Toddlers' Unintentional Injuries: The Role of Maternal-Reported Paternal and Maternal Supervision*

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Research indicates that mothers' supervision protects children from injuries. However, little research has examined the role of fathers' supervision in children's injuries. **Objectives** This study compared the role of maternal and paternal supervision in children's injury risk and severity using maternal reports. **Methods** Mothers ($n = 170$) of toddlers were interviewed for 6 months about their children's unintentional injuries. **Results** Children were more likely to engage in high activity levels and were at higher risk for injury when being cared for by their fathers. Although higher supervision predicted lower injury risk for both mothers and fathers, fathers' close supervision (as reported by mothers) was a stronger predictor of injury risk than mothers' supervision. **Conclusion** Children's higher levels of activities may have accounted for their higher risk of injury when in their fathers' care. These findings indicate the need to include fathers in injury prevention efforts.

Key words caregiver supervision; fathers; unintentional child injury.

Unintentional injuries are the leading cause of death among children in the United States. In fact, unintentional injuries account for 12,175 deaths each year for children between the ages of 0 and 19 (Borse et al., 2008). Moreover, ~9.2 million children visit the emergency room yearly for unintentional injuries, resulting in 17 billion dollars annually in medical costs (Borse et al., 2008). The significant impact of injuries on children's health suggests that injury prevention is key to improving children's well-being.

In an effort to find prevention targets, many studies have examined the role of primary caregivers in children's risk for injury. For example, several studies have found a protective role for caregiver supervision in children's injury risk (Damashek, Williams, Sher, & Peterson, 2009; Morrongiello, Corbett, & Brison, 2009a; Morrongiello, Corbett, McCourt, & Johnson, 2006; Morrongiello, Ondejko, & Littlejohn, 2004). However, the vast majority of these studies have only examined the role of maternal supervision in children's injury risk, despite the fact that fathers are increasingly taking more responsibility for childcare because of higher rates of maternal employment (Cabrera, Tomis-LeMonda, Bradley, Hofferth, & Lamb, 2000; Paquette, 2004). In fact, current studies have found that fathers spend double the amount of time with their children compared with studies from three decades before (Cabrera et al., 2000; Yeung, Sandberg, David-Kean, & Hofferth, 2001). As the percentage of time that children spend with their fathers increases, so does the importance of including fathers in research on childhood injuries.

Previous research has found similarities and differences in the way in which fathers and mothers interact with their children. For example, researchers have found that both fathers and mothers successfully engage children

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in play, promote proper social skills, and respond appropriately to infant signals (Paquette, 2004; Parke & O'Leary, 1976; Yogman, 1981). Moreover, a study by Morrongiello and Dawber (1999) found that both mothers and fathers promoted risk-taking behaviors with their sons more than they did with their daughters. However, other studies have found differences in the ways that mothers and fathers interact with their children. In particular, several studies have found that fathers generally tend to promote physical play and exploratory behaviors more often than mothers (Brussoni & Olsen, 2011; MacDonald & Parke, 1986; Paquette, 2004; Yogman, 1981). Differences in play styles may impact children's risk for injury; however, few studies have examined the relation of fathers' parenting behaviors to children's injury risk.

A few studies have examined maternal and paternal attitudes and reactions to children's unintentional injuries. Lewis, DiLillo, and Peterson (2004) found that fathers were more likely than mothers to endorse the idea that minor injuries benefit toddlers because injuries will toughen them (i.e., the notion of ''no pain, no gain'') or teach them what to do in risky situations. These attitudes in combination with increased physical play may result in higher injury risk for children. Brussoni and Olsen (2011) examined only fathers' attitudes and practices toward child injury prevention through in-home interviews. They found that most fathers viewed minor injuries as an unavoidable experience that would help children learn from their mistakes. However, when examining a sample of mothers, Morrongiello and Dayler (1996) found that mothers also held such views. Indeed, a later study by Morrongiello, Zdzieborski, and Normand (2010) examined parents' self-reported reactions to children's (24–36 months) hypothetical risk-taking behaviors and injuries and found that mothers and fathers had similar reactions to children's risk-taking behavior and injuries (e.g., educating their children about risky situations and safety behaviors and providing comfort and aid after a medically attended injury).

Other research has examined both mothers' and fathers' roles in children's actual injury occurrence. One study that examined the relation of parent–child relationship quality to child injury risk found that positive father–child relationships were related to a decreased number of medically attended unintentional injuries among children in grades 1–6, especially among male children. However, the study also found that maternal traits (i.e., parenting style and depression) were not predictive of injury (Schwebel & Brezausek, 2010). Similarly, another study by Schwebel and Brezausek (2004) found that there was a trend for increased paternal involvement with children (ages 6–36 months) to be related to a decrease in injuries. In addition, several indicators of mothers' engagement with their children (e.g., interacting with and participating in outings with their child) predicted a decrease in child injury risk (Schwebel & Brezausek, 2004).

As noted earlier, nearly all of the studies specifically examining the relation of caregiver supervision to child injury have focused exclusively on maternal supervision, and few have examined paternal supervision. One observational study comparing mothers' and fathers' supervision of their children's play on an obstacle course (Hagan & Kuebli, 2007) found that mothers supervised their sons and daughters similarly, but fathers supervised their daughters more closely than their sons. A study by Morrongiello, Walpole, and MacArthur (2009b) examined the role of mothers' and fathers' supervision beliefs and practices in mothers' retrospective reports (from the previous 6 months) of children's (ages of 2–5 years) minor to severe unintentional injuries. Mothers' and fathers' self-reported supervision beliefs and practices were similar; they both reported that they supervised younger children and girls more closely than older children and boys. However, only maternal supervision predicted lower injury frequency, whereas paternal supervision did not. The authors suggested that parenting styles may be one reason for this result, as fathers are often more playful with their children than are mothers (Morrongiello et al., 2009b). Future studies may need to take into account children's activity level when examining the role of maternal and paternal supervision in injury risk. Moreover, prospective reports of injuries may provide a more accurate understanding of the role of parents' supervision in children's injury risk.

