

Unintentional Injury Risk in Children with Externalizing Behavior Disorders at Summer Camp

David C. Schwebel · Casie L. Tavares ·
Elizabeth K. Lucas · Elizabeth B. Bowling ·
J. Bart Hodgins

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Abstract Children with externalizing behavior disorders such as attention-deficit/hyperactivity disorder (ADHD), oppositional defiant disorder (ODD), and conduct disorder (CD) have greatly increased risk of unintentional injury, but it is unclear what mechanisms are responsible for that increased risk. This study followed 22 children participating in a summer camp for children with ADHD. Injury incidents were recorded daily and a set of primary symptoms of behavioral disorders were recorded at 15-min intervals over the course of the 6-week summer camp experience (roughly 300 h of observing each child). We predicted symptoms of ODD and CD would be more strongly related to injury incidence than symptoms of ADHD. Results from univariate Poisson regression models confirmed our prediction. Symptoms of ODD and CD—violations and intentional aggression in particular—were related to injury incidence but symptoms of ADHD were not. This finding is consistent with a growing body of evidence that oppositional, noncompliant, and aggressive behavior patterns might be primarily responsible for increased risk for injury among children with externalizing behavior disorders.

Keywords Injury · Safety · Attention-deficit/hyperactivity disorder (ADHD) · Oppositional defiant disorder (ODD) · Externalizing behavior

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D. C. Schwebel (✉) · C. L. Tavares · E. K. Lucas ·
E. B. Bowling · J. B. Hodgins
Department of Psychology, University of Alabama at
Birmingham, 1300 University Blvd., CH 415, Birmingham,
AL 35294, USA
e-mail: schwebel@uab.edu

Unintentional injuries are the leading cause of death for American children ages 1–18, killing more children than the next 20 causes of death combined (National Center for Injury Prevention and Control [NCIPC], 2006). As government (NCIPC, 2002) and academic (Sleet & Bryn, 2003) experts express concern about the magnitude of child injury as a public health problem, scientists have felt increased urgency to study and prevent pediatric injury. One technique that has promise for the development of injury prevention programs is identification of the mechanisms that cause some children to have particularly increased risk for injury. Children with externalizing behavior disorders such as attention-deficit/hyperactivity disorder (ADHD), oppositional defiant disorder (ODD), and conduct disorder (CD) are one such group. By some estimates, children with externalizing behavior disorders have an injury rate at least 1.5 times that of their counterparts without those disorders (Brehaut, Miller, Raina, & McGrail, 2002).

It is unclear why children with externalizing behavior disorders might have elevated risk of unintentional injury. One prominent theory, mentioned in the current diagnostic manual (American Psychiatric Association, 2000), is that the hyperactive, inattentive, and impulsive features of ADHD lead children to behave in dangerous ways near hazards (e.g., Brehaut et al., 2002). There is solid evidence that hyperactive behavior patterns are related to increased risk among normal samples, particularly during the pre-school years (Schwebel & Barton, 2006). Some studies also report increased risk of injury in children diagnosed with ADHD (Brehaut et al., 2002; DiScala, Lescoghier, Barthel, & Li, 1998; Lam, Yang, Zheng, Ruan, & Lei, 2006; Swensen et al., 2004), but other empirical reports suggest children diagnosed with ADHD are not at increased risk for injury (Byrne, Bawden, Beattie, & DeWolfe, 2003), particularly after controlling for oppositional behavior patterns

or ODD diagnoses (Davidson, Hughes, & O'Connor, 1988; Schwebel, Speltz, Jones, & Bardina, 2002).

