*Journal of Pediatric Psychology,* Vol. 24, No. 5, 1999, pp. 423–433

# Predictors of Unintentional Injuries to School-Age Children Seen in Pediatric Primary Care

***Kirsten Bradbury,***[1] MS, ***David M. Janicke,***[1] MA, ***Anne W. Riley,***[2] PhD, and ***Jack W. Finney,***[1] PhD

*[1]Virginia Polytechnic Institute and State University and [2]Johns Hopkins University School of Hygiene and Public Health*

***Objective:*** **To identify predictors of unintentional injury to school-age children seen in pediatric primary care.**

***Methods:*** **Members of a managed health care system (295 children ages 5–11 years and their mothers) participated. We used Time 1 measures of child, maternal, and family functioning and health care utilization to predict rates of unintentional child injury for the following year. Multiple regression analyses were performed to identify variables contributing to prospective injury rates.**

***Results:*** **The final regression model included eight Time 1 variables and accounted for 21% of the variance in Time 2 injury rates. Significant predictors of increased injury liability were younger child age, more children at home, child behavior problems, child social competence, three indices of reduced child health, and maternal anxiety.**

***Conclusions:*** **We discuss the utility of these predictors for pediatric psychologists in targeting primary care preventive interventions to families at risk for unintentional child injury.**

***Key words:*** *injury; children; primary care; prevention.*

Pediatric injury is an enormous problem in our society. From a child's first birthday through adolescence, injuries account for more deaths to North American children than do the next several leading causes combined (Centers for Disease Control [CDC], 1990). In the United States each year, twenty-two million children are injured (Boyce & Sobolewski, 1989)—16 million of these children require emergency department care, 600,000 are hospitalized, and 30,000 are permanently disabled (Rodriguez, 1990). These statistics represent enormous human suffering, as well as more pragmatic societal burdens. The direct costs of pediatric injury have been estimated to exceed $7.5 billion annually (CDC, 1990). The indirect costs of child injuries are less quantifiable but undeniably substantial (Scheidt et al., 1995). Despite clear evidence that injuries constitute the paramount threat to children's health and well-being, research on the impact of injury has not followed (Finney et al., 1993).

Unintentional injuries are not random events; they are understandable through the same scientific processes that help explicate other nonrandom occurrences (Boyce & Sobolewski, 1989; Peterson, Farmer, & Mori, 1987; Rivara & Mueller, 1987). They are, however, complex phenomena. The processes that lead to unintentional injuries to children are multideterministic; an exclusive focus on child factors or on environmental factors is insufficient

*All correspondence should be sent to Jack W. Finney, Department of Psychology (0436), Virginia Tech, Blacksburg, Virginia 24061. E-mail: finney@vt.edu.*

and overlooks the reciprocal, transactional nature of injury events (Garling & Valsiner, 1985; Valsiner & Lightfoot, 1987). The complexity inherent in injury events has been examined at various levels of analysis (Malek, Guyer, & Lescohier, 1990; Morrongiello, 1997; Peterson et al., 1987; Valsiner & Lightfoot, 1987; Wills, Christoffel, Lavigne, & Tanz, 1997). Injuries result from specific behavior-environment interactions, and many if not all injuries require a failure or breakdown at multiple levels of the system in which the child is permanently embedded (Finney et al., 1993; Garling & Valsiner, 1985). Even specific injury types (e.g., pedestrian injury from motor vehicle collision) cannot be explicated without reference to multiple subtype combinations of human and environmental factors (Malek et al., 1990).

Prevention, which can be directed toward behavioral or environmental changes or toward changes in the transactions that occur between the two, is the best mode of injury control (Finney et al., 1993). Fortunately, because injury requires multiple system failures, many access points for prevention exist. Although injury prevention is considered a priority at all ages according to the counseling guidelines of the American Academy of Pediatrics, to what extent primary care providers actively encourage injury prevention practices in their patient families is unknown. With an estimated 2 minutes to devote to all anticipatory guidance during traditional well-child visits (Christophersen, 1994), primary care providers are unlikely to engage in extensive injury prevention counseling with parents. Pediatric psychologists working in primary care may be well-placed to improve injury prevention efforts in these settings through programmatic interventions.

Unfortunately, although recognized as appropriately within the medical purview, injuries are much easier for medical personnel to treat than to prevent. Effective prevention requires successful prediction. Very little injury research is prospective, a major limitation in establishing preventive guidelines. Additionally, for pediatric psychologists and others making preventive efforts in particular communities, limited sociodemographic variability may reduce the utility of some risk factors related to injury as a population phenomenon. The role of pediatric psychologists and other health care providers in preventing unintentional injuries to children could be enhanced by identification of variables that contribute to prospective injury liability in children seen in primary care settings. To be useful, these risk factors must be identifiable in primary care practice. Access to medical care may be related to injury risk and may influence injury reporting; prediction of injuries in populations with differential access barriers could require separate models. By restricting a study sample to participants with similar barriers to care-seeking (in this case, members of a health maintenance organization [HMO] type of managed care system), researchers can more clearly delineate the variables that do contribute to injury for a particular group of children.

