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Family Adaptation 18 Months After Traumatic Brain Injury in Early Childhood

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Abstract

Objective—The purpose of this study was to examine family adaptation to a traumatic brain injury (TBI) in young children during the first 18-month postinjury, when compared with children who had an orthopedic injury.

Methods—A concurrent cohort/prospective research design was used with repeated assessments of children aged 3 to 6 years with TBI or orthopedic injury requiring hospitalization and their families. Shortly after injury and at 6-, 12-, and 18-month postinjury, parents of 99 children with TBI (20 severe, 64 moderate, 15 mild) and 117 with orthopedic injury completed standardized assessments of family functioning, parental distress and coping, injury-related burden, and noninjury-related parent stressors and resources. Mixed models analyses examined group differences in parental burden and distress adjusted for race and social demographic factors.

Results—Both moderate and severe TBI were associated with higher levels of injury-related stress than orthopedic injury, with stress levels diminishing over time in all groups. Severe TBI

was also associated with greater psychological distress on the Brief Symptom Inventory but not with more depressive symptoms. Family functioning and social resources moderated the relationship of TBI severity to injury-related burden and caregiver distress, respectively. Lower child adaptive skills were associated with poorer family outcome but group differences remained even when controlling for this effect.

Conclusions—Severe TBI in young children has adverse consequences for parents and families during the first 18-month postinjury. The consequences lessen over time for many families and vary as a function of social resources.

Index terms

traumatic brain injury; family impact; parent coping; early childhood

A number of studies have shown that school-age children and adolescents who sustain a traumatic brain injury (TBI) display persistent negative academic and behavioral sequelae, particularly in children with severe injuries.^{1–5} In addition, TBI has been shown to have a profound negative impact on both the caregiver and the family. In particular, severe TBI has been shown to be associated with both acute and long-term family burden and distress.^{6–18}

Family impact of TBI is an important consideration for several reasons. Pediatric TBI can result in considerable financial, emotional, and social strain for families, contributing to caregiver burden and distress and potentially leading to a decline in overall quality of life for families. Increasing the quality and years of healthy life is a primary goal for Healthy People 2010, which recognizes the importance of examining how chronic illness conditions interferes with a person's day-to-day life. The importance of examining family impact is underscored by more recent research indicating that recovery (academic and behavioral) after TBI in school-age children is influenced by the postinjury environment, including family functioning and interpersonal stresses and resources.^{3–5,14,15} Studies have suggested that the effects of the social environment are amplified after severe TBI, with greatest effects on the child's social and behavioral functioning.^{5,6} Emerging behavior problems, in turn, adversely influence postinjury family functioning, contributing to greater dysfunction. Thus, there is growing evidence for reciprocal influences between child recovery and family adaptation over time after pediatric TBI.⁹

Although few studies have examined the impact of TBI in young children over time, existing data suggest that a TBI in a young child results in different and potentially more severe cognitive sequelae than is the case for older children because many of the skills that are critical for later development are emerging at this time.^{16–19} There are even fewer reports on the effects of TBI in young children on their caregivers and family.²⁰ Stancin et al²¹ examined factors that affect parental burden and distress during the first few months after TBI in children ages 3 to 6 years. Results suggested that family and caregiver functioning was more adversely affected after TBI in young children than following an orthopedic injury, although differences were modest. Chronic life stresses and interpersonal resources accounted for significant variance in measures of acute injury-related burden and parent distress in parents of younger children.

Longer term consequences of TBI on families of 3- to 12-year-old children were reported by Anderson et al.,²² who followed children 30-month post-TBI. They found that families of children with severe TBI consistently reported higher levels of family burden. Family burden was predicted by injury severity, degree of physical impairment, age at injury, and preinjury behavior. Although this study provided important longer term follow-up information about children with TBI, the age cohort was not specific to younger children, and there was no comparison group of children without brain injuries.

By using a cohort described in a previous report of baseline functioning,²¹ this study examines subsequent family adaptation to a TBI in children under age 7 years in the 18-month postinjury compared with children who had an orthopedic injury. We hypothesize that TBI will have adverse effects on parent distress and family burden at follow-up, especially with severe TBI, and that impact will be moderated by family functioning and social resources.

