Understanding Toddlers’ In-Home Injuries: I. Context, Correlates, and Determinants

Barbara A. Morrongiello, PhD, Lisa Ondejko, MA, and Amanda Littlejohn, BA

University of Guelph

Multimethod strategies (i.e., questionnaires, parents' observations, injury-event recording diaries, telephone and home interviews) were used to study in-home injuries experienced by toddlers over a 3-month period. Cuts, scrapes, and puncture wounds were the most common injuries. The majority of injuries affected children's limbs, and injuries most often occurred in the morning. Boys were injured most often in rooms designated for play, and a majority of their injuries followed from misbehavior. Girls were most often injured in nonplay areas of the home, with the majority of injuries occurring during play activities. Boys experienced more frequent and severe injuries than girls, although girls reacted more than boys to their injuries. Child factors relevant to injury included: risk taking, sensation seeking, and ease of behavior management. Temperament factors did not relate to child injury. Parent factors relevant to child injury included parents' beliefs about control over their child's health, protectiveness, and beliefs about child supervision. Regression analyses revealed that both child (i.e., risk taking) and parent (i.e., protectiveness) factors were significant determinants of child injury.

In most industrial countries, including Canada and the United States, unintentional injuries rank as the number-one cause of death and a leading cause of hospitalization for children older than 1 year (Canadian Institute of Child Health [CICH], 1994; Rodriguez, 1990). The number of unintentional injury deaths to children in the United States is greater than the next nine causes of death combined (Centers for Disease Control and Prevention, 2000). Estimates indicate that one in four children in the United States experience a medically attended injury each year (Scheidt et al., 1994). In 1995, for example, unintentional injuries were the second leading cause of hospitalization among youths under 15 years of age (National Center for Health Statistics, 1997). Not surprisingly, because injuries pose such a significant threat to the health of children, there have been numerous calls for research to identify factors that contribute to injury risk during childhood (Finney et al., 1993; Miller, Romano, & Spicer, 2000; Roberts & Brooks, 1987).

Epidemiological data reveal systematic variation in childhood injury as a function of the child's sex and age. One of the most common findings is that males experience more frequent and severe injuries than females. This sex difference emerges at around 2 years of age and persists throughout childhood and into adulthood (Baker, O'Neill, & Ginsburg, 1992; CICH, 1994; Rivara, Bergman, LoGerfo, & Weiss, 1982). Incidence studies also indicate that the type and location of injury vary as a function of a child's developmental level (Rivara, 1995; Scheidt et al., 1994; Shannon, Brashaw, Lewis, & Feldman, 1992). Specifically, toddlers and preschoolers experience most injuries in and around the home, with the most frequent being falls, burns, and poisonings. In contrast, injuries to school-age children are most likely to occur when the children are outside playing and not in the vicinity of their home, with the more common injuries being sports-, pedestrian-, and bicycle-related traumas.

To date, most research on childhood injuries has been conducted within an epidemiological framework.
Although an epidemiological approach to the study of child injury is valuable for identifying systematic variation in injury rates, it provides limited insights into the determinants of injuries. For example, toddlers may be at elevated risk of injury at home due to any number of reasons, including poor supervision, elevated risk taking at this developmental stage, or insufficient safety proofing and hazard removal. Hence, advances in our understanding of childhood injury require an approach that is process analytic (cf. Peterson, Farmer, & Mori, 1987) or explanation oriented, in which there is analysis of the contribution of a variety of factors that may elevate injury risk, with the ultimate goal being the identification of those factors that best predict the occurrence of child injuries.

Incorporating such an approach, the present study sought to address gaps in knowledge about factors that contribute to in-home injuries that toddlers experience. Specifically, there were three goals in this research: (1) to identify the nature of injuries that children experience at home (e.g., types of injuries, body parts affected, severity of injuries, and reactions to them) and examine the injury context in greater detail (e.g., where do children get injured at home? doing what types of activities? under what level of supervision?), (2) to assess for sex differences in children's injuries and the injury context, and (3) to identify those child and/or parent characteristics that elevate child injury risk.

Questionnaire, interview, parents' observations, and diary reporting methods (i.e., written diary entries and telephone interviews about each injury event) were used to examine parent-based factors (e.g., beliefs about supervision, beliefs about control over the child's health) and child-based factors (e.g., risk taking; sensation seeking; temperament, compliance, or ease of behavioral management) that may relate to in-home injuries among toddlers.

For a period of 12 weeks mothers tracked actual injuries to their child and completed a diary entry form for each event (e.g., the type of injury, body part affected, location, time of day, what the child was doing at the time, what the mother was doing and her location, level of supervision at the time of injury); this type of method has been used successfully to study child-injury events reported by parents (e.g., Peterson, Brown, Bartelstone, & Kern, 1996), as well as by children (Morrongiello, 1997). Within 2–3 days of the event, mothers completed a telephone interview in which further information about the injury was obtained (e.g., whether the child’s behavior was appropriate or in violation of a rule; what preventive action was taken, if any). Questionnaires provided information about characteristics of the child (i.e., sensation seeking, risk taking, injury history, temperament, and compliance/ease of behavioral management) and the mother (i.e., demographic information, protectiveness of her child, beliefs about her child’s vulnerability to health-related problems, beliefs about supervision, and perceived control over her child’s health) that seemed likely to impact on young children's risk of injury in the home. In addition, for each room in the home, mothers provided information about anticipatory or proactive initiatives taken to prevent child injury (parent-, child-, environment-based initiatives) and gave ratings indicating the extent of environmental risk they perceived; these data are considered under a separate publication that follows this one, along with data on supervision strategies to manage injury risk in the home (Morrongiello, Ondejko, & Littlejohn, 2004).

