Association of Externalizing Behavior Disorder Symptoms and Injury Among Fifth Graders

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Received for publication November 24, 2010; accepted March 3, 2011.

ABSTRACT

OBJECTIVE: Injury is the leading cause of death among American youth, killing more 11-year-olds than all other causes combined. Children with symptoms of externalizing behavior disorders such as attention-deficit/hyperactivity disorder (ADHD) and conduct disorder (CD) may have increased risk. Our aims were to determine: (1) whether increasing symptoms of ADHD and CD associate positively with injuries among a community sample of fifth graders; and (2) whether symptoms of ADHD and CD have a multiplicative rather than additive association with injuries among the sample.

METHODS: Data were collected from 4745 fifth graders and their primary caregivers participating in Healthy Passages, a multisite, community-based study of pediatric health risk behaviors and health outcomes. The primary outcome was injury frequency. Primary independent variables were ADHD and CD symptoms. Additional covariates included gender, race/ethnicity, and household income. Ordinal logistic regression examined correlates of injury frequency. The interaction between ADHD and CD symptoms also was examined.

RESULTS: In bivariate analyses, the odds of injury increased as ADHD symptoms (odds ratio [OR] 1.29; 95% confidence interval [95% CI] 1.18–1.41) and CD symptoms (OR 1.18; 95% CI 1.07–1.31) increased. However, in multivariate analysis, only ADHD symptoms were significantly associated with injury (OR 1.22; 95% CI 1.10–1.35). There was no statistically significant interaction between ADHD and CD symptoms.

CONCLUSIONS: ADHD symptoms are associated with increased odds of injury in fifth graders. Findings have implications for potential injury prevention strategies for mental health practitioners (for example, cognitive training with at-risk youth), pediatricians (ADHD screening), and parents (improved supervision).

KEYWORDS: attention-deficit/hyperactivity disorder; behavior disorders; conduct disorder; early adolescence; fifth graders; injury

ACADEMIC PEDIATRICS 2011;11:427–431

WHAT’S NEW

In bivariate analyses, fifth graders with attention-deficit/hyperactivity disorder (ADHD) and fifth graders with conduct disorder (CD) had elevated odds of injury compared to fifth graders without these disorders. ADHD was more strongly associated with injury than CD in multivariate analyses, but the interaction between ADHD and CD symptoms was not associated with additional increased odds of injury.

INJURY IS THE leading cause of death among Americans in early adolescence, killing more 11-year-olds than all other causes of death combined. Injury prevention strategies may benefit from accurate identification of subgroups at increased risk.

In preschool,2,3 elementary school,4,5 and adolescent6–9 samples, children with 2 externalizing behavior disorders, attention-deficit/hyperactivity disorder (ADHD) and oppositional defiant disorder (ODD), appear to have increased injury risk. This finding is also apparent in studies examining risk in multigenerational samples spanning childhood and adolescence.10–13 Previous work has largely overlooked relations between injury risk and a third common externalizing disorder in childhood and adolescent behavior (CD). CD, which emerges as particularly relevant when youth grow into the early adolescent and adolescent years,14 is characterized as a chronic disorder dominated by defiant, antisocial, aggressive, and criminal behavior patterns. Such symptoms can readily be conceptualized as behavior patterns that could increase both intentional and unintentional injury rates.

Moreover, studies suggest that for younger children, co-morbid externalizing problems—for example, comorbid ADHD and ODD behavior patterns—may place children at particularly elevated risk of injury beyond that of having...
symptoms of just one disorder. It is unknown whether similar multiplicative patterns of ADHD and CD symptoms may create elevated injury risk among older children, but it seems plausible in that the combination of impulsive and inattentive behavior patterns associated with ADHD, plus defiant and aggressive behavior patterns associated with CD, could create particularly elevated injury risk compared to just one set of risky behavior patterns.

Our study sought to examine the association of ADHD symptoms, CD symptoms, and their interaction with injury risk among a community sample of 4745 fifth graders. We hypothesized that both ADHD and CD symptoms would be associated with injury risk, and that the interaction between both sets of behavior patterns would create risk in a multiplicative manner. Consistent with theory about the dimensional nature of psychopathology,16,17 in this paper we conceptualize ADHD and CD as disorders marked by a continuum of symptoms, such that greater symptom counts—even at subclinical levels—are meaningful in understanding injury risk, and that a large number of symptoms above the threshold of clinical disorder may be more strongly associated with injury than a symptom count just above the threshold of abnormality. This contrasts with typical psychiatric practice where ADHD and CD are classified categorically, but is more helpful from an injury prevention perspective as it allows us to examine the influence of the full range of symptom patterns.

METHODS

DATA SOURCE

Data come from Healthy Passages, a community-based longitudinal study of adolescent health. This report uses baseline data collected in 2 cohorts from 2004 to 2006, when the sample consisted of 5147 individuals in the fifth grade. Participants in Healthy Passages were sampled from public schools in 3 geographic areas: 1) 10 contiguous public school districts in and around Birmingham, Alabama; 2) 25 contiguous public school districts in Los Angeles County, California; and 3) the largest public school district in Houston, Texas. Within these 36 districts, schools with at least 25 fifth graders (representing over 99% of students enrolled in regular classrooms) were eligible for selection.