An alternative hypothesis is that children with externalizing behavior disorders are at increased risk of injury not because of hyperactive or inattentive symptoms, but instead because they are oppositional to adult commands or defiant toward safety rules. This possibility is supported by findings that children with ADHD understand and remember safety rules as well as same-age children without ADHD (Farmer & Peterson, 1995), that parent-child communication patterns play an important role in safety among children with externalizing behavior disorders (Schwebel, Hodgins, & Sterling, 2006), and that children with ODD or CD appear to have the same or even higher risk of injury compared to children with ADHD (Davidson et al., 1988; Rowe, Maughan, & Goodman, 2004; Schwebel et al., 2002).

The present study was designed to consider further the mechanisms through which children with externalizing behavior symptoms might have increased risk for injury. We studied what symptoms might be associated with increased risk of unintentional injury by following 22 children with behavior disorders using highly intensive behavioral monitoring techniques. Monitoring of the children occurred during a 6-week summer camp experience for children with ADHD. During the camp, we recorded details concerning all injuries children incurred. We also recorded several externalizing behavior symptoms every 15 min to understand their frequency of occurrence and their relations to injury among this at-risk population.

Based on previous research, we hypothesized that symptoms related to ODD—in particular, noncompliance and violations of rules—would be most closely related to children's injury incidents. We predicted symptoms related to ADHD—inattention and interruptions, for example—would be less closely related to injury incidents.

We believed testing these hypotheses would move the field further in understanding the mechanisms that lead to unintentional injury among children with externalizing behavior disorders and, by extension, among typically developing children. Ultimately, this understanding may lead to development of highly effective, empirically based injury prevention programs.

Methods

Participants

Participants consisted of 22 children (mean age = 9.09 years, range = 6 to 13 years old; and including 1 six-year-old, 2 seven-year-olds, 6 eight-year-olds, 4 nine-year-olds, 3 ten-year-olds, 3 eleven-year-olds, 1 twelve-year-old, and 1 thirteen-year-old) who participated in the

Summer Treatment Program (STP) at the University of Alabama at Birmingham. The STP is an empirically supported treatment program for ADHD and related behavioral symptoms (Pelham, Greiner, & Gnagy, 1998), and participants of the treatment program attended the camp for 9 h daily, 5 days a week, for 6 weeks. The program included training in social, sports, and motor skills, and behavior therapy. The behavioral training portion of the summer treatment program implemented a point system through which the children earned points for positive and attentive behaviors and lost points for negative, rule-violating, and disruptive behaviors. The sample was mostly male (77.27%) and Caucasian (86.36%). Specific data on SES was not collected, although the sample was known to be mostly but not exclusively composed of children from middle and upper-middle class family backgrounds.

Children were recruited and referred from a variety of sources—including professional referrals, “word of mouth” from other clinic patients, announcements in the local media, and flyers sent to local pediatricians and clinical psychologists. All potential participants were screened via a comprehensive behavioral assessment by a team of mental health providers (including a licensed psychologist and physician, as well as trainees in those fields). Evaluations included interviews with parents and children; comprehensive self-report batteries by child, parent, and teacher; standardized behavioral assessments; and other evaluations, as deemed clinically appropriate by the team. Children included in the camp (and study) exhibited behavioral, social, and academic difficulties that could be addressed and treated through participation in the program. Each participant received a diagnosis of an externalizing behavioral disorder from the team (two children participating in the camp were given a primary diagnosis of Asperger's Disorder, and were omitted from this study). Exclusion criteria were few, but did include (a) a clinical symptom pattern that would not be likely to yield benefit from the STP program (e.g., ADHD, Predominantly Inattentive Type), (b) a high level of aggression and aggressive behavior patterns, and (c) a high risk of running away.

Of the 22 children participating in this study, 20 had primary diagnoses of ADHD and the other 2 had primary diagnoses of ODD. Most of those children had co-morbid secondary diagnoses (e.g., ODD, neurofibromatosis, and language disorders). Like most STP camp populations, the sample was one that could generally be described as having complex clinical presentations with a range of co-morbid diagnoses, but one where symptoms of inattention, hyperactivity, impulsivity, oppositionality, and defiance toward rules were prominent. Prior to the camp experience, all children were being treated psychologically, pharmacologically, or both, for externalizing behavior disorders.