Our investigation included consideration of child factors (child health and medical care utilization, mental health, and social adjustment), maternal functioning (mother's mental health, social support, and health care utilization), family environment (stress and adjustment), and sociodemographic variables. These were measured at Time 1, when subjects were age 5–11 years. One year later, mothers reported on injuries incurred by the child over the previous year. We performed multiple regression analyses to determine which variables measured at Time 1 best accounted for variations in injury rates for the following year. We discuss our results in terms of the utility of these predictors for pediatric psychologists interested in increasing injury prevention in primary care settings.

## Method

### *Setting*

The Columbia Medical Plan (CMP) was a large suburban-based HMO that provided comprehensive prepaid medical services to residents of central Maryland. Most pediatric office visits required a nominal co-payment (e.g., $5.00); co-payment charges for specialty visits varied (e.g., $25.00 for a psychiatry office visit). All patient encounters were recorded, coded, and stored on a computerized patient database maintained by CMP; this database has been investigated for accuracy by the investigators (Finney, Lemanek, Cataldo, Katz, & Fuqua, 1989; Finney, Riley, & Cataldo, 1991), and by others (Hankin et al., 1984).

### *Participants*

Data from 295 children and their parents were obtained from a longitudinal study on children's health care use (Riley et al., 1993). These children constituted 65% of a stratified random sample of

451 children and their parents who were recruited for the original study. Of the 451, 61 did not complete the longitudinal study and 95 had incomplete data and were not included in the current sample. The longitudinal sample included approximately equal numbers of boys and girls who were 5 to 11 years of age on January 1, 1989. The current sample was found to be sociodemographically comparable to the total sample. More extensive description of study procedures was provided in a previous article (Riley et al., 1993).

### *Initial Assessment Procedure and Measures*

Mothers brought their children to the CMP pediatrics department for an after-hours assessment appointment. Informed consent was obtained from mothers and assent was obtained from children 6 years and older. Mothers completed the study questionnaires while children were weighed, measured, and received hearing and vision screenings. Participating parents were compensated $5. The following instruments were completed by the mother at the Time 1 assessment visit.

*Sociodemographics.* A 24-item questionnaire was used to obtain information about the family including age, income, education, and occupation of both parents, child's race, and number of children at home.

*Family Environment Scale (FES).* The FES (Moos & Moos, 1986) is a commonly used measure of family functioning. Four subscales of the FES were administered: Conflict, Expressiveness, Cohesion, and Organization.

*Family Life Events Inventory (FLEI).* The FLEI, developed for the Rand Health Insurance Experiment (Rand HIE) (Eisen, Donald, Ware, & Brook, 1980), lists 20 life changes, with indicators of physical illness specifically excluded.

*Health Status Questionnaire (HSQ).* The HSQ, adapted from the Medical History Questionnaire developed for the Rand HIE (Eisen et al., 1980), is a 126-item instrument with acceptable psychometric qualities that assesses parental perceptions of child physical health, mental health, and interpersonal relationships.

*Child Behavior Checklist (CBCL).* The CBCL is an extensively validated 113-item parent-report checklist designed to assess the behavioral problems and social competencies of children ages 4 to 16 years (Achenbach & Edelbrock, 1983). Ample normative data are available, and the instrument is psychometrically sound.

*Mental Health Index (MHI).* The MHI, developed for the Rand HIE, is a reliable and stable self-report measure of adult psychological well-being and distress (Viet & Ware, 1983).

*Social Support Questionnaire (SSQ).* Mothers' social support was assessed using a validated 12-item scale that assesses the number of people the mother can depend on for support, as well as her satisfaction with the support she receives from each (Sarason, Levine, Basham, & Sarason, 1983).

*Health Care Utilization.* Information on the child and mother's health care use was obtained directly from the CMP database. The number of medical visits each child made during the 2-year period prior to the assessment visit constituted the primary measure of retrospective pediatric health care use. Similarly, maternal health care use was measured by obtaining each mother's total number of CMP-recorded visits during the 2-year period prior to assessment. Utilization was considered both with and without laboratory and radiographic procedures. Use of care outside the plan was assessed by subject report and found to be less than 3% of total visits.

### *Follow-up Assessment and Maternal Report of Child Injury*

Approximately 1 year after the initial assessment, mothers returned for the Time 2 assessment. At this time, mothers reported on the number and type of medically attended injuries sustained by their children over the past year. Mothers were instructed to include only those injuries for which the child had been seen by a medical professional.

### *Data Analysis*

The questionnaire data were entered and assessed for accuracy using a double entry, comparison, and correction procedure. Health care use data were checked for redundancy and corrected. Nonnormally distributed variables were converted using square-root or log transformations to distributions that approximated the normal. A number of health variables could not be normalized because of their bimodal distributions and thus were converted to dichotomous variables.