Method
Participants
A final sample of 62 mothers participated, including 31 mothers having a firstborn son in the target age range of 2 to 2.5 years (M = 2.3, SD = 3 months) and 31 mothers having a firstborn daughter (M = 2.3 years, SD = 3 months); an additional 8 mothers discontinued participation and their data were therefore excluded. All mothers were married and living with their spouse; none of the mothers were employed outside the home. An equal number of participants with sons and daughters were surveyed in the spring, summer, fall, and winter to control for any seasonal variation in injury rates at home. Participants were randomly selected from an existing database of families interested in research on child development. In general, the sample comprised families in the low- to moderate-income range, with the majority of participants having completed only high school. Specifically, maternal education for the sample showed the following distribution: 91% had some high school or had obtained a high school diploma and 9% had some university or had obtained a university degree, compared with 78% and 22%, respectively, for fathers. Annual family-income distribution for the sample was as follows: 25% earned less than $25,000; 48% earned $25,000–$49,999; 19% earned $50,000–$74,999; and the remaining 8% earned over $75,000. On average, participants had lived at their current residence for 52 months. None of the immediate family members had ever been hospitalized for an injury. There was little ethnic diversity in the sample; nearly all families were caucasian.
**Measures**

**Questionnaires**

During the initial home visit, mothers completed the following to provide further information about themselves and their child:

1. a demographic sheet to assess the extent of each mother's education and family income level;
2. the Parent Protectiveness Scale (PPS) (Thomasgard, Metz, Edelbrock, & Shonkoff, 1992), which provides an index of the mother's tendency to be protective of her child of 2 to 10 years of age (e.g., "I keep a close watch on my child"; "I know exactly what my child is doing"). This 25-item questionnaire has parents indicate how frequently each item applies to them using a 4-point Likert scale (0 = never, 3 = always). We summed across items to obtain a total score (0–75 range), with higher scores indicating greater protectiveness. Internal consistency has been shown to be acceptable (.73) and test-retest reliability was .86 over a 3- to 5-week interval (cf. Thomasgard et al., 1992). In this study, internal consistency was quite good (.87);
3. the Child Vulnerability Scale (CVS) (Forsyth, Horowitz, Leventhal, & Burger, 1996), which provides an index of the extent to which a parent views the child as vulnerable to health-related problems (e.g., "My child gets more colds than other children I know"; "Sometimes I get concerned that my child does not look as healthy as s/he should"). Each of the eight items is rated from 0 to 3, resulting in a total score between 0 and 24, with higher scores indicating greater perceived vulnerability. Internal consistency has been shown to be acceptable (.74) and was acceptable herein too (.78);
4. the Beliefs About Supervision Questionnaire, which is a measure developed by the first author and loosely modeled after the Proneness to Protect by Supervision Questionnaire (cf. Sundelin, Rasonussen, Berfenstam, & Troedsson, 1996). For each of 10 situations (e.g., in the child's bedroom, in the kitchen, in the bathtub, playing on playground equipment in a fenced yard) parents indicate their judgment as to the youngest age at which a child could be left under two conditions: without supervision for at least 10 minutes, or with indirect supervision (i.e., periodically checking on the child). The younger the age listed, the more lax the supervision by the parent; prior research demonstrates a relation between child injury and parental responses on this questionnaire (Morrongiello & Hogg, 2004). In this study, internal consistency was good both for judgments about the child being left alone (.68) and for the child receiving minimal supervision (.72);
5. the Parent Health Locus of Control questionnaire (PHLOC) (DeVellis et al., 1993), which comprises 30 items that sample perceived parental control over the status of the child's health. Respondents express their degree of agreement or disagreement using a 6-point Likert scale (1 = strongly disagree, 6 = strongly agree), with higher scores indicating greater perceived health control.

Questionnaires to obtain information about the child included:

1. the Injury Behavior Checklist (IBC) (Speltz, Gonzales, Sulzbacher, & Quan, 1990), which provides a standardized measure of the child’s risk-taking behavior. Scores range from 0 to 96, and the higher the score the more risky the child’s usual behavior. Internal consistency has been shown to be acceptable (.87), with 1-month test-retest scores showing good reliability (.81). In the present study, internal consistency was also quite good (.89);
2. an injury history questionnaire, which provided an index of the frequency during the last 6 months (i.e., before initiation of the study) with which the child had sustained 16 different types of moderate to severe injuries (e.g., electricity-related injury such as electric shock; poisoning from a chemical such as a drug; choking; a fall from a substantial height such as off a change table or countertop). The higher the score, the more frequently the child had sustained non-minor injuries. Prior research indicates that mothers accurately recollect child injury information for more serious injuries (Pless & Pless, 1995), although their recollection of more minor injuries is poorer (see Peterson, Harbeck, & Moreno, 1993), which is why we chose to phone mothers every few days in this study;
3. the Toddler Temperament Scale (Fullard, McDevitt, & Carey, 1984), which allows the temperaments of children to be categorized as easy, difficult, slow to warm up, and intermediate based on a number of characteristics (i.e., ratings of
activity, rhythmicity, approach, adaptability, persistence, threshold, intensity of behavioral reaction, distractibility, and mood;

4. the Toddler Sensation Seeking Scale, which was a 24-item measure modeled after one used for preschoolers by Belsky and his colleagues (personal communication, May 20, 1997), and similar measures for children (e.g., Russo et al., 1993) and adolescents (e.g., Huba, Newcomb, & Bentler, 1981). This scale comprised three subscales—boredom susceptibility, intensity of behavior, and thrill seeking—each having eight items. Internal consistency proved very good for thrill seeking (.78) and intensity of behavior (.79), but poor for boredom susceptibility (.21). Hence, final scores were computed after excluding the boredom susceptibility subscale, resulting in a possible range of scores between 0 and 16 and an overall alpha of .87.

Diary and Interview
Mothers completed a diary entry form each time the target child experienced an injury at home, with injury defined (cf. Morrongiello, Midgett, & Shields, 2001) as tissue damage (e.g., cut, burn, bump, redness) lasting longer than 30 minutes, including evidence suggesting internal (nonvisible) tissue damage, such as symptoms indicating a negative reaction (e.g., vomiting) in response to the ingestion of a hazardous substance (e.g., poison); the definition did not include any requirement about intervention or pain because our pilot data revealed that young children were especially prone to carry on (e.g., cry and whine, suggesting pain) in response to very minor tissue damage that lasted only a few minutes, and we did not want to include such very minor injuries. Mothers also recorded this event on an injury-recording calendar that was placed on the refrigerator. The calendar allowed them to track study calls and injury events, thereby making it easy for them to indicate to the interviewer how many, if any, injuries had occurred since the last phone call.