In summary, several studies have found that maternal supervision predicts lower injury risk; however, despite a recent increase of paternal involvement in childcare (Cabrera et al., 2000; Paquette, 2004), few studies have compared the roles that mothers and fathers play in children's unintentional injuries, and even fewer have compared maternal and paternal supervision. Thus, further research is needed to determine whether there are differences between mothers' and fathers' supervision practices and whether children's injury outcomes differ when fathers are supervising compared with when mothers are supervising.

The present study used an existing data set of prospectively reported minor unintentional childhood injuries that were matched to within-subject control conditions to compare the role of self-reported maternal supervision and mothers' reports of paternal supervision in toddlers' injury risk and severity. Although reliance on maternal report of fathers' supervision practices may be somewhat limiting,

given the paucity of research in this area, these data can provide important preliminary findings about the potential role of fathers' supervision in children's unintentional injury risk. Moreover, the use of prospective data and the matched within-subjects control may allow for a more accurate prediction of children's injury risk than the use of retrospective reports of injury events.

Specifically, this study examined whether: (1) fathers' levels of supervision of toddlers differed from mothers' levels of supervision; (2a) toddlers' injury risk and (2b) severity differed when supervised by fathers versus mothers; caregiver type moderated the effect of caregiver supervision on (3a) injury risk and (3b) severity; and toddler activity level moderated the effect of supervisor type (mother vs. father) on (4a) injury risk and (4b) severity. Based on findings from previous studies, it was hypothesized that: (1) fathers and mothers would have similar supervision levels; (2a) children would be at higher risk for injury and (2b) would have more severe injuries when supervised by fathers; (3a) supervision would interact with caregiver type in that maternal supervision would be more protective than paternal supervision in terms of reducing injury risk and (3b) severity (Morrongiello et al., 2009b); and (4a) there would be an interaction between supervisor type and child activity level so that children would be at a higher risk for injury and (4b) would sustain more severe injuries when supervised by fathers and when engaging in high levels of activity.

Methods

Participants

Data for this study were collected for the Toddler Injury Observation Survey, a larger study examining the antecedents and consequences of unintentional injuries in young children (Peterson, DiLillo, Lewis, & Sher, 2002). Mothers of toddlers were recruited in a midsize midwestern community through flyers, newspaper advertisements, and telephone calls to patients from a pediatric clinic. Families were ineligible to participate if (1) the child had a developmental disability; (2) the child had been hospitalized overnight for a previous injury; (3) English was not the mother's primary language; and (4) there was more than one child in the home, unless the other child was older than the age of 10 years. Criteria (1) and (2) were used to ensure that mothers' supervision was not unduly influenced by child characteristics or experiences. Criterion (3) was used to ensure that mothers could accurately understand and respond to interview questions. Finally, criterion (4) was used to ensure that mothers' injury prevention practices did not differ based on previous experiences with child rearing. Data were collected during the years 1997–1999. Of eligible participants ($n = 275$), 66% ($n = 181$) agreed to participate in the study. Of those, 11 dropped out of the study before the third interview and are not included in the present sample. Among the remaining 170 participants, 89% completed the entire 6 months of the study, and the remaining participants completed a minimum of 6 weeks of data collection. We were still able to use data from families who did not complete the entire 6 months of the study because our analyses focused on event level outcomes (i.e., injury risk and injury severity), rather than the total number of injuries sustained.

The sample consisted of 170 mother–child dyads. Children were between the ages of 15 and 36 months, and the mean age of the children was 24 months (standard deviation [SD] = 7 months). The majority (54%) of the sample were boys. Most of the mothers were Caucasian (91%), married (83%), college educated (80%), earned >$30,000 yearly (78%), and in their mid-to-late 20s ($M = 28.8$, $SD = 4.43$). The largest portion of mothers were employed full time (i.e., >30 hr/week; 42.3%); however, a substantial portion (28.8%) were full-time homemakers, and 18.8% worked only part time.

Procedure

Before study enrollment, mothers were given information regarding the study, were informed that all information would remain confidential (except if child maltreatment or harm to others or themselves was suspected), and consented to participate in the study. Mothers used the Participant Event Monitoring method (Peterson, Brown, Bartelstone, & Kern, 1996a) to record the antecedents and consequences of all of their children's minor unintentional injuries over a 6-month period. Mothers were trained to use monitoring sheets that allowed them to briefly record information each time their child sustained an injury and information about events that occurred during scheduled control conditions (see later). The monitoring sheets included a space to record the day and time, the type of injury (e.g., cut), and to write a short narrative about the incident leading to the event. Mothers were instructed to record all injuries that occurred during the study period, regardless of the location in which they occurred (e.g., home or day care).