We used best-subsets regression analysis (Max-R, SAS, 1989) to determine which Time 1 variables predicted the number of child injuries reported by mothers at Time 2 for the intervening 1-year period. Data were analyzed first within each of five components: child health variables, child mental health

**Table I.** Variables Included in Each of the Component Analyses

| Component and variable | Source |
|---|---|
| Child health | |
| Acute and acute recurring illnesses | HSQ |
| Child current health | HSQ |
| Child pain | HSQ |
| Child prior health | HSQ |
| Child susceptibility to illness | HSQ |
| Serious/acute illness, lifetime | HSQ |
| Symptoms and signs, last 30 days | HSQ |
| Summary symptoms score | HSQ |
| Square root retro visits, all procedures | CMP |
| Square root retro visits, no X-ray, lab | CMP |
| Was child on meds at recruitment | HSQ |
| Child mental health | |
| Any visits with psych diagnosis | CMP |
| Behavior total T-score | CDCL |
| Child activity T-score (part 1) | CBCL |
| Child in gifted and talented | HSQ |
| Child on psych meds for problems | HSQ |
| Child positive well-being | HSQ |
| Child social competence T-score (part 1) | CBCL |
| Externalizing T-score | CBCL |
| Internalizing T-score | CBCL |
| Log of child's anxiety | HSQ |
| Log of child's depression | HSQ |
| Maternal variables | |
| Life events | FLEI |
| Log of mother's anxiety | MHI |
| Log of mother's depression | MHI |
| Log of mother's emotional control | MHI |
| Mental health index summary score | MHI |
| Number of supporters | SSQ |
| Psychological well-being | SSQ |
| Satisfaction with support | SSQ |
| Square root retro visits, all procedures | CMP |
| Square root retro visits, no X-ray, lab | CMP |
| Family variables | |
| Cohesion standard score | FES |
| Conflict standard score | FES |
| Expressiveness standard score | FES |
| Organization standard score | FES |
| Sociodemographics | |
| Child age | DQ |
| First child raised | DQ |
| Household income | DQ |
| Is mother working | DQ |
| Mother's age | DQ |
| Mother's education | DQ |
| Mother's marital status, dichotomous | DQ |
| Mother's occupational category | DQ |
| Number of children at home at recruitment | DQ |
| Gender of child | DQ |

HSQ = Rand Health Status Questionnaire. CMP = Columbia Medical Plan database. CBCL = Child Behavior checklist. FLEI = Family Life Events Inventory. MHI = Rand Mental Health Index. SSQ = Social Support Questionnaire. FES = Family Environment Scale. DQ = Demographic Questionnaire.

variables, maternal variables, family variables, and sociodemographic variables. A full list of the variables in each component is provided in Table I. Those main effect variables that contributed to the best predictive model in each of the components were then entered into the full across-components analysis. In those cases where the best predictive model for each component contained fewer than three variables, the best three-variable model was selected for inclusion in the across-components analysis, provided that each variable had a $p$ value $< .25$.

## Results

Demographically representative of its local community (Riley et al., 1993), this predominantly white, middle- to upper-middle-class sample lived in traditionally organized two-parent households with an average of two children. Mothers (average age 38 years) and fathers (average age 40 years) were generally well-educated, and most worked in professional, managerial, administrative, or teaching positions. Average age for children was 8 years. Equal numbers of boys and girls participated in the study, with approximately equal gender distribution at each year of age. Sociodemographic information is provided in Table II.

Children sustained an average of 1.54 injuries during the 12-month study period. At all ages, approximately equal numbers of boys and girls sustained injuries, and at all levels of injury frequency boys and girls were about equally represented. Of the total sample ($N = 295$), 63.7% sustained one or more injuries. The 188 injured children sustained a total of 455 medically attended injuries in 1 year, the majority of which were lacerations, broken bones, and sprains. Information regarding injury distribution in the sample and types of injuries sustained is provided in Table III.

The factors selected from each of the component analyses for inclusion in the full across-components analysis are listed in Table IV. Standardized multiple regression coefficients are reported to permit comparison of the strength of the variables within a component. Because the variables are intercorrelated, the coefficients of specific variables should not be compared across different components.

The 16 variables selected from the within-components analyses were entered into a full across-components multiple regression analysis on

**Table II.** Sociodemographic Characteristics of the Study Sample

| Characteristic | *M* (*SD*) or % of sample |
|---|---|
| Child age (years) | 8.2 (1.9) |
| Child gender (% male) | 51.5 |
| Child race | |
| Caucasian | 87.5 |
| African American | 7.1 |
| Asian | 2.0 |
| Biracial/other race | 3.4 |
| Number of children in household | 2.29 (.89) |
| 1 child | 13.9 |
| 2 children | 53.9 |
| 3 children | 24.1 |
| 4 or more children | 8.1 |
| Mother is married | 91.5 |
| Mother is biological parent | 94.6 |
| Second adult in home is biological father | 92.3 |
| Mother's age (years) | 38.2 (4.8) |
| Father's age (years) | 40.5 (5.8) |
| Mother's education (years) | 15.5 (2.4) |
| Father's education (years) | 16.7 (2.9) |
| Mother employed outside the home | 79.3 |
| Mother's occupation | |
| Doctor/lawyer/engineer | 2.4 |
| Admin/teacher/manager | 61.4 |
| Sales/clerical/office | 23.7 |
| Attendant/clerk/librarian | 12.5 |
| Father's occupation | |
| Doctor/lawyer/engineer | 28.1 |
| Admin/teacher/manager | 52.5 |
| Sales/clerical/office | 8.1 |
| Attendant/clerk/librarian | 4.1 |
| Military/other | 7.1 |
| Household income ($) | 62,853 (27K) |

