.1%) had known developmental and behavioral disorders and 37 (11.4%) had suspected developmental and behavioral disorders. This high prevalence of developmental and behavioral disorders included high rates of cerebral palsy (6.1%) and mental retardation or developmental delay (8.6%).

CONCLUSION. Hospitalization for treatment of acute conditions provides another opportunity for developmental surveillance. This higher prevalence of developmental and behavioral disorders in hospitalized children emphasizes the need to screen for developmental disabilities at every opportunity. Strategies to implement systematic screening of hospitalized children should be examined. *Pediatrics* 2009;123:e490–e495

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Key Words
developmental disabilities, developmental disorders, behavior disorders, screening, hospitalized children, cerebral palsy, mental retardation

Abbreviations
ADHD—attention-deficit/hyperactivity disorder
CDI—Child Development Inventory
CI—confidence interval
DBD—developmental and behavioral disorder
DD—developmental disability
OR—odds ratio
PEDS—Parents' Evaluation of Developmental Status
PSC—Pediatric Symptom Checklist
VADPRS—Vanderbilt Attention-Deficit/Hyperactivity Disorder Parent Rating Scale

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THERE IS LIMITED information about the prevalence of developmental disabilities (DDs) in children admitted to pediatric hospitals. Individuals with DDs have more hospitalizations than the average population.[1] For this reason, it is expected that the prevalence of DDs among children who are admitted to a pediatric hospital would be higher. For the same reason, a higher prevalence of DDs that have not been identified is expected. The first study on the prevalence of DDs in a pediatric hospital was conducted by Feldman et al.[2] The retrospective study included 135 children who were <3 years of age and were hospitalized in a tertiary care setting for >1 month. The authors found that 54% of the children were eligible for early intervention services on the basis of a biological diagnosis (eg, Down syndrome or cerebral palsy) or developmental delay. A developmental evaluation was completed for 61% of the children, of whom 78% had developmental delay. Feldman et al[2] concluded that children with prolonged hospitalizations need developmental assessments.

In a previous retrospective study, we found a high prevalence of DDs (30%) in children admitted to a pediatric hospital.[3] When pediatric resident physicians conducted a short, informal, developmental screening (caregiver estimation of the child's age and calculation of a developmental quotient,[4] elicitation of caregiver concerns about the

child's development,[5] and assessment of current milestones for younger children[6,7] or school performance for older children), 10% of hospitalized children were identified for the first time as having a DD. In that study, we found a 34.8% prevalence of confirmed or suspected developmental and behavioral disorders (DBDs). The prevalence of cerebral palsy was 6.6%, and the prevalence of mental retardation or developmental delay was 7.7%. We also found that 15.4% of the children had a suspected DBD.

The lack of prospective data and the use of a convenience sample of children admitted only by university faculty physicians limited the generalization of those data. With the exception of that previous retrospective study, there is no published information about the prevalence of DDs among children admitted for short hospital stays. The developmental status of hospitalized children often is not considered a relevant issue when children are hospitalized with acute conditions and is not recorded in the medical record. Even in outpatient settings, the number of pediatricians who perform periodic developmental screenings is small.[8]

We conducted a prospective study to determine the prevalence of DBDs among children in an acute care, pediatric hospital setting. We hypothesized that a large number of hospitalized children would have unidentified DBDs.

METHODS

Participants

This cross-sectional, prospective study was conducted at a 225-bed pediatric hospital that serves a 6-state region in the southern United States. Data were collected from a convenience sample of 325 caregivers of hospitalized children between 6 months and 17 years of age. Eight parents refused to participate because of activities involving their child, the child's imminent discharge, or personal preference. Caregivers of children who were admitted to the general pediatric medical units by university faculty physicians or community pediatricians were selected to participate in the study. Approximately 2590 patients were admitted to the general pediatric services on the days data were collected. Only patients admitted for acute care were included. Elective admissions were excluded. Admission diagnoses are listed in Table 1. The research assistant collected data within the first few days (with a small proportion within the first 2 weeks) after a child's admission or transfer to or from the ICU or other units in the hospital.