An unintentional injury was defined as an injury that occurred following an unintentional event and left a mark (e.g., bruise) or caused significant discomfort (e.g., muscle strain) for at least 24 hr after the injury occurred. There were a total of 28 injury categories that included the method of injury (e.g., occupant in a car, trip/slip, near

drowning, and poisoning), as well as the type of injury (e.g., cut and eye injury). Events in which the child aspirated water into his/her lungs were recorded as near drownings. During each interview, data collectors asked mothers whether their child received an injury in each of the categories. The majority of the injuries reported were trips/slips/falls (46.3%), cuts and scrapes (23.7%), bumps/bruises (16.5%), sting/bite/scratch (3.3%), and crushing injuries (3.2%). This pattern of injuries is consistent with data from the Centers for Disease Control and Prevention regarding frequency of injury types (Borse et al., 2008). Intentional injuries (e.g., from another child) were excluded from the study.

A case crossover design was used to capture circumstances surrounding injury and noninjury (i.e., control condition) events for each family. Case crossover designs can be used to examine the likelihood of an acute transient event (e.g., injury) given a particular circumstance (e.g., caregiver behavior). The design is preferable to a case control because it is a within-subjects design in which the subject is their own control (Maclure, 1991; Maclure & Mittleman, 2000). Therefore, the design controls for between-subject variability due to traits such as child gender or impulsivity. Control conditions (noninjury events) were matched to days and times that a child had a previous injury. For example, if a child had an injury at 5:00 p.m. on a Monday, the mother was instructed to record what the child was doing the following Monday at 5:00 p.m. The noninjury event would then be used as a control condition for the injury event. When there was more than one injury in a 2-week period, control condition times were matched to the most severe injury, as determined by interviewers based on mothers' reports of the physical characteristics of injuries. Mothers reported information for all injury and control events, regardless of whether they were the primary supervisor at the time. If they were not the primary supervisor at the time of an event, they were instructed to gather information about the injury event or control condition from the person who was supervising the child at that time. Research assistants met with mothers in their homes every 2 weeks over a 6-month period to obtain data about the injury events and control conditions.

Measures

Caregiver Type

During each interview, mothers reported who the primary caregiver was at the time of the injury and control conditions. Caregiver type was coded ''0'' for mothers and ''1'' for fathers. Data for events when other caregivers (e.g., day care employees in 15% of cases) were the primary supervisors were excluded from the present analyses. In this truncated data set, mothers were the caregivers for 83% of all events, and fathers were the caregivers for 17% of all events.

Caregiver Supervision

Mothers answered questions regarding how closely caregivers (i.e., mothers or fathers) were supervising their child at the time of a control or injury event. Mothers reported what the child and caregiver were doing before the event, whether the caregiver was engaged in an activity with the child, and how many feet the caregiver was from the child. Interviewers then used this information to code how closely the caregiver was supervising the child using a 1–7 Likert scale (Table I). For the present analyses, these scores were reverse coded so that 7 was the highest level of supervision and 1 was the lowest level of supervision. As can be seen from the codes, interviewers had to make some judgments about the mothers' distance from the child and the amount of time it would take to reach the child. The average pairwise coding reliability for all six study interviewers was excellent ($r = .90$).

Child Activity Level

Mothers reported activities that children were engaged in before injuries or control conditions. For injuries, the interview question was worded, ''What was your child doing at the exact moment when he/she was injured?'' Activities were coded into 27 codes by two trained coders ($\kappa = .65$). For the present study, these 27 codes were collapsed into two categories, either high activity level or low activity level (Table II).

Table I. *Scale Used to Code Caregiver Supervision*

Scale	Scale Identifier
1	Caregiver and child are <6 feet apart (caregiver not engaged in other activity).
2	Caregiver and child are <6 feet apart (caregiver engaged in another activity).
3	Caregiver and child are >6 feet apart (child has caregiver's full attention).
4	Caregiver and child are >6 feet apart (caregiver not paying attention).
5	Caregiver and child are >6 feet apart (no visual contact but is auditory contact)
6	No visual or auditory contact (caregiver could reach the child in 30 s)
7	No visual or auditory contact (caregiver could not reach the child in 30 s)

Note. This scale was reverse scored for the analyses in this manuscript.

Table II. *Percentage of Injury and Control Events That Occurred During Each Activity Type*

	Control (%)	Injury (%)	Total (%)
Low activity level			
Personal hygiene (e.g., bathing and brushing teeth)	3.5	0.9	4.4
Eating	8.2	0.7	8.9
Sitting inside moving vehicle	4.1	0.1	4.2
Adult action (being carried or pushed in stroller or shopping cart by adult)	2.3	0.8	3.1
Structured low-level activity (e.g., board game and videogame)	0.8	0.2	1.0
Unstructured low-level activity (e.g., coloring and reading)	5.1	2.2	7.3
Passive amusement (e.g., watching TV)	7.4	1.5	8.9
Total low-level activity	31.3	6.4	37.8
High activity level			
Walking	1.2	9.2	10.4
Running	0.6	10.1	10.7
Riding a big wheel or bicycle/tricycle	0.4	1.1	1.6
Structured high-level activity (e.g., gymnastics and tag)	0.4	0.4	0.8
Unstructured high-level activity (e.g., crawling and playing with toys)	17.4	21.5	39.0
Total high activity level	20.0	42.3	62.2
Total low and high activity level	51.3	48.7	100

Note. $n = 1{,}979$.