Within 2–3 days of each injury, mothers completed a structured interview over the telephone about the injury event. The interview expanded on the information reported on the diary sheet and yielded information about the level of supervision in effect at the time of injury.

In sum, the diary and interview, taken together, provided information about (1) the injury and the physical, temporal, circumstantial, and sociohistorical context within which it occurred (including level of supervision at the time of the injury); (2) parental perceptions of the seriousness of the injury; and (3) parental reactions to the injury (i.e., treatment of the injury and interventions to prevent recurrence).

Procedure
An initial 2.5-hour home visit was made during which mothers completed questionnaires and an interview about home safety (see Morrongiello et al., 2004), received an injury-recording calendar to place on the refrigerator, and became familiar with how to complete the injury-recording forms, which were organized in a binder. Sample forms were reviewed to ensure that all mothers fully understood what was to be done following an injury to their child.

Participants were contacted by telephone every 2–3 days so that information about injury events would still be fresh in their memory. Participants were contacted in this way for 12 weeks, with a minimum of two injuries required for inclusion in the study; all participants met this inclusion criterion. About 10 minutes per injury event was a typical interview length—if there were more than three injuries to report on during a phone call, then only three were randomly selected by the interviewer for discussion, in order to keep the phone calls to a reasonable length of not more than 30 minutes. At the end of each phone call, a time for the next was scheduled.

At the conclusion of the study, an interviewer returned to the home to pick up the binder containing injury-relevant forms and to give the mother a bouquet of flowers, pamphlets about child safety, and a Safe Seasons calendar as thank-you gifts.

Results
Because much of the data of interest were gathered via interviews, a great deal of coding was necessary to obtain analyzable data. To ensure reliability of the coding, for all data sets reported, a second person independently coded at least 40% of the records. The reliability for all data sets ranged between 94% and 99% (Cohen's
kappa). Because a sex difference in the frequency of injuries was obtained, the data about injuries were converted to proportion scores by dividing the score obtained by the total number of injuries. Analyses were then conducted on the proportion scores; when assessing for within-subject effects we used the multivariate approach to repeated measures. Similarly, because of our interest in sex differences in risk factors for injuries, correlations were conducted in two ways: separately for the boy and girl samples, as well as for the overall sample. When significant correlations are reported for the boy and girl samples, the reader should assume that the same pattern of significant results was also obtained for the overall sample, except as specifically indicated herein. In an effort to identify key risk factors for injury, regression analyses were conducted, incorporating child and parent factors; unfortunately, the small sample size precluded our conducting separate regressions for boys and girls, although the child’s gender was included as a child factor.

**Contextual Analysis of Children’s Injuries**

What types of injuries occurred, how severe were they, and how did children react? Because of the low incidence of some types of injuries, four broad categories of injury were developed: burn related (e.g., food, scald); cuts, scrapes, punctures; bumps, bruises, crushing; and ingestion related. The incidence of injuries of each type was then converted to proportion scores, and an analysis of variance (ANOVA) was applied to the data, with sex (2) as a between-subject factor and type of injury (4) as a within-subject factor. Results revealed a main effect of type of injury, $F(3, 240) = 143.63, p < .001$. Paired contrasts, with a Bonferroni correction applied, indicated (Figure 1) that for both boys and girls, the incidence of cuts, scrapes, and punctures was significantly greater than all other types of injuries ($p < .05$), and the incidence of bumps, bruises, and crushing significantly exceeded burn-related and ingestion-related injuries ($p < .05$).

Each injury was also coded to indicate the body part affected: 1 = limb (arm, leg); 2 = torso; 3 = head and neck (including within the mouth); and 4 = internal torso (e.g., stomach upset in reaction to ingesting a hazardous substance). Analyses of these proportion scores, with sex (2) as a between-subject factor and body part (4) as a within-subject factor, revealed that the body part affected by the injury varied for boys and girls, as indicated by a significant interaction effect, $F(3, 240) = 5.29, p < .001$. Follow-up paired comparison tests, with a Bonferroni correction applied, revealed that injuries to boys more often affected the head and neck than injuries to girls ($p < .05$; see Figure 2). Examination of the girls’ data alone revealed that, compared with other body parts, the greatest incidence of injuries affected their limbs ($p < .05$) and the fewest number of injuries affected the internal torso ($p < .05$). For boys, there was a comparably high incidence of injuries affecting their limbs (1) and the fewest number of injuries affecting their head and neck ($p < .05$). For boys, there was a comparably high incidence of injuries affecting their limbs as affected their head and neck ($p > .05$). Hence, boys were more likely than girls to engage in behaviors that resulted in injury to their head and neck, suggesting that they are at greater risk than girls for more potentially serious injuries. This interpretation is consistent with mothers’ reporting on the severity of injuries to boys and girls.

Specifically, for each injury, mothers provided a rating of severity. We attempted to utilize the Minor Injury
Severity Scale (Peterson, Saldana, & Heiblum, 1996) for coding injuries; however, the scale proved too cumbersome and mothers found the information required to apply the scale too burdensome to gather for every injury to their child. Hence, we used the following scale, with higher numbers indicating greater severity: 1 = not at all serious (may have given the child a hug or kissed the area affected but did nothing at all to treat the injury), 2 = a little serious (parent did something minor to the injury but it was more for the purpose of helping the child calm down and/or feel better than because the injury required treatment; for example, gently rubbing the injury for a few minutes), 3 = somewhat serious (parent did something to treat the injury, such as applying an ice pack or cleaning the injury and applying a bandage), and 4 = very serious (e.g., took the child to see a doctor or dentist).