**Table III.** Medically Attended Injuries Sustained by Study Sample ($N$ = 295) in 12 Months

| No. or type of reported injuries | % |
|---|---|
| No. of reported injuries[a] | |
| None | 36.3 |
| 1–2 | 41.4 |
| 3–4 | 13.5 |
| 5 or more | 8.8 |
| Total no. of injuries | 455 |
| *M* (*SD*) | 1.54 (1.70) |
| Range | 0–7 |
| Type of injury reported[b] | |
| Lacerations | 34.1 |
| Sprains | 22.0 |
| Broken bone | 14.6 |
| Head injury | 12.2 |
| Contusions | 7.3 |
| Burns | 2.4 |
| Poisoning | 2.4 |
| Other | 5.0 |

[a]Reported as % of sample.
[b]Reported as % of total injuries.

the number of mother-reported medically attended injuries sustained by the child over the following year. The final full multiple regression model included eight main-effect variables that combined to account for 21% of the variance, $F$ (294) = 9.55, $p < .0001$, summarized in Table V. Injuries were prospectively associated with higher child symptom summary scores, more child behavior problems, higher child social competency, younger child age, more recent child signs and symptoms of illness, the child's greater susceptibility to illness, greater maternal anxiety, and larger family size.

## Discussion

Our results suggest several prospective injury risk factors that can be used by pediatric psychologists to develop targeted primary care counseling programs to prevent injuries to school-age children. In this sample, mother-reported injury rates were linked to behavioral problems and social competency, indices of compromised child health, maternal anxiety, younger child age, and larger family size. The sociodemographic homogeneity of the study sample was intended not to detect some variables that have been associated with injury risk in broader populations but to examine what variables in children with similar access to medical care (i.e., members of the same HMO) contribute to which particular children are injured. Thus, in our predominantly white sample, race was quite unlikely to make a contribution to injury liability. Similarly, in this sample very few children came from homes headed by a single parent, and there was little socioeconomic variability. The homogeneity observed here supports the contention that for some primary care practices, low variability on some sociodemographic characteristics makes these variables ineffective markers for identifying patients at risk for unintentional injury. Moreover, given the homogeneity of the study sample, sociodemographic factors that did remain related to injury liability may be expected to exert even greater effects in samples with wider variability on these characteristics.

Only two sociodemographic variables contributed to injury risk in this sample: child age and the number of children in the home. It has been sug-

**Table IV.** Initial Within-Component Multiple Regression Analyses

| Component | Standardized coefficient | Partial[a] $R^2$ |
|---|---|---|
| Child health variables | | |
| Symptoms summary score | 1.302 | .080[b] |
| Symptoms and signs, past 30 days | 0.200 | .030[b] |
| Child susceptibility to illness | 0.138 | .010[c] |
| Child illness-related pain | 0.203 | .010[d] |
| Child mental health variables | | |
| Behavior problems total score (CBCL) | 0.059 | .070[b] |
| Social competency score (CBCL) | 0.114 | .010[c] |
| Positive well-being | 0.051 | .010[e] |
| Gifted | 0.283 | .005[e] |
| Maternal variables | | |
| Log of mother's anxiety | 0.704 | .025[c] |
| Satisfaction with social support | −0.227 | .010[d] |
| Family functioning variables | | |
| Cohesion | −0.010 | .020[e] |
| Conflict | 0.012 | .010[e] |
| Organization | −0.012 | .050[e] |
| Sociodemographic variables | | |
| Child's age | −0.114 | .020[c] |
| No. of children at home at recruitment | 0.215 | .010[c] |
| Mother's marital status | 0.556 | .010[d] |

[a]Additional variance accounted for by the addition of the variable. The total variance accounted for by a component is the sum of the partial $R$ for the component. Regression coefficients are standardized so that they represent the amount of change in the independent variable that is attributable to a 1-unit change in the standard score of the predictor variables, independent of all other variables examined.
[b]$p < .01$ for the $F$ test.
[c]$p < .05$ for the $F$ test.
[d]$p < .15$ for the $F$ test.
[e]$p < .25$ for the $F$ test.

**Table V.** Full Across-Components Multiple Regression Model of Significant Predictors of Mother-Reported Medically Treated Child Injuries

| Component | Standardized coefficent | Partial $R^2$ |
|---|---|---|
| Symptoms summary score | 1.086 | .08[a] |
| Standard behavior total score | 0.051 | .05[a] |
| Social competency (CBCL) | 0.121 | .02[b] |
| Child's age | −0.096 | .02[b] |
| Signs and symptoms, past 30 days | 0.181 | .01[b] |
| Child susceptibility to illness | 0.110 | .01[c] |
| Log of mother's anxiety | 0.779 | .01[c] |
| No. of children in home at recruitment | 0.205 | .01[c] |

Regression coefficents are standardized so that they represent the amount of change in the dependent variable that is attributable to a 1-unit change in the standard score of the predictor variable, independent of all other variables examined.
[a]$p < .001$ for the $F$ test.
[b]$p < .01$ for the $F$ test.
[c]$p < .05$ for the $F$ test.