Injury Severity

The Minor Injury Severity Scale (Peterson, Heiblum, & Saldana, 1996b) was used to code injury severity. Mothers were instructed to draw life-size pictures of the injuries their children sustained and to indicate where on the body the injuries occurred using diagrams of children's bodies. During the interviews, mothers answered questions about the physical characteristics of each injury, such as the size, shape, color (for bruises), depth, and amount of blood loss. Trained coders used the injury descriptions to rate the injury severity on a 0–6 Likert scale (0 = no tissue damage to 6 = a disabling injury or death). Undergraduate coders were trained by a graduate student using a detailed training manual and examples of child injuries, and coders practiced using the coding scheme and sample injuries. The mean interclass correlation for pairs of raters was .86. Injury severity was only recorded for injury events and not for control conditions.

Results

Plan of Analysis

We first examined descriptive statistics and bivariate relations between the predictor variables and the two outcome variables (injury risk and injury severity). We also examined relations between caregiver type (i.e., mother vs. father) and child activity level.

We used two data sets to conduct analyses for each of the two outcome variables. The data set used for examining child injury risk included only a subset of injury events that were matched to control conditions. There were 1,282 injury events that were matched to 1,282 control conditions, resulting in a total of 2,564 observations for this data set. The data set used to examine injury severity included all of the injuries for the entire project that were coded for injury severity ($n = 2{,}375$), regardless of whether they were matched to control conditions. Control condition data were not used in these analyses because injury severity could not be coded for noninjury events. For both data sets, we excluded intentional injury events (1%). We also excluded activities that were coded as ''child sleeping'' (3.5% of observations in matched data and 0.6% of injury-only data),''child sitting in vehicle'' (0.09% of observations in matched data and 0.04% of injury-only data), or ''other'' (4% of observations in the matched data and 6.5% of observations in the injury-only data). Finally, because of the fact that supervision scores were skewed so that 99% of cases were scored as three or higher, we omitted instances in which supervision was coded below three. This resulted in 1,982 observations in the matched injury and noninjury data set and 1,850 observations available for examining injury severity.

For Aims 1, 2a, 3a, and 4a, we used the matched injury/no injury data set to examine injury risk as an outcome. In these analyses, we used conditional logistic regression because this type of analysis is appropriate for use with case crossover designs by accounting for the matching between injury and noninjury events (Maclure, 1991; Maclure & Mittleman, 2000).

We used the injury-only data set to predict injury severity (Aims 2b, 3b, and 4b). For these analyses, we used multilevel modeling because this approach is appropriate for use with clustered data and accounts for the inherent dependence among observations (Raudenbush & Bryk, 2002). The data used for the present study were nested because there were several injury events per child, and clustered data may violate the assumption of independent error variances in ordinary least squares regression. We controlled for child age and gender in this model because, unlike the conditional logistic regression, this type of analysis does not control for within-subject variability. When conducting these analyses, because of the nonnormal distribution of the injury severity variable, we used a sandwich estimator, which is robust to nonnormality (Hayes & Cai, 2000, Long & Ervin, 2000).

Descriptive Data

Using the injury-only data, the mean number of injuries per 2-week period for all children in the study was 2.4 ($SD = 1.5$, range = 0–8.3) and was slightly higher for boys ($M = 2.6$, $SD = 2.3$) than for girls [$M = 2.1$, $SD = 1.8$; $t(168) = 2.2$, $p = .03$]. Mean injury severity was relatively low ($M = 1.6$, $SD = 0.68$, range = 1–5), indicating that the majority of the injuries were minor. Mean caregiver supervision was relatively high (in both data sets), with a mean of 5.8–5.9 ($SD = 1.2$–1.3, range = 1–7). In the matched injury/no injury data set, the majority of child activities (62.2%) were coded as high activity level. However, there were more high-level activities (87.0%) represented in the injury-only data. Child age was not associated with injury risk [i.e., injury vs. no injury; $t(1{,}980) = 0.43$, $p = .67$] or severity ($r = .02$, $p = .39$).

Bivariate Analyses

Bivariate relations between predictor variables and the two outcomes (i.e., injury risk and injury severity) were examined. For associations with injury risk, we used the data set that included only injuries that were matched to control conditions. With regard to injury risk, 2×2 comparisons using χ^2 analyses (e.g., injury or control condition × mother or father) revealed that children were significantly more likely to be injured when they were being supervised by fathers versus mothers [χ^2 (1, $n = 1{,}980$) = 12.1, $p = .00$]. Further 2×2 analyses indicated that children were also more likely to be injured when engaging in high activity levels [χ^2 (1, $n = 1{,}979$) = 490.2, $p < .0001$] than in low activity levels. See Table II for a breakdown of activity type by injury versus control. To examine the relation between injury risk and supervision, we conducted a paired samples *t*-test, as mothers reported on supervision for both injury and noninjury events. Supervision levels were significantly higher ($M = 6.1$, $SD = 1.1$) in noninjury than in injury situations [$M = 5.8$, $SD = 1.2$; $t(812) = 4.1$, $p < .0001$].

Additional analyses examined the relation of caregiver type to activity level. A 2×2 χ^2 analysis revealed that children were 2.4 times more likely to engage in high-level activities when they were supervised by their fathers than when supervised by their mothers [χ^2 (1, $n = 1{,}977$) = 11.0, $p = .001$]. Table III shows the frequency with which fathers and mothers were the caregivers during each child activity.

When examining associations with injury severity, we used the injury-only data set. To examine the relation of caregiver supervision and injury severity, we conducted a correlational analysis. Caregiver supervision was negatively associated with injury severity ($r = -.06$, $p = .02$). We used paired *t*-tests to examine whether supervision differed based on child activity level and caregiver type because mothers reported injury severity for themselves, as well as fathers. We used a nonpaired *t*-test to examine whether injury severity differed based on child gender because each mother only reported on injury severity for one gender (i.e., her own child). Injury severity did not differ based on child activity level [$t(202) = -0.65$, $p = .52$], caregiver type [i.e., mothers vs. fathers; $t(272) = -1.7$, $p = .10$], or child gender [$t(1{,}848) = -0.13$, $p = .89$].