Analyses of the proportion of injuries at each level of severity revealed that the severity of injuries significantly varied for boys and girls, as indicated by a significant interaction effect, $F(3, 240) = 22.67, p < .001$. As can be seen in Figure 3, and confirmed by follow-up tests with a Bonferroni correction applied, girls experienced more injuries that were judged to be not at all serious, $t(60) = 4.55, p < .001$, and boys experienced more injuries that were rated as a little serious, somewhat serious, and very serious, $t(60) = 3.25, 4.70$, and $4.05$, respectively, $p < .05$. Thus, the types of injuries boys experienced were judged by mothers to be more serious than those experienced by girls.
Although mothers judged the severity of injuries to be greater for boys than girls, boys reacted less to being injured. Specifically, mothers were asked to rate their child’s reaction to each injury event, with higher scores indicating greater reaction: 1 = Child does not even examine the area and pretty much continues as if nothing had happened (e.g., while running, trips and falls, gets up, and continues running); 2 = child examines or rubs the area and says “ouch” but shows no upset or notable reaction (e.g., while running, trips and falls, says “ouch” and examines knee, rubs hands together, then continues running); 3 = child whimpers, moans, complains of pain, or cries but for not more than 5 minutes; and 4 = child whimpers, moans, complains of pain, or cries for more than 5 minutes, generally carrying on about the event. The proportion of injuries for which children demonstrated these different reactions was analyzed, with sex (2) and extent of reaction (4) as factors. Results revealed that boys and girls reacted differently to injuries, as indicated by a significant interaction, $F(3, 240) = 122.38, p < .001$. As shown in Figure 4, and confirmed by follow-up tests with a Bonferroni correction applied, boys more often than girls showed no or little reaction to getting injured, and girls more often than boys carried on and showed a greater reaction to injury, $t(60) = 5.61, 10.25,$ and $16.54$, respectively, $p < .05$. Thus, even though boys experienced more severe injuries, girls reacted more extremely to theirs.

Where did injuries occur? Mothers indicated the location of their child in the home at the time of injury, and these descriptions were coded as follows: 1 = nonplay area (i.e., kitchen, bathroom, or living room); 2 = child play area (i.e., playroom or child’s bedroom); or 3 = nonroom area (i.e., hall or stairs). These proportion scores were then analyzed using an ANOVA with sex (2) as a between-subject factor and location (3) as a within-subject factor. Results revealed that boys and girls were injured in different locations in the home, as indicated by a significant interaction, $F(2, 180) = 19.95, p < .001$. Follow-up tests with a Bonferroni correction applied revealed more injuries to boys than girls in child play areas of the home ($M = 54\%$ and $28\%$, $SD = 18\%$ for each) and more injuries to girls than boys in nonplay areas ($M = 61\%$ and $39\%$, $SD = 20\%$ and $15\%$, respectively) ($p < .05$). The incidence of injuries in nonroom areas of the home was comparably low for both boys and girls ($M = 7\%$ and $11\%$, $SD = 9\%$ and $17\%$, respectively). Examining boys alone revealed that significantly more injuries occurred in child play areas ($M = 54\%$) than nonplay ($M = 39\%$) and nonroom areas ($M = 7\%$), with more injuries in nonplay than nonroom areas ($p < .05$). In contrast, for girls, significantly more injuries occurred in nonplay areas ($M = 61\%$) than child play ($M = 28\%$) or nonroom ($M = 11\%$) areas, with more injuries in child play than nonroom areas ($p < .05$). In sum, the greatest injury risk to boys occurred in the child play areas of the home, whereas girls were more likely to experience injuries in the nonplay areas.

When did injuries occur? An ANOVA with sex (2) as a between-subject factor and time (5) as a within-subject factor was applied to the proportion of injuries that occurred during five time periods: morning (from the time the child awoke until lunch); during lunchtime; afternoon (from the conclusion of lunch until dinner began); during dinnertime; and bedtime (from after dinner until the child woke up in the morning)—we did
not distinguish a separate breakfast time period because many children did not eat breakfast per se or drank a bottle in their crib for breakfast before getting up for the day. As can be seen in Figure 5, all children experienced the greatest number of injuries in the morning, as indicated by a main effect of time of injury, $F(4, 300) = 13.78$, $p < .001$, and follow-up Bonferroni paired-comparison tests. There was, however, some noteworthy variation regarding other times when injuries occurred to boys and girls, as indicated by a significant interaction effect, $F(4, 300) = 3.51$, $p < .01$. Follow-up Bonferroni $t$-tests indicated that girls experienced more injuries than boys in the afternoon and fewer injuries than boys during dinnertime, $t(60) = 2.04$ and $5.08$, respectively, $p < .05$. Hence, morning was a high-risk time for all children, and injury risk differed for boys and girls during the remaining periods of the day.

What was the child doing that led to injury? Mothers reported on what the child was doing that led to injury and these data were coded as follows: 1 = nonphysically active play (e.g., sitting on the floor and playing with blocks or coloring); 2 = physically active play (e.g., running after or kicking a ball); 3 = physically active nonplay (e.g., running to answer the phone); 4 = inappropriate behavior that the mother reports the child should not have been doing (e.g., climbing on counter-top); or 5 = ordinary nonplay (e.g., walking down the stairs). These data were then converted to proportion scores, and an ANOVA was applied with sex (2) as a within-subject factor and activity (5) as a within-subject factor.

Results indicated that boys and girls differed in what activities led to injuries, as indicated by a significant interaction, $F(4, 300) = 7.60$, $p < .001$. As can be seen in Figure 6, and confirmed by follow-up Bonferroni $t$-tests, girls were more likely than boys to be injured during nonphysically active play, whereas boys were more likely than girls to be injured doing things they were not supposed to be doing, $t(60) = 3.96$ and $4.21$, respectively, $p < .05$. Analysis of the data for boys and girls separately, with a Bonferroni correction applied, indicated significantly more injuries to boys when they engaged in physically active play and misbehavior, as compared with nonphysically active play, physically active nonplay, and ordinary nonplay; the latter three conditions did not significantly differ from one another. In contrast, significantly more injuries occurred to girls when they engaged in play behavior (physically active or not) as compared with misbehavior, physically active nonplay, or ordinary nonplay, the latter three conditions not significantly differing from one another. In sum, injuries to boys most often resulted when they were engaging in misbehavior or physically active play, whereas those to girls were most likely during play activities.

