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# Supervision and Risk of Unintentional Injury in Young Children

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## Abstract

**Objective—**Assess the association between caregiver supervision and acute unintentional injury in young children; evaluate whether lower levels of supervision result in more severe injury.

**Methods—**A case-crossover study was conducted. Parents of children ≤ age 4 whose injuries required Emergency Department (ED sample) treatment or admission to the hospital (inpatient sample) were interviewed. Information on supervision (3 dimensions: proximity, attention, continuity) at the time of injury and 1 hour before the injury (control time) was collected. An overall supervision score was created; a higher score indicates closer supervision. Hospital admission served as a proxy for injury severity. Odds ratios (OR) and 95% confidence intervals (95% CI) were calculated.

**Results—**Interviews were completed by 222 participants; 50 (23%) were in the inpatient sample. For each supervision dimension the inpatient sample had higher odds of injury, indicating effect modification requiring separate analyses for inpatient and ED samples. For both samples, proximity “beyond reach” was associated with the highest odds of injury; compared to 1 hour before injury, children were more likely to be beyond reach of their caregiver at the time of injury (inpatient sample: OR 11.5, 95% CI 2.7-48.8; ED sample: OR 2.9, 95% CI 1.8-4.9). Children with lower supervision scores had the greatest odds of injury (Inpatient sample: OR 8.0, 95% CI 2.4-26.6; ED sample: OR 3.3, 95% CI 1.9-5.6).

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M. Denise Dowd: Dr. Dowd contributed to conceptualization and study design; coordinated and supervised data collection at one study site, contributed to interpretation of study findings, critically reviewed and revised the manuscript, and approved the final manuscript as submitted.
Robin L. Kruse: Dr. Kruse contributed to design of the data collection instruments, conducted data analyses, critically reviewed and revised the manuscript, and approved the final manuscript as submitted.
Barbara A. Morrongiello: Dr. Morrongiello designed several of the data collection instruments; contributed to conceptualization of the study and interpretation of the data, critically reviewed and revised the manuscript, and approved the final manuscript as submitted.

**Conclusions—**Lower levels of adult supervision are associated with higher odds of more severe injury in young children. Proximity is the most important supervision dimension for reducing injury risk.

### Keywords

child injury; supervision; prevention; epidemiology

## Introduction

Despite advances in prevention, injuries remain a leading cause of morbidity and mortality among children.[1-5] Parenting practices are an important determinant of child safety, and inadequate supervision is often cited as a contributing factor for childhood injuries.[6-7] However, it is only in the past decade that strategies for defining and measuring supervision have been proposed, and research is untangling the complex relationship between supervision and child injury.[8-11]

Research indicates that characteristics and behaviors of both child and supervisor influence child injury risk. Known risks for childhood injury include child factors, with boys and young children at highest risk,[12-14] and maternal factors such as being young, single, and unemployed.[13,15] In terms of child behavior, toddlers who prefer boisterous, risk-taking/sensation-seeking activities are at increased risk of injury.[16,17] Furthermore, research documenting supervision patterns has shown that parents routinely leave young children unsupervised for some portion of the day [18] and some parents adjust their supervision based on their perception of injury risk and their child's behavior.[19] It has also been demonstrated that young children experience more injuries when left unsupervised.[20] This research provides support for a link between level of caregiver supervision and child injury risk, particularly in young children. Nevertheless, research also documents that children are injured even when closely supervised,[21] a compelling reminder of the complexity of these relationships.

One case-control study of supervision and medically attended injury in young children reported lower levels of supervision were associated with a five-fold increase in injury risk.[22] This study was limited by a small sample recruited from one suburban hospital. Furthermore, use of children seen in the emergency department (ED) for an illness as the control group may have introduced bias if parents who bring their ill child to the ED are more protective than parents who do not. The current study addresses these limitations.

A recently published case-crossover study of supervision and injuries in toddlers also reported that lower levels of parental supervision were significantly associated with increased injury risk, and this association was stronger when the child's father rather than the mother was supervising.[23] These authors also report a negative association between supervision and injury severity, but acknowledge the injuries sustained in the study population were predominantly minor injuries, scrapes and bruises that did not require medical attention.