Examination of Study Aims

Aim 1. Examining Whether Paternal Supervision Levels Differ From Maternal Supervision Levels

Paired *t*-tests were used to examine differences in mothers' versus fathers' supervision levels because mothers reported on their own and fathers' supervision. When examining differences in supervision between mothers and fathers for all types of events (i.e., injuries and noninjuries), mothers' reports of fathers' supervision ($M = 6.2$, $SD = 1.1$) were significantly higher than mothers' reports of their own supervision [$M = 5.9$, $SD = 1.9$; $t(203) = -2.1$, $p = .03$]. When examining only noninjury events, supervision was significantly higher for mothers' reports of fathers' supervision ($M = 6.4$, $SD = 0.9$) than for mothers reports of their own supervision [$M = 6.0$, $SD = 1.1$; $t(82) = -4.9$, $p < .0001$]. However, when examining only injury events, maternal reports of fathers' supervision ($M = 5.9$, $SD = 1.2$) were not significantly higher than mothers' reports of their own supervision [$M = 5.8$, $SD = 1.2$; $t(121) = 1.0$, $p = .34$].

Table III. *Frequency With Which Children Engaged in Each Activity Type While Being Supervised by Mothers and Fathers*

Child activities	Frequency of activity while mothers were supervising (%)	Frequency of activity while fathers were supervising (%)
Low activity level		
Personal hygiene (e.g., bathing and brushing teeth)	4.6	3.5
Eating	9.5	6.2
Sitting inside moving vehicle	4.5	2.9
Adult action (being carried or pushed in stroller or shopping cart by adult)	3.0	2.7
Structured low-level activity (e.g., board game and videogame)	0.6	2.4
Unstructured low-level activity (e.g., coloring and reading)	7.5	6.5
Passive amusement (e.g., watching TV)	9.6	5.5
Total low activity level	39.3	29.7
High activity level		
Walking	9.3	15.6
Running	11.2	8.5
Riding a big wheel or bicycle/tricycle	1.6	1.2
Structured high level activity (e.g., gymnastics and tag)	0.6	0.6
Unstructured high-level activity (e.g., crawling and playing with toys)	38.0	44.4
Total high activity level	60.7	70.3
Total	100	100

Note. $n = 1{,}977$. Based on matched case control data.

Aims 2a and b. Predicting Child Injury Risk and Severity From Caregiver Type

When predicting injury risk by caregiver type, children were at higher risk for injury when being supervised by their fathers versus their mothers (odds ratio [OR] = 1.5, 95% confidence interval [CI] = 1.1–2.0, $p = .005$). However, caregiver type did not predict injury severity ($b = .04$, $p = .38$).

Aims 3a and b. Examining Whether Caregiver Type Moderated the Effect of Caregiver Supervision on Injury Risk and Severity

A model containing an interaction between supervision and caregiver type was tested to examine Aims 3a and b. The supervision variable was centered. We did not include age and gender as covariates because those variables are controlled for, given the within-subjects structure of the analysis. As shown in Table IV in the left column, when predicting injury risk, there was a significant interaction between caregiver type and caregiver supervision level, indicating that caregiver type moderated the effect of supervision on child injury risk. We probed this interaction by performing a separate conditional logistic regression for mothers and for fathers. For both mothers (OR = 0.88, 95% CI = 0.80–0.98) and fathers (OR = 0.75, 95% CI = 0.48–1.17), lower supervision levels predicted higher injury risk; however, the effect was stronger for fathers than for mothers. As seen in Table V in the middle column, when predicting injury severity, the interaction between caregiver type and caregiver supervision was not significant.

Aims 4a and b. Examining Whether Child Activity Level Moderated the Effect of Caregiver Type on Injury Risk and Severity

A secondary model was used to examine the interaction between caregiver type and child activity level. As shown in Tables IV and V, child activity level did not interact with caregiver type to predict injury risk or severity. However, there was a large main effect of child activity level on child injury risk such that children were nearly 14 times more likely to be injured when engaging in a high activity level.

Supplemental Analyses

One limitation of the data is that mothers reported on fathers' supervision levels before injury and noninjury events. Given concern that mothers' reports of paternal supervision may be biased, we examined a subset of the data for which mothers indicated that they were present during the injury or control event, despite the fact that they indicated that fathers were the primary supervisors during the event. It is possible that mothers' reports of paternal supervision may be more accurate if they are present during the event. During the interview, mothers were asked if any adults, other than the primary supervisor, were present during the injury. If they answered ''yes,''

Table IV. *Conditional Logistic Regression Model Predicting Children's Risk for Injury*

Variable	OR (95% CI)	OR (95% CI)
Caregiver supervision	1.00 (0.88–1.13)	0.94 (0.84–1.11)
Caregiver (mother vs. father)	1.7** (1.15–2.52)	1.32 (0.67–2.61)
Child activity level	13.96*** (9.55–20.40)	13.54*** (9.11–20.12)
Supervision * caregiver type	0.65 (0.46–0.92)*	–
Caregiver type * activity level	–	1.18 (0.53–2.61)