**Child Characteristics and Injury Risk**

To examine the incidence of injuries for boys and girls, an ANOVA was conducted with sex (2) as a between-subject factor and injury score (2) (the prior 6 months to the study period) as a within-subject factor. A main effect of sex, $F(3, 56) = 34.09$, $p < .001$, indicated that boys experienced more injuries than girls for both measures, including more serious injuries for the 6 months preceding the study ($M = 5.2$ and $2.0$, $SD = 2.9$ and $1.2$, respectively) and minor injuries during the 3-month...
study period ($M = 13.7$ and $4.4$, $SD = 5.2$ and $2.1$, respectively). Correlations confirmed that these injury scores were highly positively correlated with one another for boys and girls, $r(31) = .67$ and $.68$, respectively, $p < .05$. Hence, children who experienced more frequent minor injuries during the study period were those reported to have experienced more frequent serious injuries during the 6-month period before the study.

Consistent with these injury scores, mothers reported on the IBC that boys engaged in more risk taking than girls ($M = 43.7$ and $24.8$, $SD = 11.0$ and $6.9$, respectively), $F(1, 60) = 65.04$, $p < .001$. Not surprisingly, risk-taking scores positively correlated with 6-month injury scores, $r(31) = .65$ and $.22$, $p < .05$, for boys and girls, respectively, and with the scores during the study, $r(31) = .68$ and $.23$, $p < .05$, although the magnitude of correlations suggested that the relation between risk taking and injury outcome was much stronger for boys than girls.

A comparison of sensation-seeking scores for boys ($M = 12.9$, $SD = 4.0$) and girls ($M = 10.4$, $SD = 3.2$) revealed a marginally significant sex difference, $F(1, 60) = 3.80$, $p = .05$, indicating that boys were higher in sensation seeking than girls. Analyses of the relation between injuries and sensation seeking revealed significant positive correlations for boys and girls for injuries during the prior 6 months, $r(31) = .57$ and $.63$, respectively, $p < .05$, and during the study period, $r(31) = .64$ and $.63$, $p < .05$. Sensation seeking was also highly positively related to risk-taking scores for boys and girls, $r(31) = .68$ and $.83$, respectively, $p < .05$, suggesting that those children high on sensation seeking also engaged in high levels of risk taking, as one might expect.

To examine the relation between child temperament and injury risk, the children were assigned a score depending on their temperament classification (see the Toddler Temperament Scale in the Measures section). There were no sex differences in temperament: 3 males and 1 female were identified as difficult, 19 males and 19 females were rated as slow to warm up or intermediate, and 9 males and 11 females were rated as having easy temperaments. Correlations were then conducted to determine whether temperament classification systematically related to injury risk. Results did not reveal any significant effects. In addition, relating children's injury scores to each of the individual scores on the nine temperamental variables separately (activity, rhythmicity, approach, adaptability, persistence, threshold, reaction intensity, distractibility, and mood) did not reveal any significant effects. Hence, as measured in this study, child temperament variables did not relate to the frequency of child injury, at least not at 2 years of age.

Finally, an analysis was conducted on mothers' ratings of the ease of managing the child and child's compliance with rules and guidelines when at home (1 = never compliant [everything is a struggle when the child doesn't want to, or wants to, do something and I disagree about it]; 2 = rarely compliant; 3 = occasionally compliant; 4 = half and half; 5 = compliant much of the time; 6 = nearly always compliant; and 7 = always compliant [child is consistently very easy to manage]). Results revealed that girls were rated as more compliant and easy to manage than boys ($M = 5.2$ and $3.6$, $SD = 1.1$ and $1.5$, respectively), $F(1, 60) = 23.91$, $p < .001$. Furthermore, for both boys and girls, children who were easier to manage engaged in less risk taking, $r(31) = -.69$
and \(-0.49\), respectively, \(p < .01\), and experienced fewer injuries both during the study, \(r(31) = -0.62\) and \(-0.73\), respectively, \(p < .01\), and during the 6 months preceding the study, \(r(31) = -0.60\) and \(-0.56\), respectively, \(p < .01\). Moreover, for boys only, those who were more difficult to manage experienced more injuries during the study from engaging in behaviors the mother judged unacceptable or in violation of a rule, \(r(31) = -0.48\), \(p < .01\). Hence, mothers’ general perceptions of their child’s manageability and compliance provided important information relevant to child injury risk.

Maternal Characteristics and Child Injury Risk

Analysis of mothers’ scores on the CVS (range 0–24) revealed significantly higher scores for mothers of girls (\(M = 7.6\), \(SD = 5.9\)) than mothers of boys (\(M = 4.0\), \(SD = 4.5\)). \(F(1,60) = 6.91\), \(p < .05\), indicating that girls were perceived by mothers to be more vulnerable to ill health than boys, even though girls experienced fewer injuries than boys. Correlational analysis indicated that the CVS was related to injury scores only for sons, not daughters. Specifically, mothers with high CVS scores had sons with fewer injuries both during the study, \(r(31) = 0.63\), \(p < .05\), and during the 6 months preceding the study, \(r(31) = 0.32\), \(p < .05\); similar significant results were obtained when the data for the entire sample were analyzed, \(r(62) = 0.28\) and \(0.22\), \(p < .05\), respectively. Hence, mothers’ ratings of their child’s vulnerability to health-related problems was a better index of injury risk for sons than daughters.

To assess for group differences in mothers’ perceived control over their child’s health, an ANOVA was applied to the PHLOC scores with sex (2) as a between-subject factor. Results revealed a greater belief in their ability to control their child’s health for mothers of daughters than sons (\(M = 3.7\) and 3.4, \(SD = 0.1\) and 0.1, respectively), \(F(1,59) = 5.34\), \(p < .05\). Correlational analyses indicated that PHLOC scores negatively related to 6-month injuries for boys and girls, \(r(31) = -0.71\) and \(-0.56\), respectively, \(p < .05\), and to the frequency of injuries experienced by boys and girls during the study, \(r(31) = -0.83\) and \(-0.55\), \(p < .05\). Hence, mothers who believed they could exercise control over the status of their child’s health had children who experienced fewer injuries.