Most children were on stimulant medications, and some were on other psychotropic medications as well.

All research was reviewed and approved by the university's IRB and parents of participants provided signed informed consent to participate.

Protocol

Throughout the course of the camp, counselors recorded all injuries children incurred. They also recorded, according to the STP protocol (Pelham et al., 1998), a variety of behavior patterns consistent with behavior disorder symptomatology. In total, each child was observed for roughly 300 h. Details about the measures appear below.

Measures

Injury logs

Two camp counselors completed logs of all injuries children incurred during the course of the camp. An injury was defined as an event that required either (a) an adult to inspect and potentially treat the bodily site of pain, or (b) tissue damage (e.g., redness, bruising, bleeding) that lasted at least 10 min. Logs, which were completed by counselors at regular daily intervals, recorded who was injured, as well as the date, time, place, type, and severity of each injury.

Severity of injury was rated on a 6-point Likert scale (very mild, mild, moderate, significant, severe, profound). These data points were objectively outlined in written detail on the coding sheet to ensure uniformity across coders (e.g., type and length of visible tissue damage; type of response from child; amount of time child was unable to engage in regular activities).

Behavioral symptoms

Measures associated with externalizing behaviors were recorded by camp counselors every 15 min throughout the day (with the exception of inattention and poor sportsmanship, which were measured every 15 min during selected activities during the day). Reliability in coding these behaviors was established through a series of four steps. First, all coders completed a week of intensive training on rating and recording behaviors. Second, inter-rater reliability was checked and established between novice and experienced coders after training and prior to the start of data collection. Third, research and treatment supervisors intermittently monitored coders and offered feedback if appropriate, to ensure accurate data collection was occurring. Fourth, inter-rater reliability was assessed on six

random occasions during the course of the research program. All reliability agreements of all variables in both the second and fourth steps were greater than 90%, as computed by agreements over agreements plus disagreements.

As detailed below, eleven variables were considered. These variables were selected due to their relevance to unintentional injury risk, their prominence in children with ADHD, ODD, and other externalizing disorders, and their occurrence (at least infrequently) among the sample studied. With the exception of the inattention measure, each variable is expressed in terms of the percentage of 15-min segments when children engaged in that behavior:

- The *inattention* variable consisted of the percentage of incorrect responses children gave in reply to one of four standardized questions concerning their current task every 15 min during recreational and group activities. As an example, the child might be asked, "Who made the last contribution to our group discussion, and what did he or she say?"
- *Interruptions* were defined as verbal or nonverbal behavior that interfered with the activity or discussion of others.
- *Unintentional aggression* was defined as unintentionally performing a behavior that produced physical injury to others or improperly restricted another's freedom of movement. Unintentional aggressive behaviors were usually the result of clumsiness, lack of skill, or inattention.
- *Leaving the activity area* was recorded as defiantly leaving the area and group, without permission.
- *Violations of rules* were recorded as violating standardized and known rules of the game or activity.
- *Noncompliance* was defined as failing to comply with adult-issued commands. After each incidence of noncompliance, the counselor penalized the child, reissued the command, and reevaluated compliance. Repeated noncompliance following this process was measured and merged with the noncompliance score.
- *Intentional aggression* was defined as intentionally performing a behavior that produced physical injury or improperly restricted another's freedom of movement.
- *Intentional destruction of property* was defined as intentionally destroying or damaging an object, defacing the surface of an object, or altering an object such that it was no longer valuable or useful.
- *Poor sportsmanship* was defined as intervals during which a child participating in a game or drill did not actively participate in the activity; "hogged" the ball; inappropriately played another child's position; boasted or bragged about individual, peer or team accomplishments; complained about the game or activity; refused to share equipment; or used equipment incorrectly.