gested that injuries result most often in situations in which children extend themselves beyond their comfortable range of competency, engaging in new or relatively unpracticed tasks, and that a mismatch between parental beliefs regarding the child's capabilities and the child's actual competency compounds this risk (Garling & Valsiner, 1985; Valsiner & Lightfoot, 1987). There is clear evidence that parents frequently underestimate the supervision needs of school-age children (Peterson, Ewigman, & Kivlahan, 1993; Rivara, Bergman, & Drake, 1989), and parental misperceptions of child abilities may be more pronounced in the early elementary grades. Dunne and colleagues found that parents overestimate the street-crossing ability of 5- to 7-year-olds more than of 8- to 9-year-olds (Dunne, Asher, & Rivara, 1992). Competency at this task changes a great deal between the ages of 5 and 9, while parental expectations of competency change little, with the result that children "grow into" their parents' expectations (Dunne et al., 1992). This finding is congruent with our data and suggests a possible mechanism by which injury risk was increased in the younger children within our elementary-age sample.

Previous findings from a large ($N$ = 10,394), well-designed prospective epidemiological study indicate that children from larger families are at increased risk of injury severe enough to require hospitalization (Bijur, Golding, & Kurzon, 1988). Despite relatively low variability in sibling cohort size, injury liability in our sample was related to the number of children living at home. School-age children in larger families may be more likely to exert themselves beyond their comfortable range of competency by attempting to "keep up" with older siblings or care for younger ones, and parental supervision practices may be less consistent than in smaller families.

Equal numbers of boys and girls participated in this study, and there is no obvious explanation for why gender failed to enter our predictive model. The finding that boys are at greater risk of injury than girls is one of the most robust in the injury literature (Bijur, Golding, Haslum, & Kurzon, 1988; Boyce & Sobolewski, 1989; Matheny, 1987; Rivara & Mueller, 1987; Scheidt et al., 1995). Beyond epidemiological differences in risk, little is known about possible gender differences in injuries to children. In this sample, activities that exposed the child to injury risk (e.g., sports participation) were likely more equally prevalent in boys and girls than in

broader populations with more widely varying types of risk exposure.

Although the concept of an "accident-prone" trait-like characteristic has been discredited, there is substantial evidence that children's psychological qualities do impact their injury liability (Matheny, 1987; Rivara, 1995). Aggressive or antisocial behavior appears to constitute a definite, consistent risk factor (Bijur, Golding, Haslum, et al., 1988; Davidson, 1987; Jaquess & Finney, 1994; Wazana, 1997), while the results concerning hyperactivity have been more equivocal (Bijur, Golding, Haslum, et al., 1988; Davidson, 1987; Wazana, 1997). Children with internalizing behavior problems have not been examined in previous studies of injury risk. Our examination included separate measures of externalizing and internalizing behaviors, but only when the child's behavior problems were considered across the internalizing/externalizing rubric did maladjustment emerge as a significant contributor to injury risk. In this sample, behavior problems in general were associated with prospective injury risk, but more specific assessments of child distress did not contribute to the prediction of injury.

The relationship between child injury and the child's health status is a neglected area in pediatric research. In one investigation, a large United Kingdom (UK) cohort study ($N$ = 10,394), high rates of illness-related hospitalization were related to injury risk but only through the effect of increased behavior problems on both variables (Bijur, Golding, Haslum, et al., 1988). Others have related irregularity in sleep and eating patterns to injury liability (Matheny, 1987), suggesting that physical dysregulation could underlie an increased vulnerability to both illness and injury. In this investigation, three indices of reduced child health (signs, symptoms, and susceptibility) contributed to the variance in child injury rates. However, health care utilization was not associated with injury liability. Although health problems may reduce child contact with hazards (e.g., through a reduction in active play), children with compromised health may be at greater risk of injury due to physical limitations or inconsistent physical ability and less extensive practice at physical tasks, especially when improvements to their health allow them to return to more active play.

Social competence predicted increased injury liability in this sample. Socially competent or active children are generally more peer-oriented and have more positive peer relationships (Ollendick & Schmidt, 1987), and decisions of school-age children in risk-taking situations are more influenced by peer persuasion when the relationship between the children is emotionally positive (Christensen & Morrongiello, 1997; Morrongiello & Bradley, 1997). Many injuries to school-age children are incurred in the presence of peers, and sports participation is a major source of injury in this age group. Socially competent children also may be more likely to experience reduced supervision in peer contexts. Many parents are more likely to allow children to engage in unsupervised activities if they are in a group. The more socially competent children could be expected both to have a friend available for such activities and to be considered by the parent to be capable of safe conduct when unsupervised. Thus, socially competent children may be at risk for injury through mechanisms that include reduced parental supervision, increased active group play, and increased peer influence on risk-taking behaviors.