Note. $n = 1{,}977$ for both analyses. OR = odds ratio; CI = confidence interval. For caregiver, 0 = mother, 1 = father. For activity level, 0 = low activity level, 1 = high activity level; $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table V. *Multilevel Model Predicting Children's Injury Severity*

Variable	Estimate (*SE*)	Estimate (*SE*)
Child age (months)	.00 (0.00)	.00 (.00)
Child gender	.00 (0.04)	.00 (.04)
Caregiver supervision	−.08 (0.04)	−.03 (.01)*
Caregiver (mom versus dad)	−.28 (0.23)	.03 (.12)
Child activity level	−.10 (0.16)	−.09 (.16)
Supervision * caregiver type	.04 (0.04)	–
Caregiver * activity level	–	02 (.13)

Note. $n = 1{,}846$ for both analyses. *SE* = standard error. For child gender, 0 = male, 1 = female. For activity level, 0 = low activity level, 1 = high activity level. For caregiver, 0 = mother, 1 = father. $^{*}p < .05$.

they then were asked to indicate who was present. We isolated instances in which mothers indicated that they were also present during the injury ($n = 123$). Using a paired samples *t*-test, we then compared whether mothers' ratings of fathers' supervision differed for times in which the mothers were also present versus times in which they were not present. We did not find a significant difference between mothers' ratings of fathers' supervision when the mothers were present ($M = 6.3$, $SD = 1.1$) versus when they were not present [$M = 6.1$, $SD = 1.1$; $t(20) = 0.29$, $p = .77$]. We also retested Aims 2a–4a (predicting injury risk) using a smaller data set that included instances in which either mothers were the primary supervisors or fathers were supervising but mothers were also present. Results indicated that children were also at higher risk of injury when cared for by their fathers (OR = 2.19, 95% CI = 1.11–4.41, $p = .03$). The effect for the interaction between caregiver type and supervision was in the same direction as the results from the larger data set (OR = 0.57, 95% CI = 0.28–1.15, $p = .12$) but was not significant.

Discussion

Several studies have found that maternal supervision is related to a decreased risk for child injury (Damashek et al., 2009; Morrongiello et al., 2004; 2009a). However, few studies have examined the role of paternal supervision in children's injury risk. The present study compared the role of mothers' reports of their own supervision and of fathers' supervision in predicting children's injury risk and severity using a prospective case crossover design.

We found that children were at higher risk for injury when cared for by their fathers than by their mothers. Children were also at higher risk for injury when engaging in high-level activities, and they engaged in more high-level activities when being cared for by their fathers. In addition, although mothers' reported levels of their own and fathers' supervision were protective against injury, mothers' reports of paternal supervision were more strongly related to lowered injury risk than were mothers' reports of their own supervision. Taken together, these findings suggest that perhaps children were at higher risk for injury when supervised by fathers because they tended to engage in higher levels of activities with their fathers. Higher paternal supervision (as reported by mothers) may have been particularly protective for children when they were engaged in high-level activities (e.g., playing tag), thus resulting in a stronger relationship between supervision and injury risk for paternal supervision than for maternal supervision. Conversely, lower supervision may have been particularly risky in situations in which children were engaging in high activity levels. It is important to note that activity level did not interact with caregiver type to predict injury risk; this indicates that the effect of activity level on injury risk did not differ for mothers versus fathers. However, this finding is consistent with the fact that fathers engaged in high activity levels more frequently with their children than did mothers, and that children were at higher risk for injury in such circumstances.

Our findings are consistent with the previous literature that has found that children tend to engage in more physical play with fathers than with mothers (Brussoni & Olsen, 2011; MacDonald & Parke, 1986; Paquette, 2004; Yogman, 1981). The present findings suggest that more physical play may increase children's risk for injury. However, the findings also indicate that close supervision

by both mothers and fathers is protective. Some authors have suggested that differences in fathers' and mothers' interactions with their children complement each other by providing a range of experiences for the child (Yogman, 1981). Evidence also suggests that there are benefits to engaging in high levels of activities for young children, such as reduced likelihood of obesity and improved motor development (Connor, 2003; Goran, Reynolds, & Lindquist, 1999; Spruijt-Metz, 2011; Vedul-Kjelsas, Sigmundsson, Stensdotter, & Haga, 2011). However, despite the potential benefits of such differential parenting techniques, our results suggest that both mothers and fathers should be educated about the need for closely supervising their young children during activities that are more likely to lead to injury.

Our findings do differ somewhat from research by Morrongiello et al. (2009b) who studied the role of paternal supervision in children's total number of injuries. These authors only found a protective role for mothers' supervision and not for fathers' supervision. Methodological differences may account for the different findings, as Morrongiello et al. (2009b) retrospectively assessed injuries and measured caregiver supervision practices using a questionnaire measure rather than event-specific reports of supervision levels. Thus, it is difficult to know how frequently the fathers were supervising their children before injury events in that study. However, a strength of the Morrongiello et al. (2009b) study was that they used fathers' own reports of supervision practices rather than mothers' reports of fathers' supervision. Additional studies, ideally using observational data, would help to remove the confound inherent in using maternal report.

We did not find that caregiver type or activity level predicted injury severity. It is possible that the lack of significant results when predicting injury severity is due to the generally low level of injury severity and the lack of variability in this variable.

Study Strengths and Limitations

An important methodological strength of the study is the use of a case crossover design. Case crossover designs provide researchers with an excellent means to examine proximal risk factors for injury, rather than trait-like factors, such as child gender or impulsivity level. Moreover, the design controls for such between-subject variables and rules out the potential for these variables to confound results (Maclure, 1991; Maclure & Mittleman, 2000). Because of the fact that these designs allow us to examine the specific behaviors that lead to children's injuries, they are crucial to designing behavioral interventions to reduce children's injury risk.