In an effort to address several limitations of these two studies, we sought to explore the association between caregiver supervision and medically attended injuries in a larger sample of young children recruited from hospitals that serve diverse, rural, suburban and urban populations using case-crossover methodology. A secondary objective of this study was to assess supervision and injury severity, using injuries requiring hospital admission as a proxy for more severe injury.

## Methods

### Study Design

We conducted a case-crossover study to examine the association between caregiver supervision and unintentional injury among children less than five years old. The case-crossover design, developed to study the effect of transient exposures on risk of an acute event,[24,25] is analogous to a traditional matched case-control study. The distinction between the two designs is that in a case-control study, the control is a different person at a similar time while in a case-crossover study, the control is the same person at a different time.[25] Consequently, in the case-crossover design, data are collected on the exposure of interest (e.g., supervision) in the relevant (case) time immediately preceding the acute outcome event (injury) and at an earlier (control) time (child not injured) for the same individual. This design is particularly useful when individual characteristics (e.g., age, behavior) influence risk, as with childhood injuries. Because cases serve as their own controls, stable person-specific factors are inherently controlled in the analysis.

### Study Population and Study Sites

The parents of children less than age five years seeking medical care for an acute unintentional injury were eligible for the study. This age group was chosen because injury is a significant cause of morbidity in young children and adult caregivers play a crucial role in protecting them from hazards.[1,2,5,14] To focus on injuries for which supervision most influences risk, parents of children with inflicted injuries or injuries sustained in a motor vehicle crash were excluded. Other exclusion criteria were injuries resulting in referral to hospital social services or state child welfare agency, those that occurred in institutional settings (e.g., daycare), life-threatening or non-acute injuries (injuries occurring more than 24 hours before ED or hospital admission), and non-English speaking parents.

Parents were recruited from the University of Missouri Hospital ED located in Columbia, Missouri (ED sample). Although this hospital serves as a referral center to more than 20 largely rural counties in mid-Missouri, in the year before this study commenced only 11 children meeting the study eligibility criteria were admitted to the hospital's trauma service, so only parents of children presenting to the ED were recruited from this hospital. Parents of children with injuries requiring hospital admission were recruited from Children's Mercy Hospital in Kansas City, Missouri (Inpatient sample). This hospital is a Level 1 pediatric trauma center that serves a largely urban population of children in the Kansas City metropolitan area and is a referral center for surrounding counties in western Missouri and eastern Kansas. The study was approved by the Institutional Review Boards at the University of Missouri and Children's Mercy Hospital.

### Subject recruitment and Data Collection

The ED sample was recruited as follows. When a child under age 5 presented with an injury, the registration clerk attached a study referral form to their chart. Then, the triage nurse briefly described the study. If the parent agreed to be contacted by the study staff, they provided their phone number and signed the referral form. A study research assistant (RA) collected the referral forms and attempted to contact the parents by telephone.

When telephone contact was made, the RA introduced herself, explained the study participation requirements, and assessed eligibility. If the eligibility criteria were met and the parent indicated they were willing to participate, a time to complete the interview at the parent's home was scheduled.

Recruitment for the inpatient sample proceeded as follows. Each morning, the study RA reviewed the hospital admission log to identify children under age five admitted with an injury. When children meeting inclusion criteria were identified, the RA spoke with the inpatient unit nursing staff about the child, reviewed the medical record to determine eligibility, and if eligible, arranged a convenient time to meet with the child's parent. If the parent agreed to participate, a time to complete the interview either during the child's hospital stay or upon return for follow-up was arranged.

All study data were collected via in-person interview with the injured child's primary caregiver, defined as the person who cared for the child the majority of the time and referred to as “parent” in this study, for simplicity. A primary caregiver who was not responsible for their child at the time of injury was eligible to participate if they met all other eligibility criteria and during study recruitment stated they could accurately describe how the injury occurred and were with their child one hour before the injury (control time). To reduce the effects of memory decay, we attempted to interview study participants as soon as possible after the injury event. If it was not possible to schedule the interview to take place within two weeks of the injury, parents were deemed ineligible.

To reduce reporting bias, hypothesis shielding was used during recruitment and data collection. During recruitment, parents were told the goal of the study was to help us better understand how injuries to young children occurred so we could develop better ways to prevent them from occurring in the first place. During data collection, the respondent was asked to explain how the injury occurred. This explanation was recorded (typed) verbatim and followed by questions designed to confirm and document child and caregiver activities, including the supervision dimensions (proximity, attention, continuity), during the injury and control times. Written informed consent was obtained prior to commencing the interview. Data collection and data entry were completed using QDS™ (Questionnaire Development System) computer-assisted personal interview software.[26] Upon completion of the interview, participants received a $30 check (ED sample) or gift card (Inpatient sample).