METHODS

Design

This study was part of a larger study of child and family outcomes associated with traumatic brain injury (TBI) in young children. A concurrent cohort prospective research design was used with repeated assessments of children ages 3 through 6 years with TBI or with an orthopedic injury (OI) not involving the central nervous system. The assessments were conducted shortly after injury and again at approximately 6, 12, and 18 months postinjury and included child tests of neuropsychological and pre-academic skills, parent ratings of children's preinjury behavior, and data from parents regarding the family environment, caregiver functioning, and injury-related burden. The focus of this study is family outcomes; hence children's behavioral and cognitive results are described in other reports.²³

Sample

The study was conducted during years 2003–2006 at 3 children's hospitals and 1 general hospital with Level 1 Trauma Units across the state of Ohio. Institutional review boards of all participating hospitals approved the study and informed consent was obtained before participation. Consecutively admitted children with documented TBI or with OI not involving the central nervous system were recruited for the study. Inclusion of a group of children with OI allowed a comparison of consequences of brain injury relative to the functioning of a group of children whose predisposition to traumatic injury provides helps to control for background child and family characteristics.

Eligibility requirements included age between 36 and 83 months at the time of injury, no documentation in the medical chart or in parent interview of child abuse as a cause of the injury, and English as the primary spoken language in the home. Children with a previous history of autism, mental retardation, or a neurological disorder were excluded. Children in the TBI group had a TBI due to blunt trauma requiring overnight admission to the hospital and a Glasgow Coma Scale (GCS),²⁴ score <15, suggesting altered neurological status, or evidence for TBI-related brain abnormalities from computed tomography or magnetic

resonance imaging. The GCS is based on a 15-point scale for estimating severity of brain injury by combining ratings of a person's best motor, verbal, and eye opening responses. Children with TBI were included whether or not they had accompanying orthopedic injuries. Children who sustained non-blunt head trauma (e.g., projectile wounds, strokes, drowning) were excluded.

Consistent with previous investigations,^{3,15,18} severe TBI was defined as 1 resulting in a GCS score of 8 or less; moderate TBI was defined as a GCS score of 9 to 12 or higher GCS with abnormal imaging (e.g., epidural or subdural hematoma); and mild TBI was defined by GCS scores of 13 to 14 without neuroimaging abnormalities. Inclusion in the OI group required a documented bone fracture (other than the skull) involving an overnight hospital stay, and the absence of any evidence of loss of consciousness or other findings suggestive of brain injury (including symptoms of concussion).

A total of 221 children (102 with TBI and 119 with OI) and their caregivers were enrolled in the study with 216 (98%) completing at least a portion of the follow-up assessments. Recruitment rates for families contacted were somewhat higher for the TBI sample than for the OI group (53 vs 35%). The higher rate of participation for families of children with TBI may reflect their greater concerns about long-term consequences of TBI relative to other injuries. Participants and non-participants did not differ with respect to census-based neighborhood income. The final sample comprised 99 children with TBI (20 severe, 64 moderate, and 15 mild) and 117 with OI. Groups did not differ in age at injury, neighborhood income, or distributions of sex, race, and maternal education levels (Table 1). Data collected in parent interview also failed to suggest group differences in preinjury developmental status as assessed by special education services or prior concerns about the child's development, behavior, or learning.

Injury and medical characteristics for each of the groups were extracted from medical records and are listed in Table 1. The groups differed in their mean New Injury Severity Score (NISS)²⁵, defined as the sum of the squares of the Abbreviated Injury Scale scores for each child's 3 most severely injured body regions. The NISS has been shown to be a better predictor of survival and to be easier to calculate than previously developed injury severity estimates.²⁵ Post-hoc tests indicated higher NISS for the severe and moderate TBI groups compared with the mild TBI and OI groups. The groups also differed in mean "non-head-injury" NISS, computed as the NISS minus the Abbreviated Injury Scale for the head region. By virtue of selection criteria, the severity of injuries to regions other than the head was higher in the OI group than in the TBI groups. The distribution of causes of injury for the TBI group were consistent with national trends for young children, with a substantial proportion of both the TBI and OI group sustaining injuries because of falls.²⁶ A significant group difference in cause of injury reflected higher rates of transportation-related injuries in the TBI groups compared with the OI group.