TABLE 1 Characteristics of Children in the Study Sample

Characteristic	*n* (%)
Age group[a]	
0–4 y	186 (57.2)
5–6 y	39 (12.0)
7–8 y	25 (7.7)
≥9 y	75 (23.1)
Gender	
Male	184 (57)
Female	141 (43)
Ethnicity[b]	
White	190 (58.6)
Black	109 (33.6)
Hispanic	16 (4.9)
Other	9 (2.8)
Health insurance[c]	
Medicaid	224 (69.3)
Commercial	97 (30.0)
No insurance	2 (0.6)
Primary care physician	
Community pediatrician	198 (60.9)
Family medicine physician	42 (12.9)
University pediatrician	33 (10.2)
Unknown	52 (16.0)
Principal admission diagnosis[d]	
Infections, other sites	80 (24.8)
Pneumonia/bronchiolitis	52 (16.1)
Asthma	47 (14.6)
Gastrointestinal (gastroenteritis)	27 (8.4)
Seizures	20 (6.2)
Neurologic (bleeding, tumor, or metabolic disorder)	17 (5.3)
Hematologic (sickle cell disease or anemias)	14 (4.3)
Trauma/intoxication	12 (3.7)
Renal (urinary tract infection)	9 (2.8)
Diabetes mellitus	9 (2.8)
Nutrition (failure to thrive)	6 (1.9)
Cystic fibrosis	5 (1.6)
Other (eg, immunologic or postsurgical)	24 (7.4)
Government assistance[e]	
No	170 (52.3)
Yes	155 (47.7)
Caregiver	
Both parents	146 (44.9)
Mother	166 (51.1)
Other	13 (4.0)
Maternal education	
College or higher	108 (33.2)
High school or less	203 (62.5)
No information	14 (4.3)

[a] Age groups were based on the instruments used.
[b] Data were missing for 1 subject.
[c] Data were missing for 2 subjects.
[d] Data were missing for 3 subjects.
[e] Receives government assistance such as Supplemental Security Income, Temporary Assistance for Needy Children, or the Supplemental Nutrition Program for Women, Infants, and Children.

Procedure for Screening

Informed consent from the caregiver and assent from children >7 years of age were obtained before study enrollment. The research assistant completed a general questionnaire by interviewing the caregiver, and the caregiver completed 2 or 3 developmental screening tests, with assistance from the research assistant as needed. The research assistant reviewed medical records to extract reasons for admission and developmental information documented in the admission history and physical examination. A board-certified developmental pediatrician reviewed the results of the developmental screening and determined whether the child needed further evaluation. Discharge diagnoses were obtained from the medical record at a later date.

After the screening results were reviewed, a letter with a brief description of the results was mailed to the

TABLE 2 Screening Tests Administered According to Child's Age

Screening Tests	0–4 y	4–6 y	6–8 y	6–18 y
CDI	X	X		
PEDS	X	X	X	
PSC		X	X	X
VADPRS			X	X
General questionnaire	X	X	X	X

caregiver who participated in the study. In addition, a telephone call was made (or attempted) to caregivers of all children identified through the screening as having a suspected DBD. Children who were not receiving intervention services were advised to undergo further evaluation and to follow up with their primary care physician. The caregivers of the children identified through the screening as having a possible DBD were called at a later date after the child's hospitalization, to determine whether the caregivers had pursued the recommended additional evaluations. A random sample of caregivers of children with no DBD also was called, to serve as an additional control group for follow-up recommendations.

Measures

Approach

The developmental screening tests included 5 tools, which are described in detail below. The tests used were age specific; therefore, different tests were used for children of different ages (Table 2).

General Questionnaire

All caregivers completed a general questionnaire to provide demographic information about the child and the family, including ages, ethnicity, household composition, caregiver's education and employment status, sources of income (including government financial assistance), type of medical insurance, and type of primary care physician (community pediatrician, university faculty pediatrician, including resident physician continuity clinic, or family medicine physician). The general questionnaire also included questions about the caregiver's concerns about the child's development, estimation of the developmental age,[4,9,10] previous diagnoses of DBDs, grade level, progress in school, and any additional resources (ie, early intervention program, special education, or allied health therapy services).