## Exposure and Outcome Measures

The outcome of interest was acute unintentional injury. Because all subjects in a case-crossover study have the outcome, the outcome specifically refers to the case time (time when the injury occurred) and the control time (one hour before the injury occurred).

The primary exposure variable was supervision. In keeping with our goal of hypothesis shielding, during the interview, parents were asked to describe how the injury occurred and other details of the parent's and child's activities at the time of injury, rather than making references to or asking about supervision specifically.[17] Data on three dimensions of supervision: proximity, attention and continuity, were collected at this time. Proximity describes the physical nearness of parent to child. Parents were asked if they were touching the child and if not whether the child was within or beyond reach. Attention includes both visual and auditory attention. Parents were asked whether they could see and hear, hear but not see, or neither see nor hear the child. The continuity dimension assessed whether attention was constant, intermittent or absent. When reported as intermittent, parents were asked how often they checked on or listened for the child. After this information was obtained, the RA asked these same questions about activities one-hour before the injury occurred (control time), reminding parents what time this would have been on the day of injury.

To capture the multidimensional nature of supervision, we created an overall supervision score, (henceforth referred to as the supervision score) for both the injury and control times. This supervision score combines the three supervision dimensions – proximity, attention, and continuity – by summing scores from each dimension. Proximity was scored 4 for touching, 3 for within reach, and 0 for beyond reach (no 1 or 2 score). Attention was scored 4 for in view and could hear child, 1 for out of sight but could hear, and 0 if they could neither see nor hear the child (no 2 or 3 score). Continuity was scored 2 for constant, 1 for intermittent, 0 for none. Summing across each dimension, the supervision score ranged from 0 (beyond reach, cannot see or hear, attention absent) to 10 (touching, in view, attention constant). For logistic regression analyses this supervision score was dichotomized. Scores of 7 or above, which represented all combinations of proximity and attention where the parent was touching or within reach and the child was in view, were classified “high;” scores below 7 were classified “low.”

## Other Measures

In addition to a variety of child and family socio-demographic characteristics, the interview included the following measures. The Parental Influence Subscale of the Parent Health Locus of Control Scales (PHLOC) is a 7-item scale with total scores ranging from 7-42. Higher scores indicate more internal locus of control.[27] This measure has high reliability ($\alpha$ = 0.68-0.82; $r$ = 0.60) and established construct validity.[27] The Parent Supervision Attributes Profile Questionnaire (PSAPQ) consists of four subscales that measure the influences of protectiveness, supervision beliefs, risk tolerance, and fate on child injury.[28] Each item is scored on a 5-point Likert scale ranging from 1 to 5. Higher scores indicate more protectiveness, closer supervision, greater risk tolerance and greater influence of fate on injuries. Reliability of the PSAPQ is high ($\alpha$ = 0.77-0.79; $r$ = 0.76-0.80) and criterion

validity is established.[28,29] The Injury Behavior Checklist (IBC) consists of 24 questions about child injury risk-taking behaviors and asks parents to rate, on a scale of 0 (never) to 4 (very often) how often their child exhibits the behavior.[30] The IBC score is the sum of the 24 items and ranges from 0-96; higher scores indicate more risky behavior. The IBC has high reliability ($\alpha = 0.87$; $r = 0.81$) and established criterion validity.[30] These questions were omitted if the child was less than one year old.

A participant's tendency toward responding in a socially desirable manner was assessed using the Marlowe-Crowne Social Desirability Scale (MCSDS).[31] MCSDS scores range from 0-33 with high score representing higher need for approval. This scale was self-administered using pen and paper after the study interview. The MCSDS has high reliability ($\alpha = 0.73$-$0.88$; $r = 0.84$-$0.88$) and validity.[32]

### Data Analysis

SAS for Windows version 9.2 was used for all analyses.[33] Univariate and bivariate analyses of key variables were conducted. Differences across study sites were assessed using the chi-square statistic for categorical variables and the *t*-test for mean values of the PHLOC, PSAPQ, IBC, and MCSDS measures. Case-crossover analyses were conducted using conditional logistic regression. Separate regression models were run for each supervision dimension and the supervision score. Odds ratios (OR) and 95 percent confidence intervals (95% CI) were calculated to assess the association between supervision and injury. Control time supervision variables were missing for nine children (7 ED and 2 Inpatient sample). These records were excluded from the regression analyses.