Procedures

When children meeting study criteria were medically stable and informed consent was obtained, medical data were abstracted from records and parents were interviewed to obtain medical, educational, and developmental histories and to collect information regarding the

injury. This assessment was conducted as soon as possible after the injury, and no later than 3-month postinjury. Mothers were the primary informant in two-parent families. As in our previous investigation,⁵ pre-injury family status was estimated by asking parents to provide retrospective ratings on measures obtained at the initial assessment. Parents also completed ratings of current child behavior and parenting stress. Follow-up assessments focusing on current functioning were repeated at 6-month interval across the initial 18-month postinjury.

Measures

The 12-item General Functioning Scale (GF) of the Family Assessment Device (FAD)^{27,28} was administered to assess global preinjury family functioning at baseline and current functioning at the follow-up assessments. The FAD-GF asks parents to indicate on a 4-point likert scale the extent to which each of several indications of family functioning (such as the willingness of family members to turn to one another for support in times of need) applies to their family. The FAD-GF has demonstrated reliability and validity and correlates highly with other FAD subscales. Higher scores on the FAD-GF indicate greater family dysfunction. For our sample, the standardized Cronbach's alpha for the FAD-GF was 0.71. Caregiver stresses and resources before the injury were assessed using Life Stressors and Social Resources Inventory-Adult Version.²⁹ The Life Stressors and Social Resources Inventory-Adult Version is an interview-based measure of life events as well as chronic stressors and resources in a variety of domains. Life events include serious illnesses, hospitalizations, or deaths of family members or friends. Chronic stressors include interpersonal conflicts, health and financial strains; resources include material or psychological supports, such as sufficient money for necessities and emotional support from family members, friends, and co-workers. The Life Stressors and Social Resources Inventory-Adult Version possesses satisfactory internal consistency and moderate to high temporal stability. Mean standard scores for the stressors and resources subscales provided indices of overall preinjury interpersonal and environmental stressors and resources, respectively, and the negative life events scale provided a measure of stressful life events experienced by the families in the previous 12 months. For our sample, the standardized Cronbach's alphas for the stressors and resources subscales were 0.71 and 0.60, respectively.

The Family Burden of Injury Interview (FBII)³⁰ was used to assess injury-related stress in the domains of the injured child's adjustment and behavior, relationship with spouse, impact on siblings, and relationships with other/extended family members. The FBII is a structured interview in which parents are asked questions pertaining to injury-related family burden in each of these domains (such as having concerns about the child's recovery or how siblings or others are adjusting to the effects of the injury on the child and family). The average stress level across items in the child, spouse, and extended family subscales, or FBIIX, provided an overall index of family burden. Additionally, subscales assessing burden associated with the injured child, spouse or partner, extended family, siblings, and immediate family provide information about specific aspects of injury-related stress. The reliability and validity of this measure from our school-aged TBI project have been reported previously.³⁰ Standardized Cronbach's alphas on the FBII subscales for the current sample ranged from 0.69 (child stress) to 0.71 (extended family stress). Caregiver psychological

distress was measured using Brief Symptom Inventory,³¹ a 53-item questionnaire tapping a wide range of psychological symptoms. Reliability and validity are well established. Overall parent distress on this measure was summarized using the General Severity Index and the Depression Scale score. Standardized Cronbach's alpha for the General Severity Index was 0.67; the depression scale alpha was 0.68.

To assess the problems in child functioning as a potential contributor to poor family outcomes, parents completed the Adaptive Behavior Assessment System-Second Edition³² at each time point. The Adaptive Behavior Assessment System-Second Edition is a standardized, norm-referenced rating scale measure of adaptive behavior and daily living skills for individuals from birth to age 89 years. The Adaptive Behavior Assessment System-Second Edition General Adaptive Composite (GAC) was used as a summary measure of the level of the child's adaptive functioning across several adaptive domains. For children younger than 6 years, these domains are communication, community use, functional pre-academics, home living, health and safety, leisure, self-care, self-direction, social, and motor; and for children 6 years of age and older, the domains are communication, community use, functional academics, home living, health and safety, leisure, self-care, self-direction, and social. The GAC has a mean of 100 and a standard deviation of 15. The GAC was included to enable consideration of the negative effects of TBI on child adaptive skills as a contributor to poor family outcomes.^{5,8,18,22} As expected, group comparisons on the GAC across all assessments revealed significantly lower scores for the severe TBI group compared with the OI group, $t(204) = -3.20, p = .002$. The group difference suggests that the GAC provides an appropriate measure of the effect of TBI on child functioning.