Within each of the 3 sites, a 2-stage probability sampling procedure was employed. In the first stage, we randomly sampled schools using probabilities that were a function of each school’s racial/ethnic distribution as compared to the site’s racial/ethnic target. In the second stage, all fifth-grade students (N = 11 532) in regular classrooms of sampled schools (N = 118) were invited to participate. About 58% of students’ families (N = 6663) expressed interest in joining the study or learning more about it. Over three-quarters of those students (77%, N = 5147) completed an interview and formed the sample for this study. Informed consent to participate was obtained from study participants (who provided developmentally appropriate assent) and their primary caregivers (henceforth referred to as “parents”). Families were compensated for their time.

Design weights were constructed to reflect different school selection probabilities by racial/ethnic composition. Nonresponse weights were constructed on the basis of participant nonresponse as a function of school, student gender, and student race/ethnicity. These 2 sets of weights were combined into a final weight representing the population of fifth graders in the public schools in the catchment areas defining each site. All analyses take into account the complex sample design, including the final probability weights. Rare cases of missing data (<5% of data for all variables, and <2% for most) were imputed using a single Markov-Chain Monte Carlo imputation. Demographic variables were not imputed. Further details concerning sampling and weighting are available elsewhere.18

Child and parent assessments were conducted separately using a combination of computer-assisted personal interview (CAPI) and audio-computer assisted self interview (A-CASI) segments. All interviews were completed in private spaces, and they were conducted in English or Spanish according to participants’ preference. The study protocol was reviewed and approved by IRBs at all participating institutions.

PARTICIPANTS

This report covers 4745 fifth graders (mean age 11.12 years, standard deviation 0.56; 52% male) and their parents (402 participants omitted as a result of missing demographic data). Racial/ethnic breakdown for youth was: 30% African American, 42% Hispanic, 23% white non-Hispanic, 5% multiracial/other ethnicities. Median annual household income was $32 500.

MEASURES

PRIMARY OUTCOME

The primary outcome was youth’s injury history. Parents reported injuries “serious enough to require professional medical attention” over the past year. Three ordinal categories were used for analyses: 0, 1, and 2+ injuries.

PRIMARY INDEPENDENT VARIABLES

Symptoms of ADHD and CD were collected by parent report on the DISC Predictive Scales (DPS),19 a reliable and valid brief instrument for screening youth psychopathology. DPS items correspond closely to selected DSM-IV symptoms for the disorders.19,20 To make interpretation of results easier, DPS scores were standardized before use in inferential analyses.

COVARIATES

Parents reported the youth’s gender, race/ethnicity, and household income. Race/ethnicity was categorized into the following categories: African American, Hispanic, white, and other (including multiracial individuals). Household income was reported within income ranges, and the median of the selected range was used for analyses.
### Results

Table 1 presents descriptive data. ADHD and CD symptom counts were positively correlated, with \( r(4743) = .50, P < .001 \). Breaking symptom counts at the top decile of the distributions to approximate clinically significant cutoffs, 10.6% of children had a score \( \geq 6 \) on the DPS ADHD scale and 13.7% of children had a score \( \geq 7 \) on the DPS CD scale. The injury distribution was 0 (86.4%), 1 (10.2%), and 2 (3.5%). A wide range of types of injuries was reported, with broken bones (52%), joint injuries/sprains/strains (15%), and cuts/bruises (15%) comprising the majority. Median time away from typical activities was 2 to 7 days.

In bivariate analyses, male gender was related to greater odds of injury than for females and Hispanic race/ethnicity was related to lower odds of injury than for non-Hispanic white race/ethnicity (Table 2). Both the number of ADHD symptoms and the number of CD symptoms were associated with increased risk of injury, and the magnitude of the associations between externalizing behavior disorder symptoms and injury was substantial. Fifth graders at the 90th percentile of ADHD symptoms in the sample had odds of injury 1.9 times that of fifth graders at the 10th percentile of ADHD symptoms. Fifth graders at the 90th percentile of CD symptoms had odds of injury 1.5 times that of those at the 10th percentile of CD symptoms. These increased odds of injury are not insignificant: As a means of comparison, the odds of injury among boys were 1.6 times that of girls.

In the multivariate model including all demographic predictor variables plus the ADHD and CD symptom variables, males had higher odds of injury than females (odds ratio [OR] 1.50; 95% CI 1.27–1.77) and Hispanic youth had lower odds of injury than non-Hispanic whites (OR 0.69; 95% CI 0.48–0.97). Among the externalizing behavior symptoms, only ADHD symptoms were related to elevated odds ratios (OR 1.22; 95% CI 1.10–1.35); CD symptoms were not associated with injury in the analysis (OR 1.00; 95% CI 0.89–1.13).