Child Development Inventory

The Child Development Inventory (CDI) consists of 3 separate instruments, based on age (3 months to 6 years).[11,12] Each reported item (yes/no response) is a descriptor of developmental skills that are easily observable in everyday situations. Items assess only the better predictors of developmental status and measure the child's skills in the social, self-help, gross and fine motor, and language domains. If the child functions at <70% of age-group normative levels, then development is considered delayed. The sensitivity and specificity across studies are >75% and >70%, respectively.[13] Doig et al[14] reported sensitivity of 80% to 100% and specificity of 94% to 96% for the CDI. Developmental age estimation with the CDI also has a strong correlation with formal psychological and/or developmental testing.[15–17]

Parents' Evaluation of Developmental Status

The Parents' Evaluation of Developmental Status (PEDS) detects a wide range of developmental issues, including behavioral and mental health problems, in children from birth to 8 years of age.[18] The PEDS consists of 10 questions that elicit parental concerns about the child's development. Developmental and behavioral/mental health risk factors are rated as high, moderate, or low. Sensitivity ranges from 68% to 87% and specificity ranges from 66% to 80% across age groups.[19,20]

Pediatric Symptom Checklist

The Pediatric Symptom Checklist (PSC) consists of 35 short statements of problem behaviors in children 4 to 16 years of age, including both externalizing (eg, conduct and attention) and internalizing (eg, adjustment, anxiety, and depression) behaviors.[21] Ratings of never, sometimes, and often are assigned values of 0, 1, and 2, respectively. Item scores are then totaled, and values are compared with age-specific cutoff scores. A positive score indicates the need for further evaluation by a qualified health or mental health professional. Sensitivity ranges from 88% to 95% and specificity ranges from 68% to 100%.[21–23] The PSC has shown high rates of agreement with other behavior assessment tools and strong internal consistency, test-retest reliability, and validity when used to assess psychosocial functioning in children.[21,23,24]

Vanderbilt Attention-Deficit/Hyperactivity Disorder Parent Rating Scale

The Vanderbilt Attention-Deficit/Hyperactivity Disorder Parent Rating Scale (VADPRS) consists of 47 items, including all 18 *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*,[25] criteria for attention-deficit/hyperactivity disorder (ADHD), 8 criteria for oppositional defiant behavior, and 12 criteria for conduct disorder.[26] The scale also includes 7 items to screen for anxiety and depression and 5 questions to address academic and performance problems at school. Behavior ratings of never, occasionally, often, and very often are assigned values of 0, 1, 2, and 3, respectively, with higher-rated items counting toward the total score. The internal consistency is acceptable, and factor analysis shows the VADPRS is consistent with the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*, and other measures of ADHD.[26]

Criteria for Screening Classification

The developmental pediatrician classified the developmental status of children who participated in screening into 1 of 3 categories, that is, known DBD, suspected DBD, or no DBD. A child was classified in the known DBD category if (1) a previous diagnosis was noted in

TABLE 3 Classification of DBDs According to Principal Developmental Diagnosis

Classification	*n* (%)							
	ADHD	Behavioral/ Psychiatric	CP/Motor Delay	Developmental Delay/MR	Language Disorder	Learning Disability	Vision/ Hearing	Total
Known DBD	8 (2.5)	4 (1.2)	19 (5.8)	22 (6.8)	7 (2.1)	8 (2.5)	4 (1.2)	72 (22.1)
Suspected DBD	6 (1.8)	8 (2.5)	2 (0.6)	6 (1.8)	10 (3.1)	5 (1.5)	0	37 (11.4)
Total	14 (4.3)	12 (3.7)	21 (6.4)	28 (8.6)	17 (5.2)	13 (4.0)	4 (1.2)	109 (33.5)

Only 1 diagnostic category was used for each child. CP indicates cerebral palsy; MR, mental retardation.

TABLE 4 Classification of DBDs According to Screening Instrument

Classification	No./No. (%)[a]						
	General Questionnaire			CDI[c]	PEDS[d]	PSC	VADPRS
	Concerns	Estimated[b]	Both				
Known DBD	46/72 (63.9)	40/72 (55.6)	52/72 (72.2)	21/31 (67.7)	38/44 (86.4)	10/43 (23.3)	8/35 (22.9)
Suspected DBD	16/37 (43.2)	6/37 (16.2)	17/37 (45.9)	5/19 (26.3)	24/31 (77.4)	8/18 (44.4)	8/15 (53.3)
No DBD	13/203 (6.0)	6/210 (2.8)	19/216 (8.8)	4/143 (2.8)	31/169 (18.3)	3/83 (3.6)	0/60 (0.0)