Socioeconomic status was defined in terms of a composite of maternal education and median income for the census tract in which the family resided (as a proxy for family income). The composite was computed by averaging the sample z scores of the two variables.

Data Analysis

General linear mixed-model analysis, also known as hierarchical linear or growth modeling, was used to examine change across follow-up in caregiver burden and psychological distress. A mixed-model approach enables utilization of data from all participants, even those not seen at every assessment, and does not require equal intervals between assessments. Raw scores were analyzed for both the FBII and Brief Symptom Inventory, as raw scores reveal changes in performance that may be obscured by transforming scores based on normative standards. Mixed-model analysis was conducted using SAS Proc Mixed.³³

The first set of analyses was conducted to examine group differences across follow-up. Group differences were analyzed using contrast terms comparing each TBI group with the OI group. The effect of time since injury was modeled as the linear and quadratic change in scores across the follow-up assessments. Linear effects accounted for constant rates of change in family outcomes postinjury and quadratic effects allowed for acceleration or deceleration in these rates. Covariates were socioeconomic status and race. Bonferroni

corrections were applied in determining the significance of domain subscales (i.e., $\alpha = 0.05/\text{number of subscales}$).

In a second series of analyses, we examined the effects of the child's level of adaptive functioning as measured by the GAC on caregiver burden and distress. In these analyses, the first series of mixed models was re-run with the GAC included as a time-varying covariate (i.e., examining the effect of the child's level of adaptive functioning at each assessment on family outcomes at that same assessment). The purpose of these analyses was to determine if family outcomes were related to children's level of adaptive functioning and if the original group differences would remain when controlling for the effects of child functioning.

A third series of mixed model analyses was performed to investigate the effects of social environmental factors on overall caregiver burden and global distress and potential moderating effects of these factors on group differences. The factors considered were the stressors, resources, and negative life events scores from the Life Stressors and Social Resources Inventory-Adult Version and family functioning as measured by the FAD-GF. To assess chronic pre-injury levels of these factors, the scores used in analyses were those obtained from the baseline assessment. These analyses examined the main effects of each factor (considered separately) and the interaction of each factor with group, time since injury, and the group $\times$ time since injury effect.

RESULTS

Main Effects Models

Mixed models analyses revealed significant main effects for both group, $F(3, 205) = 9.74, p < .001$, and time since injury, $F(2, 212) = 24.73, p < .001$, in predicting overall family burden on the Family Burden of Injury Interview. In these analyses, caregivers of children with both moderate and severe traumatic brain injury (TBI) reported significantly more injury-related burden over time than those of children with orthopedic injury (OI), with burden levels declining in all groups over time. Caregivers of children with moderate and severe TBI also endorsed a higher proportion of items as stressful than did caregivers of children with OI, $F(3, 201) = 7.43, p < .001$.

With respect to specific aspects of injury-related burden, both the severe and moderate TBI groups reported significantly more injury-related stress associated with the injured child's adjustment and behavior and the reactions of extended family than the OI group, with stress levels diminishing significantly for all groups over time. With respect to injury-related stresses with spouse or partner, caregivers of children with mild, moderate, and severe TBI all reported significantly higher levels of stress over time than those of children with OI. For sibling and immediate family concerns, only the severe TBI group reported more stress than the OI group over time. Thus, while severe TBI was associated with increased injury-related stress across domains, less severe injuries had more circumscribed effects.

In mixed models analyses examining parental distress as assessed by the Brief Symptom Inventory (BSI), the contrast between severe TBI and OI was significant, $t(214) = 2.10, p = .04$. Levels of distress did not change significantly over time and there were no significant

effects of group or time on the BSI depression scale, suggesting that depressive symptoms did not vary as a function of injury severity or time since injury.