In adjusted analyses that included the interaction between ADHD and CD symptoms, odds ratios were very similar to the model without the interaction term. The interaction was not associated with injury (OR 0.96; 95% CI 0.88–1.05). We also considered ADHD by gender, ADHD by race/ethnicity, and ADHD by household income interactions in the model; none is statistically significant.

### Discussion

This study examined the relation between ADHD and CD symptoms and injury in fifth graders. Fourteen percent of children had \( \geq 1 \) injury requiring medical attention in the previous year. Our findings suggest that presence of externalizing behavior disorder symptoms is associated with higher odds of injury among our sample of early adolescents.

In multivariate analysis, ADHD symptoms appear to be more strongly associated with injury than are CD symptoms. The bivariate association of CD symptoms with injury may be due in part or whole to comorbid ADHD symptoms. Contrary to our hypothesis, there was no indication that the combined effect of ADHD and CD symptoms caused particularly elevated risk for injury.

Taken together, the results suggest behavior disorder symptoms, and especially ADHD symptoms, are associated with increased risk of pediatric injury among fifth graders. Although our results do not elucidate the mechanism of this association, others have suggested potential causal pathways between ADHD and injury, including decreased attentional capacity, increased impulsivity and poor impulse control, disobeying safety-related rules, and hyperactive behavior patterns. Critical to a consideration of causal mechanisms is the developmental stage of the participants. Fifth graders frequently act outside of direct parental control; therefore, symptom-driven behavior patterns are plausible mechanisms for associations between behavior disorder symptoms and injury because direct adult intervention may be absent.

The finding that ADHD symptoms were more relevant than CD symptoms is consistent with work from older adolescent populations but differs from reports with younger...
samples, in which oppositional behavior patterns positively correlate with injury risk as strongly, if not more strongly, than ADHD symptomatology. The differences in those results compared to the present study may reflect developmental change in the samples studied. During the preschool and school years, children are expected to obey safety-related rules and admonitions. Disobedient and oppositional children may be at increased risk of injury because they do not heed safety-related rules or warnings from supervising adults. As children develop, their cognitive capacity to recognize risks in their environment matures. They rely less on adult supervision to avert injury, and instead utilize their own maturing cognitive processing skills and executive function to inhibit potentially injurious behaviors. Thus, although noncompliant, aggressive, and antisocial behaviors can result in a range of negative consequences during early adolescence, injurious consequences may be averted because the youth have developed their cognitive functioning to the point that even those who are noncompliant or antisocial, as evidenced by CD symptoms, can exhibit self-control to avoid injury.

At later points in child development, ADHD symptoms may become increasingly relevant to risk for injury. Youth with ADHD symptoms have underdeveloped self-control and inhibition systems compared to same-age peers without ADHD symptoms. Thus, ADHD symptoms may emerge in late childhood as a stronger correlate of injury risk, when adult supervision is absent, whereas oppositional and defiant symptoms are more pertinent in the earlier years of child development.

Outside our primary hypotheses, 2 other findings warrant mention. In both bivariate and multivariate models, Hispanic children had reduced injury risk. This result replicates other findings in the pediatric injury literature, and may reflect some combination of cultural differences and environmental exposure to injury risk. We also found research site differences. We are unsure what factors, perhaps related to geography or culture, may have caused those differences. Replication is recommended.

The Healthy Passages cohort is a large and diverse sample of fifth graders who are at a developmental stage that is underrepresented in the literature. Limitations include the fact that validated thresholds for clinically relevant ADHD and CD symptoms have not been established. Moreover, as we relied on symptoms checklists as a proxy for externalizing behavior patterns, we lacked formal evaluations or diagnoses of disorders in the sample. In addition, we relied on questionnaire data rather than behavioral measures, and the use of parent-report for injury history can suffer from recall biases. We targeted injury frequency but not injury severity. Finally, the cross-sectional design prevents us from making causal inferences about the associations seen here. Even with these caveats, these data suggest that fifth graders with symptoms of behavior disorders, and with ADHD symptoms in particular, are at increased risk for injury.

Our findings have implications for injury prevention. Injuries are caused by a wide range of individual, interpersonal, and environmental factors, but our results suggest fifth graders with ADHD and CD symptoms appear to have increased risk of injury. For this reason, health professionals might consider ways to train at-risk youth to recognize potentially dangerous activities through strategies such as using cognitive training with a fifth grader with ADHD to reflect before acting in a potentially dangerous environment. Pediatricians treating children at this developmental stage after injury might consider administering ADHD or CD screens. Still other possible interventions could target parents of fifth graders with externalizing behavior patterns. Such youth may need increased supervision or monitoring in potentially risky situations.

**ACKNOWLEDGMENT**

The Healthy Passages Study is funded by the Centers for Disease Control and Prevention, Prevention Research Centers (Cooperative...
Agreements U48DP000046, U48DP000057, and U48DP000056). The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention. Thanks to Martha Hovater for data analysis support. The authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

REFERENCES