Maternal stress has been associated with parenting deficits and hazardous homes (Greaves, Glik, Kronenfeld, & Jackson, 1994), but the relationship between maternal psychological status and child injury risk is unclear. Other measures of maternal psychological adjustment included in our analyses did not contribute to the predictive model (i.e., depression, general well-being, loss of emotional control), suggesting that in this sample it was maternal anxiety in particular that elevated child injury risk. There is little precedent for this finding, although Peterson and colleagues did find that mothers who report anxiety responses following their child's injuries are less likely to react to the injury event with remediative consequences such as a safety discussion or lecture, removal of privileges, making changes to a household safety rule, or any form of discipline (Peterson, Bartelstone, Kern, & Gillies, 1995). Other research suggests that exaggerated parental perceptions of child vulnerability do not necessarily lead to more protective parental behavior (Thomasgard & Metz, 1997).

A real limitation of this study is that we relied on a single informant—the child's mother—to provide us with information on herself, her child, her family, and her child's injuries. There is ample evidence that mothers systematically underestimate the number of injuries their children sustain (Bijur, Golding, Haslum, et al., 1988; Peterson & Schick, 1993; Scheidt et al., 1995) and that more distal reporting increases this effect (Peterson, Harbeck, & Moreno, 1993; Scheidt et al., 1995). Significantly, it is unlikely that our injury data are inaccurate in a

direction that would affect the interpretation of our results. There is evidence that mothers of boys with and without behavior problems underestimate injuries retrospectively at similar rates (Bijur, Golding, Haslum, et al., 1988), suggesting that the influence of behavior problems on injury liability in this sample is not simply a reflection of reporting biases that vary with this characteristic. Similarly, parents with more children have been found to underreport child injuries to a greater extent than do parents of fewer or only children (Bijur, Golding, & Kurzon, 1988); for this reason, the association between injury risk and sibling cohort size may be stronger than observed here. The role of maternal anxiety in influencing reports of injury rates is unknown; mothers who are more anxious could seek medical care for child injuries of lesser severity than would less anxious mothers, and they may recall a greater proportion of injury events if these were anxiety-provoking experiences for them. Although maternal anxiety appears to negatively influence the mother's active participation in the socialization of injury prevention, it is also possible that anxious mothers are prone to exaggerate child concerns: medical, psychological, and injury-related.

While acknowledging the likelihood of such biases, we must also bear in mind the central role of the mother in promoting and defining the health and well-being of her child. For considering issues pertinent to the provision of counseling to prevent child injuries, information provided by the mother is appropriate because this information will be used in practice. Thus, we can say that women with more than one child who report themselves to be anxious and their children to be susceptible to illness, to exhibit problem behaviors, and to be socially active, regardless of the biases that enter into these reports, are more likely to have children who sustain unintentional injuries that the mother considers worthy of medical care. In the context of a middle-class suburban managed care setting, these are the mothers who are more likely to seek medical attention for an injured school-age child in the next year. These families should be considered urgent targets for injury-prevention counseling in pediatric primary care.

Pediatric psychologists have the knowledge base necessary for approaching complex behavioral issues surrounding injury prevention. For example, considering variables that affect the implementation of injury prevention behaviors is similar to considering the issue of adherence to medical regimens (Christophersen, 1994). Pediatric psychologists are trained to think developmentally about child problems, which is necessary since injury prevention requires a forward-looking perspective that considers the challenges and risks the child will face in the near and extended future of his or her development. Pediatric psychologists have expertise in counseling and communication, as well as skill in developing and evaluating clinical interventions. Pediatric psychologists in primary care are thus well-qualified to improve injury prevention efforts.

In primary care and other medical settings, interdisciplinary collaboration takes many forms. Pediatric psychologists play varied roles in health care delivery systems, but one likely commonality is that, as for all managed care providers, their time is at a premium. Efficient, effective injury prevention programs for primary care settings need to be developed and implemented. Although pediatric psychologists cannot provide direct intervention to large numbers of families individually, pediatric psychologists could be instrumental in assessing current staff practices, investigating alternatives, designing interventions that could be realistically implemented by available staff, providing staff training, and evaluating program implementation.

Our findings allow for some initial conclusions concerning program development to prevent injuries in school-age children. First, the early school years are a particularly vulnerable time; the physical examination often required for school entry could provide an opportunity for proactive counseling to parents of children making the developmental transition into this high-risk group. Broad preventive programs that target entire age cohorts (e.g., car seats for newborns) are most successful when they capitalize on the universality (or near universality) of the contact point with health personnel. For many parents, their child's transition to elementary school initiates a reduction in the frequency of contact with health professionals (e.g., health supervision and immunization visits decrease). Thus, the school entry visit may be a critical opportunity to counsel parents regarding injury prevention during the elementary school years.

One strategy for injury prevention programs with school-age children would be to provide brief, basic informational counseling to parents of all children at the school-entry visit, with more extensive educational interventions for families at particular risk. Our results suggest that in some primary care practices, children in large families, children with general behavioral maladjustment, children with health problems, children with active peer social lives, and children with anxious mothers are at

increased risk of unintentional injury. While some small number of underlying risk-factors may have increased injury liability in all these children (e.g., they may all be more likely to overextend themselves beyond a safe range of competency, or to experience inconsistent supervision during activities), preventive measures will be most effective if targeted at particular behavioral and environmental combinations indicated by patients with elevated risk-profiles. In many instances, these targeted interventions could be delivered in a group format to families facing similar risks (Thomas, Hassanein, & Christophersen, 1984). For example, targeted prevention efforts with families of socially active children could include information on safety practices during sports and active games, adequate supervision during peer activities, and encouraging the child to perform within his or her abilities. In contrast, it would be appropriate to counsel anxious mothers regarding realistic risks to the child and the importance of parental participation in socializing injury prevention, but additional mental health intervention to treat the mother's anxiety could be warranted.