In addition to measures of actual supervision at the time of child injury (reported in Morrongiello et al., 2004), there were global indices of mothers’ general orientation to supervision included in this study, and each was analyzed separately. To examine whether mothers of boys differed from mothers of girls in their general tendency toward protectiveness of their child, an ANOVA was applied to the PPS scores with sex (2) as a between-subject factor. Results revealed that mothers of boys showed less protectiveness (\(M = 25.0\), \(SD = 11.5\)) than mothers of daughters (\(M = 40.2\), \(SD = 8.6\)), \(F(1,60) = 35.01\), \(p < .001\). Furthermore, correlational analyses indicated that mothers who earned high PPS scores, indicating greater protectiveness, had children who experienced fewer injuries both during the 6 months prior to the study, \(r(31) = 0.67\) and 0.68 for boys and girls, respectively, \(p < .05\), and during the study period, \(r(31) = 0.87\) and 0.62 for boys and girls, respectively, \(p < .05\).

On the Beliefs About Supervision Questionnaire, mothers reported on the youngest age at which they thought it would be appropriate for their child to participate in ten activities under conditions of minimal supervision (MS) and no supervision (NS). These scores were averaged across activities to yield a total average age for the MS and NS conditions, with lower scores indicating younger ages at which the mother would allow the child to engage in the activity under that supervision condition. Analysis of these data, with sex (2) as a between-subject factor and supervision condition (2) as a within-subject factor, revealed a main effect of sex, \(F(1,120) = 8.54\), \(p < .01\). As can be seen in Figure 7, mothers of sons, as compared with mothers of daughters, indicated younger ages at which they would allow their child to engage in the designated activities, with either minimal or no supervision. As one would expect, a main effect of supervision condition, \(F(1,120) = 60.0\), \(p < .05\), indicated that mothers would leave their child without supervision at older ages than they would allow their child to perform the activity under minimal supervision (see Figure 7), although these measures were highly positively correlated, \(r(62) = 0.87\), \(p < .001\). To examine the relation between supervision beliefs and child injury, correlational analyses were conducted. Results revealed that mothers who reported that they would leave their child without supervision at young ages had children who experienced more injuries in the 6 months prior to the study, \(r(31) = -0.27\) for both boys and girls, respectively, \(p < .05\), as well as during the study, \(r(31) = -0.32\) and \(-0.25\), \(p < .05\). Hence, measures of maternal protectiveness and mothers’ beliefs about their child’s general need for supervision proved informative for the identification of children at risk for injury.

Determinants of Child Injury

To identify the best predictors of toddlers’ in-home injuries, hierarchical regressions were conducted, with child
characteristics entered first to control for these, followed by maternal characteristics. A number of different factor groupings were tried in an effort to identify the model with the greatest predictive value. Preliminary screening to test for meeting the necessary assumptions (cf. Tabachnik & Fidell, 1989) was conducted, and no concerns were indicated regarding outliers or distribution issues. Child characteristics included a risk-taking (IBC) score, a sensation-seeking score, an ease of manageability or compliance score, and sex of the child. Parent characteristics included a protectiveness (PPS) score and the average score on the Beliefs About Supervision Questionnaire for the no-supervision condition; from among the three questionnaire measures related to mothers’ beliefs about their child’s health and that correlated well with child injury (i.e., PPS, CVS, and PHLOC), the PPS was selected because it was judged to have items most relevant to child injury and was highly correlated with the CVS, $r(62) = .74$, $p < .05$, and PHLOC, $r(62) = .78$, $p < .05$, indicating a high degree of redundancy for the three measures.

With the criterion defined as the number of injuries in the 6 months prior to the study, the regression analyses revealed the IBC and the PPS as the only significant predictors ($\beta = .77$ and $-.38$, $SE = .02$ and $.04$), $t(60) = 9.50$ and $-2.33$, respectively, $p < .05$, accounting for 62% of the total variance. With the criterion defined as the number of injuries during the study, the regression model that best explained injuries included sex of the child, IBC, and PPS ($\beta = -.20$, $.81$, $-.31$, $SE = .61$, $.02$, $.03$), $t(60) = -3.67$, $15.17$, $-4.75$, respectively, $p < .001$, accounting for 64% of the variance. In sum, both child and parent factors significantly contributed to the prediction of toddlers’ in-home injuries.

**Discussion**

In the present research, a multimethod approach to data collection (i.e., questionnaires, mothers’ observations and injury-recording diaries, home and telephone interviews) was used to gather information relevant to epidemiological and process-analytic approaches to the study of child injury. The present study therefore provides a thorough analysis of the context within which injuries occur to toddlers at home, the extent and types of such injuries, and the child- and parent-based factors contributing to such injuries.*

Although the definition of injury used in this study was biased toward mothers reporting on minor injuries to their children, the high positive correlation between an individual’s injuries during the study and more serious injuries experienced in the 6 months preceding the study confirms that minor injuries are useful proxy events for more serious ones. Peterson et al. (2002) also

*While the present manuscript was being processed, a similar study of home injuries experienced by children 15 to 18 and 33 to 36 months of age was published (Peterson, DiLillo, Lewis, & Sher, 2002). Although a similar methodology was used, there are some noteworthy differences between the two studies, including: Peterson et al. define injury as requiring visible tissue damage lasting 24 hours; theirs is a predominantly well educated and middle-class sample; and interviews about injuries were completed every other week in the home. Despite these methodological differences, aspects of their findings are relevant to those reported herein and are noted where appropriate throughout the Discussion.
argue for the relevance of studying minor injuries in order to better understand the occurrence of more severe ones. Specifically, they found that for 72% of 2,483 injuries that young children experienced at home over a 6-month interval, the potential for injury was rated to be more severe than was the case. Thus, the study of minor injuries can contribute to our understanding of more severe injuries, and the present findings therefore would seem quite relevant to understanding factors contributing to more serious in-home injuries to toddlers.

**Contextual Analysis of Child Injury**

In the present sample, injuries occurred more frequently in the mornings than at any other time of day. This probably reflects a combination of factors, including mothers having a number of tasks they wish to complete at the start of the day (e.g., making coffee, breakfast, the beds, etc.) and children being well rested and therefore particularly energetic and active. The most common types of injuries involved cuts, scrapes, and punctures, followed by bumps and bruises, all of which were typically relatively minor injuries. Peterson et al. (2002) also found cuts and scrapes to be common home injuries in young children.