The potential for effect modification by injury severity was assessed using stratified analysis, with separate regression analyses for each site. Meaningful differences in OR across sites indicate effect modification and necessitate reporting results by study site rather than combining data from both sites. Statistical significance of an effect modifier is typically assessed using an interaction term in a regression model. However, it is not possible to assess effect modification by study site using an interaction term in a case-crossover design because the study site is the same for both the case and control times. As a result, for this variable and other measures that do not vary across case and control time (PHLOC, IBC, PSAPQ, MCSDS) there are no discordant pairs and the variable drops out of the analysis. This perfect collinearity prohibits traditional assessment of statistically significant effect modification – using an interaction term in the regression model.

## Results

Interviews were completed by 172 parents from the ED sample and 50 from the inpatient sample. This represents 58 percent of the eligible ED referrals and 30 percent of the potential inpatient admissions identified during the study period. The lower participation by eligible inpatient sample parents may be related to the requirement by the hospital that all study interviews be completed at the hospital, either at the time of admission or during a follow-up clinic visit. This requirement, coupled with the fact that many of the eligible children were discharged within a day or two of admission, made recruitment of the inpatient sample particularly challenging. Participation rates and reason for non-

participation are detailed in Table 1. Most interviews were completed within 10 days of injury; the mean time to interview was 9 and 7 days for the ED and inpatient samples, respectively (Table 2).

The majority of participants were responsible for their child at the time of injury, 140 (81%) and 47 (94%) in the ED and inpatient samples, respectively. The remaining three inpatient sample participants reported they were at home with the child but another adult, a parent (2) or nanny (1), was responsible for the child when the injury occurred. In the ED sample, 16 (9%) participants who were not responsible for their child at the time of injury reported they were either with the child but another adult was responsible and/or the other parent was responsible for the child. Ten (6%) respondents reported another relative (e.g., grandparent) was responsible for the child when the injury occurred. Thus, for over 90% of the ED and 100% of the inpatient sample the respondent was present at the time of injury, even when they reported someone else was watching the child.

The ED and inpatient participants were similar in terms of age, educational attainment, and income. A significantly higher proportion of the inpatient sample participants were male or unemployed (Table 2). The age and sex of the injured child were similar across samples. Although the mean time from injury to interview was longer for the ED sample (9 vs. 7 days), and a smaller proportion of the inpatient sample children were Caucasian, these differences were not statistically significant (Table 2).

The characteristics of the child's injuries (mechanism, body part, injury type) were significantly different across samples (Table 2). The inpatient sample was more likely to be injured by hot liquids/objects and ingestions, resulting in an increased proportion sustaining burns and poisonings. A higher proportion of the inpatient sample sustained a fracture or dislocation while the ED sample more often reported injury by fall, injured their head or upper extremity, and sustained a laceration or contusion (Table 2).

Descriptive analysis of the supervision dimensions and supervision score documented a higher proportion of children beyond reach and out of view of their supervisor at the time of injury compared to the control time (Table 3). Similarly, a larger proportion of children had lower supervision scores at the time of injury compared to the control time. These proportional differences in both the supervision dimensions and supervision score were greater in the inpatient sample.

For each dimension of supervision assessed, and the supervision score, the odds of injury were greater in the inpatient sample, implying effect modification. Although it is not possible to test the statistical significance of this effect modification using traditional methods due to the unique structure of case-crossover data, Bateson and Schwartz developed a measure of relative effect modification for use in case-crossover studies,[34] which we applied to each of our supervision variables; none reached statistical significance, possibly due to small numbers. Nevertheless, the effect estimates for the ED and inpatient samples are quite different, indicating effect modification; therefore, we present the results for the two samples separately.

Compared to one hour prior to injury, children were more likely to be beyond reach of their caregiver at the time of injury. The increased odds for this supervision dimension (proximity) was greater in the inpatient sample (OR 11.5, CI: 2.7-48.8) than the ED sample (OR 2.9, CI 1.8-4.9), and was the dimension associated with the highest injury risk (Table 4). The attention dimension was significantly elevated 5-fold in the inpatient sample; but not in the ED sample. The continuity dimension was not significantly elevated in either sample.