In developing programmatic interventions, pediatric psychologists should become aware of major risks to children at different ages and in different social contexts (e.g., risks for particular injuries vary according to race, socioeconomic status, and geography). The Injury Prevention Program (TIPP) of the American Academy of Pediatrics (AAP) is only one of several programs that provide informational materials for parents about common child injuries and their prevention (AAP TIPP Revision Subcommittee, 1994). We have attempted to provide some indications about which school-age children should be considered high priorities for preventive intervention in primary care. Finding ways to identify these children and intervene preventively on their behalf will require that pediatric psychologists working in primary care settings locate or devise programmatic interventions appropriate to their contact context. Such programs should likely incorporate education regarding risks and prevention, as well as some acknowledgment of barriers to implementing suggested preventive measures. Liaison relationships with related service agencies will help in working through some of these adherence barriers (e.g., free smoke alarms are often available to families who cannot afford them), but for some high-risk families it may be necessary to take more time to understand a family's barriers to safe behavior, through discussion with the pediatric psychologist or referral for more extensive counseling. This will be especially true for those families in which serious barriers to effective parenting exist (e.g., alcohol abuse).

We recognize that pediatric psychologists have many responsibilities and that injury prevention is only one concern on a long list of serious issues. However, even brief interventions aimed at providing parents with developmentally appropriate prevention information (e.g., flyers, pamphlets, videos) may save children's lives, and the serious impact of injuries and their wide applicability make them good candidates for prioritized counseling time. Whether through direct contact with the pediatric psychologists, through contact with other professionals trained to implement injury preventions, or through exposure to educational materials, interventions to prevent child injuries should be a priority for program development and implementation in primary care settings. The predictors identified here may provide initial guidelines for efficiently targeting these important interventions.

## Acknowledgments

This research was supported in part by a research grant (RO1 MH47903) from the National Institute of Mental Health. We thank the patients, pediatric staff, and information systems group of the Columbia Medical Plan.

*Received July 17, 1998; revisions received March 2, 1999; accepted March 16, 1999*

## References

Achenbach, T., & Edelbrock, C. (1983). *Manual for the Revised Child Behavior Checklist and Revised Child Behavior Profile.* Burlington, VT: T. M. Achenbach.

American Academy of Pediatrics (AAP) TIPP Revision Subcommittee. (1994). *TIPP: A guide to implementing safety counseling in office practice.* Elk Grove, IL: AAP.

Bijur, P., Golding, J., Haslum, M., & Kurzon, M. (1988). Behavioral predictors of injury in school-age children. *American Journal of Diseases of Children, 142,* 1307–1312.

Bijur, P. E., Golding, J., & Kurzon, M. (1988). Childhood accidents, family size and birth order. *Social Sciences and Medicine, 26,* 839–843.

Boyce, W. T., & Sobolewski, S. (1989). Recurrent injuries in schoolchildren. *American Journal of Diseases of Children, 143,* 338–342.

Centers for Disease Control (CDC). (1990). Childhood injuries in the United States. *American Journal of Diseases of Children, 144,* 627–646.

Christensen, S., & Morrongiello, B. A. (1997). The influence of peers on children's judgements about engaging in of behaviors that threaten their safety. *Journal Applied Developmental Psychology, 23,* 33–44.

Christophersen, E. R. (1994). *Pediatric compliance: A guide for the primary care physician.* New York: Plenum.

Davidson, L. L. (1987). Hyperactivity, antisocial behavior, and childhood injury: A critical analysis of the literature. *Journal of Developmental and Behavioral Pediatrics, 8,* 335–340.

Dunne, R. G., Asher, K. N., & Rivara, F. P. (1992). Behavior and parental expectations of child pedestrians. *Pediatrics, 89,* 486–490.

Eisen, M., Donald, C., Ware, J. E., & Brook, R. (1980). *Conceptualization and measurement of health for children in the health insurance study.* Santa Monica, CA: Rand.

Finney, J. W., Christophersen, E. R., Friman, P. C., Kalnins, I. V., Maddux, J. E., Peterson, L., Roberts, M. C., & Wolraich, M. (1993). Society of Pediatric Psychology Task Force report: Pediatric psychology and injury control. *Journal of Pediatric Psychology, 18,* 499–526.

Finney, J. W., Lemanek, K., Cataldo, M. F., Katz, H. P., & Fuqua, R. W. (1989). Pediatric psychology in primary health care: Brief targeted therapy for recurrent abdominal pain. *Behavior Therapy, 20,* 283–293.

Finney, J. W., Riley, A. W., & Cataldo, M. F. (1991). Psychology in primary care: Effects of brief targeted therapy on children's medical care utilization. *Journal of Pediatric Psychology, 16,* 447–461.

Garling, T., & Valsiner, J. (Eds.). (1985). *Children within environments: Toward a psychology of accident prevention.* New York: Plenum.