- *Complaining and whining* was defined as displaying verbal or nonverbal behavior that inappropriately stated discomfort, dissatisfaction, or resentment using content, gestures or tone of voice.
- *Unintentional destruction of property* was defined as unintentionally destroying or damaging an object, defacing the surface of an object, or altering an object such that it was no longer valuable or useful.

Analysis

The analysis was comprised of four steps. First, we considered descriptive data and intercorrelations between the measures of interest. Included in our analysis of descriptive data was a consideration of the ecology of injuries experienced. Second, we considered univariate Poisson relations between the externalizing behavior disorder symptoms and the dependent injury variable. Third, we aggregated behavioral symptoms into those most closely associated with ADHD and those most closely associated with ODD/CD. Finally, we constructed Poisson regressions predicting injury from the aggregate measures.

Results

Table 1 displays descriptive data concerning the sample. As shown, some symptoms occurred rather frequently (e.g.,

Table 1 Descriptive statistics ($N = 22$)

Variable	Mean (SD)
Demographics	
Gender	77.27% male
Ethnicity	86.36% Caucasian
Injuries	2.180 (1.99)
ADHD composite	0.000 (0.79)
Inattention	0.216 (0.10)
Unintentional aggressive acts	0.028 (0.04)
Leaving the area	0.150 (0.17)
Interruptions	0.074 (0.05)
ODD/CD composite	0.000 (0.83)
Violations	0.172 (0.11)
Intentional aggressive acts	0.004 (0.00)
Noncompliance	0.020 (0.02)
Intentional destruction of property	0.002 (0.00)
Other symptoms	
Poor sportsmanship	0.100 (0.08)
Whining and complaining	0.218 (0.19)
Unintentional destruction of property	0.026 (0.04)

Note. All behavioral symptoms are expressed as the proportion of 15-min observational intervals during which they occurred

the average child committed a violation during about 17% of 15-min intervals; the average child whined or complained during about 22% of 15-min intervals) while others were much more rare (e.g., the average child committed both intentional aggression and intentional destruction of property during less than 0.5% of 15-min intervals).

Table 2 shows an intercorrelation matrix between all of the externalizing behavior symptoms and injuries. All predictors showed adequate normality for correlational analyses. The behavioral symptoms tended to intercorrelate well.

As part of our descriptive analyses, we also considered in greater detail the ecological aspects of the injuries children experienced during the camp experience. Altogether, the children experienced 48 injuries requiring adult attention or tissue damage lasting 10 min or longer during their 6-week camp experience (median number of injuries = 2; mean = 2.18; $SD = 1.99$). A total of 8 of the children experienced no injuries; four experienced two; four experienced three; four experienced four; and two children experienced six injuries over the course of the camp.

Divided by the time of observation (approximately 300 h per child, or 6600 child-hours of observation), the injury rate was comparatively high: Each child experienced 7.27 injuries for every 1,000 h of exposure. Children experienced a wide range of injuries, but bumps and bruises were the most common type of injury (52.94% of injuries) noted. Children also experienced cuts and scrapes (32.35%) and sprains and strains (14.71%). The average severity of all injuries, as rated by the camp counselors on the 6-point Likert scale (very mild, mild, moderate, significant, severe, profound), was 2.56 ($SD = .98$); no injuries were serious enough that the child needed to be taken to a doctor or emergency room.

A majority of reported injuries (65.63%) occurred in the morning, when recreational activities took place. Children were injured most frequently during sports activities—particularly during basketball (28.13%), soccer (15.63%), dodgeball (15.63%), recess (12.50%), and kickball (9.38%). Fewer injuries occurred during transition periods (9.38%) and yoga activities (3.13%).