Analysis of the supervision score demonstrated that odds of injury were highest for children with lower levels of supervision. The magnitude of this association was higher in the inpatient sample (OR 8.0, 95% CI 2.4-26.6) than the ED sample (OR 3.3, 95% CI 1.9-5.6) indicating that lower supervision scores were associated with greater odds for severe injury (Table 4).

Given the difference in odds ratios identified across our two samples, we sought to determine if individual characteristics such as parental beliefs about supervision or child risk-taking behaviors, rather than characteristics of supervision, might explain the different results across the samples. There were not, however, significant differences across samples on the PHLOC, any of the 4 subscales of the PSAPQ, the IBC, or the MCSDS (Table 2).

## Discussion

We assessed the relationship between supervision and injury for three supervision dimensions: proximity, attention, and continuity; as well as for a composite supervision score. We found that children were more likely to be beyond reach and out of view at the time of injury compared to the control time, one hour before. For each measure of supervision the odds of injury was higher if the child was admitted to the hospital, our proxy for injury severity. The results of this case-crossover study lend support to the accumulating evidence that characteristics of adult supervision influence risk of unintentional injuries in young children. Importantly, the findings suggest that not only is poor supervision associated with injury in young children, but that the lower the level of supervision, the greater the odds for more severe injury.

Because the ED and inpatient samples were recruited from hospitals in different locations, it is possible that differences in the study population rather than differences in supervision were responsible for the disparate results. To assess this, we compared socio-demographic characteristics, child behavior, parental health locus of control and supervision beliefs across samples. We found the samples were similar in most characteristics except that respondents in the inpatient sample were more likely to be male (fathers) or unemployed. This may reflect a tendency in this urban population for the child's mother to be working, leaving the unemployed father in the role of primary caregiver.

In one published case-control study examining adult supervision and injuries in young children, Morrongiello and colleagues reported that lower levels of supervision resulted in a five-fold increase in risk of medically attended injury;[22] a finding confirmed in our study. Our use of a case-crossover design extends these findings by providing inherent control for child injury risk behaviors and caregiver supervision practices, important contributors to

child injury risk. Furthermore, our study sample was larger, racially diverse (33% racial minority) and included a higher proportion of low income families (39% < $25,000 vs. 10% < $20,000) than the Morrongiello et al. study.[22]

Our findings are also consistent with Damashek and colleagues' recently published case-crossover study. This study, designed to assess the role of paternal vs. maternal supervision and child injury risk, not only reported that higher supervision predicted lower injury risk, [23] but that this effect was stronger for fathers than for mothers. Although we weren't able to conduct a similar analysis, this paternal effect might explain our finding that respondents in our inpatient sample were more likely to be fathers. Damashek et al. also reported that level of supervision was inversely associated with injury severity; however, this finding was limited by their study sample, which included only minor injuries, such as scrapes and bruises. Not only do our results support the Damashek et al. findings, they provide stronger evidence of a relationship between supervision and injury severity because all injuries included in our study were severe enough to require medical attention and 23% required hospital admission for treatment. Furthermore, our study sample was larger and more diverse, with substantially higher proportions of racial minorities, low income and lower educated parents, indicating that the findings reported by Morrongiello et al. and Damashek et al. can be replicated in a larger, more heterogeneous population. Thus, considering these three studies together, the consistency in findings is striking and reveals that across a wide variety of adult demographic characteristics (race, income, caregiver gender), when caregivers engage in poor supervision, young children are at increased risk for experiencing injuries that require medical attention.

To capture the multidimensional nature of supervision, we classified supervision based on proximity, attention, and continuity.[8] Although these dimensions have been used by others, they have not always been operationalized in the same way. A review by Petrass and colleagues summarizes supervision and child injury research that has characterized supervision using one, two or all three of these dimensions.[10] Conclusions from this review suggest that proximity may offer the most protection from injury; our results support this suggestion. Petrass et al. also discuss the challenge of measuring supervision continuity and point out that although it has most often been operationalized as a lapse or absence of supervision in studies of drowning, documenting the length of time supervision is absent would enhance the usefulness of this dimension. We included this element of time by asking the parents who indicated less than constant attention how often they were actively checking on their child.[17] Many participants had a difficult time quantifying this. Often the response included a statement that the parent knew to check on the child when they no longer heard them, indicating they were subconsciously listening but not actively checking on the child on a regular basis. Other times the parent would say they were constantly watching or listening, even though they reported engaging in other activities (e.g., cooking, watching television) while supervising. The failure of the continuity dimension to document increased odds of injury in this study may reflect the wording and structure of our questionnaire or other challenges of measuring this dimension, rather than the importance of this dimension in child injury risk. Further development and measurement of supervision continuity is warranted.