Greaves, P., Glik, D.C., Kronenfeld, J. J., & Jackson, K. (1994). Determinants of controllable in-home child safety hazards. *Health Education Research, 9,* 307–315.

Hankin, J. R., Starfield, B., Steinwachs, D., Benson, P., Livingston, G., & Katz, H. (1984). The relationship between specialized mental health care and patterns of primary care use among children enrolled in a prepaid group practice. *Research in Community and Mental Health, 4,* 203–214.

Jaquess, D., & Finney, J. W. (1994). Previous injuries and behavior problems predict children's injuries. *Journal of Pediatric Psychology, 19,* 79–89.

Malek, M., Guyer, B., & Lescohier, I. (1990). The epidemiology and prevention of child pedestrian injury. *Accident Analysis and Prevention, 22,* 301–313.

Matheny, A. P. (1987). Psychological characteristics of childhood accidents. *Journal of Social Issues, 43,* 45–60.

Moos, R. H., & Moos, B. (1986). Family Environment Scale manual. Palo Alto, CA: Consulting Psychologists Press.

Morrongiello, B. A. (1997). Children's perspectives on injury and close-call experiences: Sex differences in injury-outcome processes. *Journal of Pediatric Psychology, 22,* 499–512.

Morrongiello, B. A., & Bradley, M. D. M. (1997). Sibling power: The influence of older siblings' judgements about risk-taking behaviours. *Injury Prevention, 3,* 23–28.

Ollendick, T. H., & Schmidt, C. R. (1987). Social learning constructs in the prediction of peer interaction. *Journal of Consulting and Clinical Psychology, 16,* 80–87.

Peterson, L., Bartelstone, J., Kern, T., & Gillies, R. (1995). Parents' socialization of children's injury prevention: Description and some initial parameters. *Child Development, 66,* 224–235.

Peterson, L., Ewigman, B., & Kivlahan, C. (1993). Judgments regarding appropriate child supervision to prevent injury: The role of environmental risk and child age. *Child Development, 64,* 934–950.

Peterson, L., Farmer, J., & Mori, L. (1987). Process analysis of injury situations: A complement to epidemiological methods. *Journal of Social Issues, 43,* 33–44.

Peterson, L., Harbeck, C., & Moreno, A. (1993). Measures of children's injuries: Self-reported versus maternal-reported events with temporally proximal versus delayed reporting. *Journal of Pediatric Psychology, 18,* 133–147.

Peterson, L., & Schick, B. (1993). Empirically derived injury prevention rules. *Journal of Applied Behavior Analysis, 26,* 451–460.

Riley, A. W., Finney, J. W., Mellits, D., Starfield, B., Kidwell, S., Quaskey, S., Cataldo, M. F., Filipp, L., & Shematek, J. P. (1993). Determinants of children's health care use: An investigation of psychosocial factors. *Medical Care, 31,* 767–783.

Rivara, F. P. (1995). Developmental and behavioral issues in childhood injury prevention. *Journal of Developmental and Behavioral Pediatrics, 16,* 362–370.

Rivara, F. P., Bergman, A. B., & Drake, C. (1989). Parental attitudes and practices toward children as pedestrians. *Pediatrics, 84,* 1017–1021.

Rivara, F. P., & Mueller, B. A. (1987). The epidemiology and causes of childhood injuries. *Journal of Social Issues, 43,* 13–31.

Rodriguez, J. G. (1990). Childhood injuries in the United States: A priority issue. *American Journal of Diseases of Children, 144,* 625–626.

Sarason, I. G., Levine, H. M., Basham, R. B., & Sarason, B. R. (1983). Assessing social support: The Social Support Questionnaire. *Journal of Personality and Social Psychology, 1,* 127–139.

SAS. (1989). SAS/STAT user's guide, version 6, 4th edition. Cary, NC: SAS Institute.

Scheidt, P. C., Harel, Y., Trumble, A. C., Jones, D. H., Overpeck, M. D., & Bijur, P. E. (1995). The epidemiology of nonfatal injuries among US children and youth. *American Journal of Public Health, 85,* 932–938.

Thomas, K. A., Hassanein, R. S., & Christophersen, E. R. (1984). An evaluation of group well-child care for improving parents' home burn prevention practices. *Pediatrics, 74,* 879–892.

Thomasgard, M., & Metz, W. P. (1997). Parental overprotection and its relation to perceived child vulnerability. *American Journal of Orthopsychiatry, 67,* 330–335.

Valsiner, J., & Lightfoot, C. (1987). Process structure of parent-child-environment relations and the prevention of children's injuries. *Journal of Social Issues, 43,* 61–72.

Viet, C. T., & Ware, J. E. (1983). The structure of psychological distress and well-being in general populations. *Journal of Consulting and Clinical Psychology, 51,* 730–742.

Wazana, A. (1997). Are there injury-prone children? A critical review of the literature. *Canadian Journal of Psychiatry, 42,* 602–610.

Wills, K. E., Christoffel, K. K., Lavigne, J. V., & Tanz, R. R. (1997). Patterns and correlates of supervision in child pedestrian injury. *Journal of Pediatric Psychology, 22,* 89–104.