[a] No./No. indicates the number of positive screening results for each instrument/number of children in each DBD category screened with that instrument.
[b] Developmental quotient of <70.
[c] Developmental quotient of ≤70 in ≥2 areas.
[d] One or more shaded areas.

the medical history, (2) the caregiver reported in the general questionnaire that the child had received a diagnosis, and/or (3) the caregiver reported in the general questionnaire that the child was currently receiving therapeutic or special education services. A suspected DBD was determined on the basis of ≥1 of the following 3 criteria being met: (1) caregiver concerns were reported in the general questionnaire, with supporting data; (2) the CDI developmental quotient was <70 in ≥1 domain of development; or (3) the child failed 1 of the screening tests (PEDS, PSC, or VADPRS), on the basis of test criteria.

Children were considered to be developing typically if parental concerns expressed during the interview were not justified on the basis of screening (PEDS, PSC, and VADPRS) findings (ie, concerns about developmental skill attainment were expressed but normal findings were obtained with the screening tests). Children who repeated 1 grade or were receiving tutoring were considered to be developing typically unless they met other criteria.

Analyses

The prevalence of DBDs in these hospitalized children was calculated by using proportions; χ^2 analysis was used to compare differences in proportions across groups. Two-tailed *t* tests were used to compare continuous variables. Multivariate logistic regression analysis was used to explore the associations of demographic and social factors and the odds ratios (ORs) for DBDs. We estimated independently the ORs for known DBD, suspected DBD, and a combination of the 2. All analyses were performed with SAS 8.0 (SAS Institute, Cary, NC).

RESULTS

Data were collected from primary caregivers of 325 hospitalized children, who ranged in age from 6 months to 17 years (mean: 6.4 years; SD: 4.7 years). Some children were admitted with >1 medical diagnosis, but they were classified into only 1 diagnostic group (Table 1). Of the 325 children screened, 72 (22.2%) were assigned to the known DBD category and 37 (11.4%) were assigned to the suspected DBD category (Table 3). The classification of children into 1 of the 3 clinical diagnostic groups according to instrument is shown in Table 4.

The prevalence of DBDs was found to be higher than expected in 2 main diagnostic groups, that is, cerebral palsy/motor delay and developmental delay/mental retardation (Table 3). The prevalence of cerebral palsy in our sample was 6.1%, whereas the expected population prevalence approximates 0.15% to 0.25%.[27–31] The prevalence of mental retardation or developmental delay was also higher than expected, with a value of 8.6%, compared with an expected population prevalence of 1.5% to 3.0%.[32,33] As shown in Table 5, the prevalence of known DBDs increased with age, from 15.6% in children <5 years of age to 34.7% in children ≥9 years of age (Spearman $R = 0.12$; $P < .02$). The logistic regression analysis of risk factors for suspected DBDs showed significant differences in household composition. Sixty-seven percent of the children in the suspected DBD category lived with a single mother (OR: 2.4 [95% confidence interval [CI]: 1.1–5.2]), 27% lived with both

TABLE 5 Classification of DBDs According to Age

Classification	*n* (%)				
	0–4 y	5–6 y	7–8 y	≥9 y	Total
Known DBD	29 (15.6)	9 (23.1)	8 (32.0)	26 (34.7)	72 (22.1)
Suspected DBD	19 (10.2)	7 (17.9)	5 (20.0)	6 (8.0)	37 (11.4)
No DBD	138 (74.2)	23 (59.0)	12 (48.0)	43 (57.3)	216 (66.5)
Total	186 (100.0)	39 (100.0)	25 (100.0)	75 (100.0)	325 (100.)

parents, and 5.4% lived with grandparents; in the no-DBD category, the distribution was 48.6%, 48.6%, and 1.9%, respectively.

Among the children in the suspected DBD category, a larger proportion (24%) had university pediatricians as their primary care providers (OR: 2.5 [95% CI: 1.02–6.3]), compared with community pediatricians (7.1%) or family practice physicians (11.1%). The relationship between suspected DBDs and type of practice remained significant in a multivariate logistic regression analysis. Posthoc analysis showed that, compared with the community pediatricians and family medicine physicians, the university pediatricians provided care to significantly more children with single mothers as head of the household (66.7% vs 49.3%; $\chi^2 = 3.5$, $P = .022$) and with Medicaid as their health insurance (87.9% vs 67.2%; $\chi^2 = 5.3$, $P = .05$). However, even after the introduction of these variables into the model, the type of primary care provider (university pediatricians) remained significant.