Despite the study's strengths, there are some limitations. First, we relied on mothers to report their own levels of supervision, as well as fathers' levels of supervision. Mothers' reports of their own or their partners' supervision may have been influenced by social desirability bias. They may be motivated to make their partners appear to be good supervisors; conversely, they may attend more to negative aspects of their partners' behavior and report lower supervision levels. Future studies would benefit by supplementing self-report with observational data. Second, although the case crossover design is an important strength of the study, some may be concerned that the caregivers' behaviors in the control conditions may be influenced by injury events that occurred during the prior week. For example, caregivers may be more cautious after an injury event. However, it is difficult to avoid this potential reactivity when consistently asking caregivers to self-report about their child's injuries over a 6-month period. This reactivity may be somewhat offset by the benefits of using prospective data (e.g., less memory bias and richness of data). Third, the majority of injury and noninjury events occurred when mothers were acting as the primary caregiver; thus, there were a limited number of observations in which fathers were acting as the primary caregiver. This limitation may be because of the fact that almost 50% of our mothers were full-time homemakers or worked only part time.

A fourth limitation of the study is the relatively low-risk nature of the sample. Although children in this age range are at high risk for injury (Borse et al., 2008), the families were mostly middle- to upper-class, two-parent families with relatively high levels of education. Given that children in low-income families are at highest risk for injury (Faelker, Pickett, & Brison, 2000; Haynes, Reading, & Gale, 2003), it would be important to conduct similar research with such families. Relatedly, the data for the present study were collected 13 years ago. Thus, it is possible that fathers' general injury prevention behaviors may have changed during this time period, and these data may not adequately represent those more recent changes.

Fifth, the injuries in our sample were predominantly minor in severity. Given that severe or medically attended injuries are a low base rate phenomenon, it is difficult to examine the etiology of such injuries prospectively. Prospective examination of minor injuries (that occur with much greater frequency) allowed us to collect data on important proximal variables that contribute to children's risk for injury. Moreover, injury experts have argued that minor injuries can be successfully used as a proxy for studying severe injuries (Peterson et al., 2002)

and have found a high correlation between the number of minor and severe injuries (Morrongiello & House, 2004).

Finally, although this examination focused on an important caregiver method of preventing injury (i.e., supervision), we were not able to examine caregiver behavior with regard to implementation of home safety devices. Such injury prevention practices are also key to preventing injuries in young children (Damashek & Peterson, 2002; King et al., 2001).

Despite limitations, given the dearth of published data on the role of paternal supervision in young children's risk for injury, the present study advances our understanding of the role that fathers may play in young children's risk for injury. The findings suggest that although fathers may supervise children closely, there may be other factors (such as child activity type) that might increase children's risk for injury when being supervised by fathers. Such findings indicate that although fathers are infrequently included in child injury research, they do play an important role in children's risk for injury. Future research using observational measures to examine the specific behaviors in which mothers and fathers are engaged while supervising young children may help to better explain fathers' roles in children's injury risk. Such data may also provide more information about ways to effectively intervene to reduce children's risk for injury.

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References

Borse, N. N., Gilchrist, J., Dellinger, A. M., Rudd, R. A., Ballesteros, M. F., & Sleet, D. A. (2008). *CDC Childhood Injury Report: Patterns of Unintentional Injuries Among 0–19 Year Olds in the United States, 2000–2006*. Atlanta, GA: Centers for Disease Control and Prevention, National Center for Injury Prevention and Control.

Brussoni, M., & Olsen, L. (2011). Striking a balance between risk and protections: Fathers' attitudes and practices toward child injury prevention. *Journal of Developmental and Behavioral Pediatrics, 32*, 491–498.

Cabrera, N. J., Tomis-LeMonda, C. S., Bradley, R. H., Hofferth, S. H., & Lamb, M. E. (2000). Fatherhood in the twenty-first century. *Child Development, 71*, 127–136.

Connor, J. M. (2003). Physical activity and well-being. In M. H. Bornstein, L. Davidson, C. L. M. Keys, & K. A. More (Eds.), *Well-being: Positive development across the life course* (pp. 65–80). London: Erlbaum.

Damashek, A., & Peterson, L. (2002). Unintentional injury prevention for young children: Levels, methods, types, and targets. *Journal of Developmental and Behavioral Pediatrics, 2*, 443–455.

Damashek, A., Williams, N., Sher, K., & Peterson, L. (2009). Relation of maternal alcohol use to unintentional childhood injury. *Journal of Pediatric Psychology, 34*, 344–353.

Faelker, T., Pickett, W., & Brison, R. J. (2000). Socioeconomic differences in childhood injury: A population based epidemiologic study in Ontario, Canada. *Injury Prevention, 6*, 203–208.

Goran, M. I., Reynolds, K. D., & Lindquist, C. D. (1999). Role of physical activity in the prevention of obesity in children. *International Journal of Obesity and Related Metabolic Disorders*. *Journal of the International Association for the Study of Obesity, 23*, 18–33.

Hagan, L. K., & Kuebli, J. (2007). Mothers' and fathers' socialization of preschoolers' physical risk taking. *Journal of Applied Developmental Psychology, 28*, 2–14.

Hayes, A. F., & Cai, L. (2000). *Using Heteroscedasticity-Consistent Standard Error Estimators in OLS Regression: An Introduction and Software Implementation*. The Ohio State University: Unpublished Manuscript.