It is of interest to note that not only did boys experience more injuries than girls (see also Peterson et al., 2002), but boys also experienced injuries of greater severity than girls (see also Rivara et al., 1982) and, consistent with this, were at greater risk of injuries to head and neck. Moreover, for boys, injuries were most likely to occur in play areas (their bedroom or playroom), while girls were more susceptible to injury in nonplay areas (kitchen, living room). Hence, although boys and girls experienced the same types of injuries, they were most often injured in different locations in the home, and the extent of injury was more serious for boys than girls.

Surprisingly, although boys’ injuries were judged more serious by mothers, it was the girls who showed greater sustained reaction (e.g., crying, whining). The extent to which boys underreact and girls overreact relative to the nature and scope of their injuries cannot be ascertained from the present data. Nonetheless, the findings are consistent with prior research involving school-age children’s reporting on their own injuries: Boys downplayed their injuries and the severity of them (Morrongiello & Rennie, 1998) and girls played up their injuries, rating the severity of minor injuries as higher than boys’ ratings and being more likely than boys to inform parents about injury events (Morrongiello, 1997). This sex difference in young children’s reaction to minor injuries highlights the importance of excluding pain as a requirement in one’s definition of injury in research such as this. Because pain is inferred by parents based on observation of children’s reactions, the inclusion of pain in one’s definition of injury may result in a misrepresentation of injury rates for young children, enhancing rates for girls and dampening rates for boys.

The salience of injury events for girls may explain, in part, the greater protectiveness of daughters than sons reported by mothers in this study. Girls, for example, have been shown to be allowed less independence than boys, to receive more encouragement for dependency than autonomy, to be granted less freedom to roam and fewer opportunities to play alone than boys, and are more likely than boys to receive discouragement or cautions when engaging in a play behavior that could lead to injury (e.g., Basow, 1986; Block, 1983; Cowan & Avants, 1988; Morrongiello & Dawber, 1999, 2000; Newson & Newson, 1976; Saegert & Hart, 1976). Possibly, because of the intensity of the reaction of girls to even minor injuries, parents may work especially hard to prevent injury occurrence to daughters, in order to avoid this intense reaction. Alternatively, the protectiveness expressed by parents via verbalizations and behaviors that serve to communicate caution messages to daughters (e.g., Morrongiello & Dawber, 1999, 2000) may result in daughters judging even minor injuries as salient and substantive events that merit a strong emotional reaction and sharing with parents. In ongoing research, we are seeking to gain greater insights into the bidirectional parent/child processes of socialization with respect to pain experienced due to injuries in early childhood.

**Child Factors Contributing to Injury Risk**

There were a number of child characteristics that correlated with in-home injuries and helped to explain why boys experienced more injuries than girls in this study. Consistent with previous research (e.g., Morrongiello & Dawber, 1999, 2000; Speltz et al., 1990), children who were reported to engage in more risk taking experienced more injuries. Similarly, scoring high on the trait of sensation seeking (i.e., thrill seeking and intensity of behavior) also emerged as a risk factor for in-home injuries. Sex differences in sensation seeking, and correlations between sensation seeking and injury risk behavior, have previously been noted for adolescents (e.g., Heino, van der Molen, & Wilde, 1996) and adults (e.g., Zuckerman, Eysenck, & Eysenck, 1978). The present study extends this developmental trajectory downward to very early childhood, raising the interesting possibility of
inborn-based differences in sensation seeking and injury risk (for further discussion, see Morrongiello & Dawber, 2000). Not surprisingly, sensation-seeking and risk-taking measures positively correlated with each other (see also Potts, Martinez, & Dedmon, 1995); however, the size of the correlation indicated that each uniquely measures aspects of injury risk, at least at these young ages.

Children’s general compliance with rules and behavioral guidelines—in other words, the ease of management of the child—also emerged as an important risk factor for in-home injuries to toddlers. Specifically, those children who mothers rated as being more difficult to manage and less compliant with rules experienced more injuries. Examination of what children were doing at the time of injury provided additional support to the hypothesis that compliance is relevant to child injury risk. Specifically, boys experienced more injuries than girls, and the largest portion of boys’ injuries (38%) resulted from their engaging in behaviors that were judged as inappropriate and unacceptable by their mother.

The importance of this manageability/compliance factor for understanding child injury risk has emerged in several previous studies. For example, in a study of preschool children’s knowledge of home safety rules, the best predictor of injury rates was compliance, not knowledge (Morrongiello et al., 2001). Similarly, in a review of the literature on behavioral characteristics of children that elevate injury risk (Davidson, 1987), there was a clearer relationship reported between injury and behavior-management problems than between injury and hyperactivity per se (see also Jacques & Finney, 1994; Pulkkinen, 1995; Schwebel, Speltz, Jones, & Bardina, 2002). Hence, several studies have identified a relation between child manageability/compliance and injury risk, although there is not much understood about the process by which this factor elevates child injury risk, and several important questions remain to be addressed. For example, in the case of children who do poorly with following rules and are difficult to manage, what strategies do parents use to moderate injury risk, and with what results? Certainly, the injury statistics to date suggest that whatever parents are doing to moderate injury risk for noncompliant, more difficult-to-manage children, the strategies are not especially effective.

Finally, one child characteristic that did not emerge as relevant to toddlers’ in-home injuries was temperament. Although a relation between injury and temperament has been reported in some prior research (e.g., Bijur, Golding, Haslum, & Kurzon, 1988; Pulkkinen, 1995; Schwebel & Plumert, 1999), in other studies no such relation has been reported (e.g., Matheny, 1986), or it has been found at some ages but not others (e.g., Plumert & Schwebel, 1997). Thus, the conditions under which temperament influences child injury risk are not well understood. Suffice it to say, as measured in this study, that child temperament variables did not relate to the frequency of in-home injuries among children 2–3 years of age.