The second step of our analysis was to consider Poisson relations between the externalizing behavior disorder symptoms and injuries (See Table 3). The Poisson curve is recommended for non-normally distributed count data such as injury frequency, and offers a better estimate of bivariate relations than linear models such as correlation (Cameron & Trivedi, 1998). Mathematically, the univariate Poisson models we computed are the loosely defined nonlinear equivalent to linear regression models with a single predictor. As shown in Table 3, two symptoms were related to injuries at a statistically significant level: violations (χ^2 (1,

Table 2 Correlation matrix: behavior disorder symptoms ($N = 22$)

	2	3	4	5	6	7	8	9	10	11
1. Inattention	.71**	.58**	.26	.27	-.28	.22	-.14	.47*	.57**	.71**
2. Unintentional aggression		.77**	.27	.17	.04	.22	.01	.61**	.72**	1.00**
3. Leaving area			.43*	.28	-.06	.16	-.15	.83**	.90**	.76**
4. Interruptions				.88**	.41	.71**	.34	.49*	.42	.24
5. Violations					.38	.72	.43*	.26	.22	.13
6. Intentional aggression						.63**	.84**	.03	-.05	.03
7. Noncompliance							.53*	.12	.08	.21
8. Intentional property destruction								-.07	-.10	-.01
9. Poor sportsmanship									.97**	.61**
10. Whining/Complaining										.72**
11. Unintentional property destruction										

* $p < .05$. ** $p < .01$.**Table 3** Univariate Poisson regressions predicting injury occurrence ($N = 22$)

Variable	<i>B</i>	<i>SE</i>	χ^2
ADHD composite	0.20	0.18	1.29
Inattention	-2.15	1.38	2.45
Unintentional aggression	2.32	3.59	0.42
Leaving area	-0.27	0.88	0.10
Interruptions	4.80	3.05	2.47
ODD/CD composite	0.31	0.16	3.79*
Violations	2.90	1.21	5.75**
Intentional aggression	43.62	21.94	3.95*
Noncompliance	13.85	9.06	2.33
Intentional property destruction	51.37	32.48	2.50
Other symptoms			
Poor sportsmanship	1.19	1.96	0.37
Whining/Complaining	0.12	0.78	0.02
Unintentional property destruction	2.64	3.53	0.56

* $p \leq .05$. ** $p < .01$

$N = 22$) = 5.75, $p < .01$) and intentional aggression (χ^2 (1, $N = 22$) = 3.95, $p < .05$).

Next, we aggregated the externalizing behavior disorder symptoms into traits of ADHD and traits of ODD/CD (see Epstein, 1983; Rushton, Brainerd, & Pressley, 1983). Aggregation was based on a combination of theoretical significance and quantitative evidence (from principal components analysis, which indicated appropriate division into two factors that mapped onto ADHD and ODD/CD traits well). The ADHD composite was comprised of four measures—inattention, unintentional aggression, leaving the area, and interruptions—and had strong internal reliability (Cronbach's $\alpha = .80$; average intercorrelation = .50). The ODD/CD composite was also comprised of four measures—violations, intentional aggression, noncompliance, and intentional destruction of property—and

had strong internal reliability (Cronbach's $\alpha = .85$; average intercorrelation = .59). Three measures—poor sportsmanship, whining/complaining, and unintentional destruction of property—did not fit cleanly into either composite and were therefore omitted from the composite measures.

Table 3 illustrates Poisson equations regressing injury from the two composite measures. As shown, the ADHD composite did not relate to injuries significantly (χ^2 (1, $N = 22$) = 1.29, ns) but the ODD/CD composite did (χ^2 (1, $N = 22$) = 3.79, $p = .05$).

Discussion

As hypothesized, among this sample of children attending an ADHD summer camp, we found that symptoms of ODD and CD—violations and intentional aggression in particular—were related to injury incidence during a 6-week summer camp experience. Symptoms of ADHD were not significantly related to injuries. These results support the growing literature (Byrne et al., 2003; Davidson, 1987; Davidson et al., 1988; Schwebel et al., 2002, 2006) suggesting ODD and CD symptoms and diagnoses might be more closely related to risk for unintentional injury than are ADHD symptoms and diagnoses.