Despite the significance of the findings, the current study has several potential limitations. We relied on parental self-report of activities at the time of injury (and control time) and classified supervision on this basis. Although we did not validate these self-reports, research has shown that parents freely report lapses in supervision[17,20] and we found this to be true in our study. It has been further documented that parents accurately report their supervision practices and these self-reports have been validated.[28,29] It is possible, however, that the parents' descriptions were subject to faulty recall. Although research suggests parents accurately recall the events leading up to a severe injury, particularly within a short timeframe for recall,[35-38] accurately recalling what they were doing one hour prior to the injury event might be more difficult. To limit memory decay influencing recall, we attempted to interview parents within one week of the child's injury and were successful in doing so for 76 percent of the inpatient sample and over half (53%) of the ED sample; 88% of all participants were interviewed within 2 weeks of injury.

Another limitation of parental self-report of supervision is the potential for social desirability to affect their responses. We assessed the propensity of our study sample to respond in a socially desirable way with the MCSDS. As shown in Table 2, there was not a statistically significant difference in social desirability between samples. In addition, there was not a statistically significant correlation between social desirability and supervision variables (data not shown). Although it is possible some of our study subjects responded in socially desirable ways, it is important to point out that a full range of supervision was reported in this study, including 62 (28% of all respondents) reports that the child was beyond reach, out of view and the caregiver either couldn't hear the child or could hear and was listening intermittently or constantly. This is consistent with Morrongiello and colleagues' research documenting that parents report routinely leaving young children unsupervised for some portion of the day.[18]

Although we made considerable effort to reduce the potential for information bias in this study, it is possible that some parents misrepresented their and their child's activities at the injury and/or control time due to faulty recall or purposefully for social or other reasons. If parents erroneously reported better supervision during the control time than the injury time, the results would be biased to show an effect of poor supervision on increased odds of injury. This would be an alternative explanation for our findings. If they erroneously reported better supervision overall (injury and control time), it would nullify any real effect, if one exists. Finally if parents erroneously reported better supervision during the injury time than the control time, it would result in lower odds of injury with poor supervision, i.e., indicate a protective effect of poor supervision. The likely scenario is that there is a mix of non-differential misclassification due to inaccurate recall and/or social desirability in these data, which would result in biasing a real effect toward the null (OR closer to 1.0). Consequently, we do not believe that social desirability biases in reporting explain our results.

Other potential limitations include use of hospital admission as a proxy, rather than using a quantitative measure of injury severity. We assumed that injuries requiring hospitalization are generally more severe than injuries treated in the ED. Although not always the case, the differences in injury characteristics across our study samples lend support for this

assumption. In addition, we did not assess potential hazards in the environment that may have increased risk of injury so we could not control for these factors or assess potential interactions with child or supervisor characteristics. Finally, it is conceivable that if parents could not provide adequate care for a child's injuries, a clinician might have chosen to admit the child to ensure adequate care. Such parents may have also provided lower levels of supervision. There is, however, no indication this occurred in our study. At Children's Mercy Hospital, concerns about a parent's ability to care for their child that are serious enough to prompt hospital admission would also trigger a social services referral, and families with a social services referral (for any reason) were excluded from our study. Importantly, our data do not indicate that the inpatient sample was providing lower levels of supervision, as evidenced by the control time data that show higher levels of supervision among the inpatient sample across all supervision dimensions (Table 3).

Despite potential limitations, our study makes an important contribution to understanding the role of supervision and injury in young children. The case-crossover study design ensures control of important child and caregiver characteristics known to increase injury risk. The large and diverse sample of children with medically attended injuries, including injuries severe enough to require hospital admission, contributes to the external validity of the findings. Parents freely reported the circumstances of their child's injuries and we were able to classify supervision based on this information.