**Parent Factors Contributing to Child Injury Risk**

Mothers completed several questionnaires that tapped global perceptions they may have had about their child’s vulnerability to illness, controllability of their child’s health, and their own tendency to be protective of their child. Results indicated that daughters were seen as more vulnerable to ill health than sons (CVS measure), even though sons experienced more injuries than daughters; not surprisingly, this measure did not reliably relate to child injury risk for sons and daughters. Interestingly, mothers perceived themselves as having greater control over the health status of daughters than sons (PHLOC measure) and showed greater protective-ness for daughters (PPS measure). Further, positive correlations between child injury and both the PHLOC and PPS measures indicated that beliefs about controllability of their child’s health and mothers’ protectiveness were related to injury risk for toddlers at home. Specifically, mothers who believed they could exercise control over their child’s health and who engaged in behaviors indicating a high level of protectiveness had toddlers who experienced fewer in-home injuries. The only other study that we know of in which one of these measures has been related to child injury risk sought to relate PHLOC beliefs to the adoption of safety measures and failed to find such a relation (Ueland & Kraft, 1996). Obviously, additional research is needed to elaborate the conditions under which, and the means by which, parental beliefs about child protection and control over the child’s health come to influence risk of in-home injuries to toddlers.

Finally, a global measure of mothers’ beliefs about supervision was used in an effort to discern whether a relation existed between such beliefs and child injury risk. The premise motivating a focus on general beliefs about supervision was a simple one: Mothers often find it difficult to elaborate the details of how they supervise, and strategies vary tremendously depending on child, parent, and environmental factors. Nonetheless, these strategies presumably derive from a higher-level set of
beliefs and assumptions about supervision and their individual child’s needs for protection. Hence, we thought it likely that one could measure global beliefs about supervision and that this might relate to child injury risk. The Beliefs About Supervision Questionnaire showed good internal consistency and revealed some interesting findings. Specifically, mothers reported younger ages at which they would allow their son to perform a number of behaviors, as compared with mothers of daughters. Moreover, these ratings correlated with home injuries: Children with a greater number of injuries had mothers who endorsed younger ages for the activities listed (see also Morrongiello & Hogg, 2004). Hence, maternal beliefs about children’s supervision needs in a number of common play situations proved relevant to understanding child injury risk at home.

In sum, the present findings suggest that global measures that tap a parent’s beliefs about control over their child’s health, protectiveness, and supervision may provide useful information for identifying toddlers at elevated risk of home injury. However, further research is needed to elaborate the processes by which these beliefs come to influence injury risk for young children.

**Determinants of Child Injury Risk**

Although a number of child and parental factors correlated with child injury, the regression model revealed that the best determinants of child injury risk were children’s risk taking and parental protectiveness, the combination of which accounted for about 62% of the variance.

In an earlier study, Matheny (1986) reported on 116 toddlers 1 to 3 years of age and found that a combination of characteristics of the mother (i.e., education level, emotional stability, and energy level) and the home environment (i.e., extent of noise/confusion) best predicted injury liability, with child characteristics (i.e., manageability and sex) significantly correlating with injury risk but making no significant further contributions to the regression model per se. The study was similar to the present one in a number of ways; for example, mothers reported on injury events, and minor (i.e., nonmedically attended) injuries were included. However, there are several important differences between the studies in treatment of the data, two of which may contribute to explain the different findings. First, for the regression analyses, Matheny fixed the order of entry of the factors to be (1) maternal characteristics, (2) environmental characteristics, and (3) child characteristics, on the assumption that characteristics external to the toddler were largely responsible for creating unsafe or safe conditions to which the child then reacted. However, this assumption precludes consideration of bidirectional effects in parents’ risk management strategies, that is, that parent behaviors and home environments managed by parents occur, at least in part, in reaction to child characteristics. Hence, child characteristics are important to consider, and control for, when attempting to explain the contribution to child injury risk of parent behaviors and environments created by parents for their children (see Morrongiello & Dawber, 1999, 2000, for further discussion). Because of our belief in the merit of bidirectionality processes in understanding child development, we entered child factors in the regression first, and then entered parent characteristics subsequently. A second difference between the present study and that of Matheny’s is that he did not consider in the analyses the actual number of injuries experienced by children. Instead he grouped children into categories of low liability (fewer than two injuries) and high liability (more than two injuries), which constrains the range of scores for the outcome variable and thereby decreases statistical power to find significant effects. At the very least the discrepancy in findings across studies highlights the need for further research in this area.

**Limitations and Directions for Future Research**

Although this study provides important insights into toddlers’ in-home injuries, some key questions could not be fully addressed. Most importantly, it would have been ideal to have a larger sample of participants in order to conduct regressions separately for boys and girls. Given the sex differences in injury rates, injury severity, and some predictors of injury (e.g., the CVS correlated with injuries for boys but not girls), a more complete exploration of differences in the models that best predicted child injury would have been preferred, and is needed. Related to this point, research on the socialization of pain due to injury is needed, and particular attention needs to be given to determining whether bidirectional processes operate and whether these differ for boys and girls; contrasting parental and child reactions to near-injuries as compared with injuries may prove particularly illuminating. Finally, there is no way of knowing the extent to which participation in the study resulted in changes in mothers’ typical behaviors (e.g., increased supervision), which would have direct influences on the findings. Although mothers readily reported on injuries and gave other information (e.g., they did not supervise properly for some injuries) that would argue against such reactivity effects, one cannot say with certainty that such effects were not operating.
Conclusions

Drawing on epidemiological and process-analytic approaches to investigating injury events, the present study used multimethod strategies to study in-home injuries experienced by toddlers over a 3-month period. The findings provide numerous insights into toddlers' in-home injuries and reveal a number of factors that relate to such injuries. Child factors relevant to injury included risk taking, sensation seeking, and degree of compliance or ease of behavioral management. Temperament factors were not found to relate to child injury. Parental factors relevant to child injury included parents' beliefs about control over their child's health, protectiveness, and beliefs about child supervision. Regression analyses revealed that the model that best predicted child injury comprised both child (i.e., risk taking) and parent (i.e., protectiveness) factors. Thus, in assessing home injury risk for toddlers, one must consider the risk-taking tendencies of the individual child within the specific context of their parents' protectiveness beliefs and practices.

Acknowledgments

This research was generously supported by grants to the first author from the Social Sciences and Humanities Research Council of Canada and the University of Guelph. The authors extend their appreciation to the parents for their interest in this research, to Dr. Serge Desmarais for statistical advice, and to Shawn Matheis for data analysis. This article is dedicated to the memory of Lizette Peterson, who encouraged us in this work and offered numerous insightful suggestions to aid us in preparation of the report for publication.

Received November 19, 2002; revisions received March 14, 2003; accepted March 18, 2003

References