This study offers a unique addition to the literature considering psychopathology and injury because it included only children with externalizing behavior disorders, and those children were followed every weekday for 6 weeks to track injury occurrences and behavior disorder symptoms. In fact, symptoms were recorded from every child every 15 min for over 300 h by skilled paraprofessionals. Injury occurrences were also recorded over that 300-h time period, a feature that overcame reliance on retrospective parental injury reports used in most studies.

Results on the ecology of injuries among this sample match results from research with non-disordered children at a slightly younger age (e.g., Morrongiello, Ondejko, & Littlejohn, 2004; Schwebel et al., 2002). In our study, children experienced bumps and bruises most often, followed by sprains and strains. They were hurt while they were active, such as during basketball and soccer games. And they experienced moderately severe injuries, on average. These factors do not seem to differ across children with externalizing behavior disorders in this study versus those without disorders studied in previous work (Morrongiello et al., 2004; Schwebel et al., 2002).

What does appear to differ among the two groups of children is frequency of injury. The rate of injury among children in this study was high, about 7.27 injuries per 1,000 h. This rate is perhaps elevated since the camp schedule included several active time periods, including sports participation, but is still quite high. In fact, the injury rate for children in this study while at camp is comparable or slightly higher than the rate of injury reported among non-disordered children while they are engaged in a high-contact athletic pursuit such as neighborhood youth soccer (rates hover around 5–7 injuries/1,000 h; Emery, Meeuwisse, & Hartmann, 2005; Junge, Rösch, Peterson, Graf-Baumann, & Dvorak, 2002), and falls just below the rate of injury in what is considered the very high-risk sport of American youth football (injury rates among children in grades 5–7 reported to be around 8 injuries/1,000 h of game-play, with rates somewhat lower in fourth graders and somewhat higher in eighth graders; Adickes & Stuart, 2004).

One reason children with oppositional behavior patterns may experience greater frequency of injury is because they violate rules and behave aggressively toward others. Results from this study suggest the “classic” symptoms of ADHD such as interrupting, having poor attentional capacity, or wandering away from an activity area may not be the factors that place children with behavior disorders at increased risk for pediatric injury, at least in an outdoor, supervised camp setting.

It is important to note, of course, that our sample—as is typical in many clinical settings—was comprised of children with complex clinical presentations and a high rate of co-morbidity. It may be that the symptoms associated with unintentional injury risk in this sample were moderated (that is, exacerbated) by symptoms not measured but associated with ADHD and other externalizing disorders. For example, a tendency to violate rules may be particularly related to injury risk in children with poor executive functioning (e.g., poor ability to inhibit impulses). Future research will need to continue to study the contributions of multiple symptoms on pediatric unintentional injury risk.

What are the implications of these findings for prevention? Most prominent perhaps is the need to supervise carefully children who have oppositional, defiant, and destructive behavior patterns. These children are often challenging to manage, but for a number of reasons—including their propensity to injury because they do not follow rules—require close, careful, and intensive adult supervision. Also important in thinking about prevention is the need for continued research on ways to train children with ODD, CD, and ADHD on safe behavior in potentially dangerous situations.

Like all research, this study had limitations. The small sample size and lack of a control group are particularly limiting. Data collection was highly intensive for this small group, but the small sample size reduced statistical power. Power to detect a medium effect size ($r = .30$) in a correlation with 22 participants ($\alpha = .05$) is only .29; to detect a large effect size, it is .73. A second limitation of the study was the composition of the sample. Because this study was conducted at a camp designed to treat ADHD, most of the sample had ADHD and a much smaller portion was diagnosed with ODD. Further, the camp was designed to treat symptoms and therefore data might be biased due to the ongoing treatment regimen. Finally, although we had excellent reliability on all behavioral symptom measures, logistical issues did not permit establishing reliability on the injury measures. Alternative research designs are needed to confirm the findings reported.

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