Our results support evidence documenting the role of supervision in risk of unintentional injury in young children. They also support our hypothesis that less supervision not only increases the odds of injury, but increases the odds of more severe injury. Development and widespread implementation of interventions that effectively improve parental supervision of young children, such as the *Supervising for Home Safety Program* developed by Morrongiello,[39] may reduce the burden of injuries requiring medical attention. In addition, study of the interactions between child, caregiver, and environmental characteristics on the role of supervision in injury risk are necessary to better understand these complex relationships and further advance child injury prevention.

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## Key Messages

**What's Known on This Subject**

- Despite advances in prevention, injuries remain a leading cause of morbidity and mortality among children.
- Supervision is an important determinant of injury, particularly among young children.
- Poor adult supervision is associated with more frequent injuries in young children.

**What This Study Adds**

- The association between adult supervision and injury risk in young children is confirmed in a heterogeneous sample with regard to caregiver demographic characteristics (e.g., race, income, gender).
- Lower levels of supervision are associated with higher risk for more serious injury among young children.
- Proximity may be the most important supervision dimension for moderating child injury risk.

## Table 1
## Recruitment and Participation by Sample

| | ED Sample N (%) | Inpatient Sample N (%) |
|---|---|---|
| Eligible referrals received (ED sample)/admissions identified (Inpatient sample) | 299 (100) | 169 (100) |
| Could not contact | 99 (33) | 52 (31) |
| Agreed to participate but interview not completed (e.g., could not schedule within 2 weeks, lived too far away, language barrier) | 8 (3) | 20 (12) |
| Declined participation | 20 (7) | 47 (28) |
| Completed interview | 172 (58) | 50 (30) |

ED, Emergency Department

## Table 2
## Caregiver, Child and Injury Characteristics, By Sample

| Characteristic | ED Sample (N=172) N (%) | Inpatient Sample (N=50) N (%) | *P-value*[a] |
|---|---|---|---|
| **Caregiver Characteristics** | | | |
| Relationship to Injured Child | | | |
| Mother | 158 (92) | 41 (82) | 0.04 |
| Father | 14 (8) | 9 (18) | |
| Caregiver Age | | | |
| < 25 years old | 52 (30) | 18 (36) | 0.99 |
| 25-35 years | 90 (52) | 23 (46) | |
| > 35 years old | 30 (17) | 9 (18) | |
| Education | | | |
| <High School | 24 (14) | 5 (10) | 0.04 |
| High School/Some College | 82 (48) | 34 (68) | |
| College Graduate | 66 (38) | 11 (22) | |
| Employment Status | | | |
| Full/Part Time | 106 (62) | 21 (42) | 0.01 |
| Unemployed | 66 (38) | 29 (58) | |
| Annual Household Income (missing n=3 from inpatient sample) | | | |
| < $25,000 | 63 (36) | 23 (50) | 0.31 |
| $25,000-$50,000 | 58 (34) | 13 (28) | |
| > $50,000 | 51 (30) | 11 (23) | |
| Time to Interview, in days | | | |
| Mean (SD) | 9 (7) | 7 (14) | 0.22[b] |
| **Child and Injury Characteristics** | | | |
| Child Age | | | |
| < 1 | 15 (9) | 3 (6) | 0.81 |
| 1 - 2 | 99 (57) | 29 (58) | |
| 3 – 4 | 58 (34) | 18 (36) | |
| Child Sex | | | |
| Male | 98 (57) | 31 (62) | 0.53 |
| Female | 74 (43) | 19 (38) | |
| Child Race | | | |
| Caucasian | 120 (70) | 28 (56) | 0.19 |
| African-American | 29 (17) | 12 (24) | |
| Other | 23 (13) | 10 (20) | |
| Mechanism of Injury | | | |
| Fall | 91 (53) | 17 (34) | <0.0001 |
| Struck by/Caught in | 49 (28) | 4 (8) | |
| Hot Liquid or object | 12 (7) | 11 (22) | |
| Ingestion/other | 20 (12) | 18 (36) | |