Haynes, R., Reading, R., & Gale, S. (2003). Household and neighborhood risks for injury to 5–14 year old children. *Social Science and Medicine, 57*, 625–636.

King, W. J., Klassen, T. P., LeBlanc, J., Bernard-Bonnin, A., Robitaille, Y., Pham, B., . . . Pless, I. B. (2001). The effectiveness of a home visit to prevent childhood injury. *Pediatrics, 108*, 382–388.

Lewis, T., DiLillo, D., & Peterson, L. (2004). Parental beliefs regarding developmental benefits of childhood injuries. *American Journal of Health Behavior, 28*, S61–S68.

Long, J. S., & Ervin, L. H. (2000). Using heteroscedasticity consistent standard errors in the linear regression model. *American Statistician, 54*, 217–224.

MacDonald, K., & Parke, R. D. (1986). Parent-child physical play: The effects of sex and age of children and parents. *Sex Roles, 15*, 367–378.

Maclure, M. (1991). The case-crossover design: A method for studying transient effects on the risk of acute events. *American Journal of Epidemiology, 133*, 144–153.

Maclure, M., & Mittleman, M. A. (2000). Should we use a case-crossover design? *Annual Review of Public Health, 21*, 193–221.

Morrongiello, B. A., Corbett, M., & Brison, R. J. (2009a). Identifying predictors of medically-attended injuries to young children: Do child or parent behavioural attributes matter? *Injury Prevention, 15*, 220–225.

Morrongiello, B.A., Corbett, M., McCourt, M., & Johnston, N. (2006). Understanding unintentional injury risk in young children II. The contribution of caregiver supervision, child attributes, and parent attributes. *Journal of Pediatric Psychology, 31*, 540–551.

Morrongiello, B. A., & Dawber, T. (1999). Parental influences on toddlers' injury-risk behaviors: Are sons and daughters socialized differently? *Journal of Applied Developmental Psychology, 20*, 227–251.

Morrongiello, B. A., & Dayler, L. (1996). A community-based study of parents' knowledge, attitudes and beliefs related to childhood injuries. *Canadian Journal of Public Health, 87*, 383–388.

Morrongiello, B. A., & House, K. (2004). Measuring parent attributes and supervision behaviors relevant to child injury risk: Examining the usefulness of questionnaire measures. *Injury Prevention, 10*, 114–118.

Morrongiello, B. A., Ondejko, L., & Littlejohn, A. (2004). Understanding toddlers' in-home injuries: II. Examining parental strategies, and their efficacy, for managing child injury risk. *Journal of Pediatric Psychology, 29*, 433–446.

Morrongiello, B. A., Walpole, B., & McArthur, B. A. (2009b). Brief report: Young children's risk of unintentional injury: A comparison of mothers' and fathers' supervision beliefs and reported practices. *The Journal of Pediatric Psychology, 34*, 1063–1068.

Morrongiello, B. A., Zdzieborski, D., & Normand, J. (2010). Understanding gender differences in childrens' risk taking and injury: A comparison of mothers' and fathers' reactions to sons and daughters misbehaving in ways that lead to injury. *Journal of Applied Developmental Psychology, 31*, 322–329.

Paquette, D. (2004). Theorizing the father-child relationship: Mechanisms and developmental outcomes. *Human Development, 47*, 193–219.

Parke, R. D., & O'Leary, S. E. (1976). Father-mother-infant interaction in the newborn period: Some findings, some observations and some unresolved issues. In K. Riegel & J. Meachem (Eds.), *The developing individual in a changing world: Social and environmental issues* (pp. 653–663). The Hague, The Netherlands: Mouton.

Peterson, L., Brown, D., Bartelstone, J., & Kern, T. (1996a). Methodological considerations in participant event monitoring of low base-rate events in health psychology: Children's injuries as a model. *Health Psychology, 15*, 124–130.

Peterson, L., DiLillo, D., Lewis, T., & Sher, K. (2002). Improvement in quantity and quality of measurement of toddler injuries and parental interventions. *Behavior Therapy, 33*, 271–297.

Peterson, L., Heiblum, N., & Saldana, L. (1996b). Validation of the minor injury severity scale: Expert and novice quantification of minor injury. *Behavior Therapy, 27*, 515–530.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical Linear Models: Applications and Data Analysis Methods* (2nd ed.). Thousand Oaks, CA: Sage.

Schwebel, D. C., & Brezausek, C. M. (2004). The role of fathers in toddlers' unintentional injury risk. *Journal of Pediatric Psychology, 29*, 19–28.

Schwebel, D. C., & Brezausek, C. M. (2010). How do mothers and fathers influence pediatric injury risk in middle childhood? *Journal of Pediatric Psychology, 25*, 801–813.

Spruijt-Metz, D. (2011). Etiology, treatment, and prevention of obesity in childhood and adolescence: A decade in review. *Journal of research on Adolescence, 21*, 129–152.

Vedul-Kjelsas, V., Sigmundsson, H., Stensdotter, A. K., & Haga, M. (2011). The relationship between motor competence, physical fitness and self-perception in children. *Child: Care, Health and Development, 38*, 394–402.

Yeung, W. J., Sandberg, J. F., David-Kean, P. E., & Hofferth, S. L. (2001). Children's time with fathers in intact families. *Journal of Marriage and Family, 63*, 136–154.

Yogman, M. W. (1981). Games fathers and mothers play with their infants. *Infant Mental Health Journal, 2*, 241–248.