The analysis of risk factors for known DBDs showed increased risk with age, ethnic group (ie, higher OR for black children), and type of primary care provider (ie, higher OR for children whose primary care physician was a university pediatrician). Multivariate analysis showed that ethnic differences became insignificant when social variables (ie, education, income source, and government assistance) were introduced into the model, whereas the type of physician continued to be a significant factor. The risk for known and/or suspected DBDs was not related to gender, type of health insurance, source of income, or maternal education. The length of stay was longer for children with known or suspected DBDs (mean: 7.8 days; SD: 4.5 days), compared with children with no DBD (mean: 3.6 days; SD: 17.4 days; $t = 3.38$, $P = .001$).

We were unable to evaluate individual child outcomes thoroughly after the screening, partly because we had significant difficulty reaching the families of the children in the suspected DBD group. Of the 37 children classified in the suspected DBD group, 30 caregivers could not be reached by telephone. In contrast, we were able to reach and/or to verify the correct telephone contact information for 13 (65%) of the 20 caregivers in a control group of children with no DBD ($\chi^2 = 3.01$, $P = .001$). Of the 7 children with suspected DBDs whose caregivers were reached, 3 children had been evaluated and had received intervention. Four of the 7 caregivers were not concerned and/or did not follow our recommendation.

DISCUSSION

To our knowledge, this is the first prospective study to determine the prevalence of DBDs in children admitted to a pediatric hospital. We found that the prevalence of DBDs in a general pediatric inpatient setting was higher than the expected population prevalence. This increased prevalence included higher rates of cerebral palsy (6.1%) and mental retardation or developmental delay (8.8%). In a retrospective study published in 2006, we found a fairly similar prevalence of DBDs in children who had been admitted by university pediatricians.[3] The current study expands on the previous study with the addition of specific screening measures.

The analysis of social risk factors shows that the university practice group serves a higher-risk population. Some of the other significant risk factors are not unexpected. For example, the prevalence of known DBDs is higher in older children, whereas ethnic group may be a by-proxy of other social factors such as education and income.

This study has several strengths. It was a prospective study in which multiple valid screening instruments were used, which gives us confidence that most of the children with a significant developmental condition were identified. Relative redundancy between screening tools makes us confident that children identified as having a suspected DBD most likely had a developmental disorder. Each case was reviewed by a developmental pediatrician, who monitored the data for consistency in collection and classified each child into 1 of the 3 DBD categories. In fact, after review, several children whose caregiver endorsed concerns on the screening tests were classified in the no-DBD group (Table 4).

Some limitations of the study should be considered. We did not perform a formal diagnostic evaluation of each child's development. We determined this was not feasible, given the constraints of the hospital environment, short hospital stays, and the concurrent acute illnesses of these hospitalized children. Although the tools used were judged to be acceptable measures for screening, a diagnostic evaluation would provide more-complete information on the type and degree of DBDs. We assessed a broad range of conditions, some of which are not targeted by all of the instruments. For example, the CDI is not designed to detect a child with ADHD, and the VADPRS has limited value in identifying a learning disability. When it is used with a child with a known diagnosis, an instrument such as the PEDS, which is based on reports of caregiver concerns, may seem to give a false-negative result (particularly if the child is receiving appropriate intervention services). Convenience sample selection for this study was not ideal, but an initial attempt to select patients through strict randomization failed for practical reasons. Efforts were made to have variability in subject selection and to avoid identified bias (characteristics of patient admission trends were monitored, to avoid patterns of selection bias). An interesting and frustrating finding in our study was the small proportion of caregivers of children with suspected DBDs (19.9%), compared with caregivers in the control group (75%), who could be contacted in the follow-up phase.

CONCLUSIONS

The prevalence of DBDs in children admitted to a pediatric hospital was higher than that expected for children in the general population, with ~10% of hospitalized children in this sample being identified as having a suspected DBD. The identification of DBDs should facilitate appropriate treatment and/or monitoring. Hospital admission should be considered another opportunity for developmental surveillance, and strategies for imple-

menting systematic developmental and behavioral screening of hospitalized children should be examined.

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