| Characteristic | ED Sample (N=172) N (%) | Inpatient Sample (N=50) N (%) | *P-value*[a] |
|---|---|---|---|
| Part of Body Injured | | | |
| Head | 106 (62) | 11 (22) | <0.0001 |
| Arm/Hand | 41 (24) | 8 (16) | |
| Foot/Leg | 15 (9) | 12 (24) | |
| Ingestion | 5 (3) | 14 (38) | |
| Trunk | 5 (3) | 5 (10) | |
| Type of Injury | | | |
| Laceration | 73 (42) | 1 (2) | <0.0001 |
| Contusion/Bruise | 44 (26) | 4 (8) | |
| Fracture/Dislocation | 29 (17) | 19 (38) | |
| Burn | 12 (7) | 12 (24) | |
| Other | 14 (8) | 14 (28) | |
| **Behavioral Measures Related to Child Injury Risk and Social Desirability** | | | |
| Measure | Mean (95% CI) | Mean (95% CI) | *P-value* |
| Parental Health Locus of Control | | | |
| Parental Influence Subscale | 37.8 (37.3 – 38.3) | 37.8 (36.9 – 38.8) | 0.96[b] |
| Parent Supervision Attributes | | | |
| Profile Questionnaire | | | |
| Protectiveness Subscale | 4.0 (3.9 – 4.1) | 4.0 (3.9 – 4.2) | 0.49[b] |
| Supervision Subscale | 3.9 (3.8 – 4.0) | 4.0 (3.8 – 4.2) | 0.62[b] |
| Risk Tolerance Subscale | 3.1 (3.0 – 3.2) | 3.1 (2.9 – 3.3) | 0.77[b] |
| Fate Subscale | 2.0 (1.9 – 2.2) | 2.1 (1.8 – 2.3) | 0.93[b] |
| Injury Behavior Checklist | 30.0 (28.0 – 31.9) | 27.4 (23.3 – 31.4) | 0.22[b] |
| Marlowe-Crowne Social Desirability Scale | 21.1 (20.2 – 22.1) | 22.8 (21.1 – 24.4) | 0.09[b] |

ED, Emergency Department; 95% CI, 95% confidence interval

[a] $\chi^2$ analysis of differences between samples

[b] *t*-test of differences in means between samples.

## Table 3

**Supervision Pattern at the Time of Injury and Control Time (One Hour Prior to Injury)**

| Supervision Dimension | ED Sample (N=172) | | Inpatient Sample (N=50) | |
|---|---|---|---|---|
| | Injury Time N (%) | Control Time N (%) (missing=7) | Injury Time N (%) | Control Time N (%) (missing=2) |
| Proximity | | | | |
| Touch/arm's reach | 57 (33) | 95 (58) | 12 (24) | 32 (67) |
| Beyond reach | 115 (67) | 70 (42) | 38 (76) | 16 (33) |
| Attention | | | | |
| In view | 125 (73) | 130 (79) | 29 (58) | 40 (83) |
| Out of view | 47 (27) | 35 (21) | 21 (42) | 8 (17) |
| Continuity | | | | |
| Constant | 72 (42) | 62 (38) | 21 (42) | 28 (58) |
| Intermittent/None | 100 (58) | 103 (62) | 29 (58) | 20 (42) |
| Supervision Score | | | | |
| High | 51 (30) | 91 (55) | 11 (22) | 31 (65) |
| Low | 121 (70) | 74 (45) | 39 (78) | 17 (35) |

ED, Emergency Department

## Table 4
### Association between Parental Supervision and Unintentional Injury in Young Children

| Supervision Dimension | ED Sample OR (95% CI)[a] | Inpatient Sample OR (95% CI) |
|---|---|---|
| Proximity | | |
| Touching/arm's reach | Reference | Reference |
| Beyond reach | 2.9 (1.8 – 4.9)[b] | 11.5 (2.7 – 48.8)[b] |
| Attention | | |
| In view | Reference | Reference |
| Out of view, listening | 1.4 (0.9 – 2.3) | 5.0 (1.5 – 17.3)[c] |
| Continuity | | |
| Constant | Reference | Reference |
| Intermittent | 0.8 (0.5 – 1.3) | 2.1 (0.9 – 5.3) |
| Supervision Score | | |
| High | Reference | Reference |
| Low | 3.3 (1.9 – 5.6)[b] | 8.0 (2.4 – 26.6)[b] |

[a] ED, Emergency Department; OR, Odds Ratio; 95% CI, 95% confidence interval

[b] $p < 0.001$

[c] $p < 0.01$