The group differences reported above remained significant when the child's adaptive behavior as measured by the General Adaptive Composite was included in the analyses as a time-varying covariate. These analyses also revealed that lower child adaptive skills were associated with both higher family burden on the Family Burden of Injury Interview X $F(1, 655) = 9.97, p = .002$ and greater parental distress on the BSI, $F(1, 663) = 8.12, p = .005$. To the extent that lower adaptive skills reflect the effects of TBI, and these findings suggest that some of the negative effects of TBI on the family may be mediated by adverse consequences of TBI on the child.⁹

Social Environmental Influences on Parental Burden and Distress

For overall injury-related family burden (Family Burden of Injury Interview X), there was a main effect for stressors, $F(1, 209) = 20.36, p < .001$, with higher levels of stress contributing to greater injury-related burden. There was also a main effect for resources, $F(1, 219) = 11.15, p = .001$, with more limited resources contributing to greater injury-related burden. More negative life events were also associated with higher levels of injury-related burden, $F(1, 218) = 10.21, p = .002$.

Family functioning (Family Assessment Device-General Functioning Scale) moderated the association between injury severity and injury-related family burden over time, $F(6, 202) = 2.84, p = .01$. As depicted in Figure 1A, at high levels of family dysfunction as defined by Family Assessment Device-General Functioning Scale scores 1 standard deviation above the sample mean, the severe TBI group reported more burden than the OI group at all four time points postinjury. However, at low levels of family dysfunction as defined by Family Assessment Device-General Functioning Scale scores 1 standard deviation below the sample mean, the severe TBI group reported higher burden than the OI group only at the 12- and 18-month assessments (Figure 1B). Comparisons of the moderate TBI and OI groups at high and low levels of family dysfunction revealed higher family burden in the moderate TBI group at both high and low levels of family dysfunction, with group differences dissipating over time for families at both levels of family dysfunction. There were no differences between the mild TBI group and OI group at any of the assessments. The findings suggest that good family functioning before the injury buffer caregivers from the acute burden associated with severe TBI but that these positive effects do not endure and that family burden persists for these children regardless of the level at which families functioned before TBI.

In analyses examining predictors of parental distress (BSI) after injury, there was a main effect for stressors, $F(1, 216) = 80.99, p < .001$, with higher levels of chronic stressors before the injury associated with higher levels of global distress on the BSI. There was also a main effect for negative life events, $F(1, 220) = 13.50, p < .001$, with higher numbers of negative life events before the injury associated with higher levels of global distress.

Social resources moderated the association between injury type/severity and global distress (BSI General Severity Index) over time, $F(6, 202) = 2.93, p = .01$. At a low level of social

resources as defined by a score 1 standard deviation below the sample mean, the severe TBI group had higher distress than the OI group at baseline and 6-month postinjury. In contrast, at a high level of social resources as defined by a score 1 standard deviation above the sample mean, the groups did not differ significantly at any of the assessments. These findings suggest that higher social resources may buffer the acute adverse effects of severe TBI on parent distress.

Family functioning also moderated the association between injury type/severity and distress over time, $F(6,205) = 3.52, p = .003$. Analogous to the moderating effects of social resources, distress was higher in the severe TBI group than in the OI group only initially (at baseline) and at a high level of family dysfunction. These findings reinforce the implication that good family functioning may protect caregivers of children with severe TBI from the acute distress arising from the injury.

DISCUSSION

The current findings are consistent with previous data indicating that perceived family burden after traumatic brain injury (TBI) is a function of both injury severity and psychosocial factors.^{1,12,13} Contrary to past findings from studies involving children sustaining TBI later in childhood,¹³ overall burden and distress levels, even after severe TBI, were not high and there were no differences in depression levels among the groups. Because children were relatively young at the time of injury (mean = 5.01 years), parents may have had fewer concerns regarding the academic and social impact of the TBI on the child or have had greater difficulty recognizing more subtle deficits post injury. As a result, perceived injury-related burden and attendant distress may have been less than that previously documented in caregivers of school-age children with TBI, despite the fact that children who sustain TBI in early childhood show little evidence for recovery of cognitive functions in comparison to children injured at later ages.^{1,16–20,34–36}

The nature and extent of injury-related burden varied as a function of the severity of the injury. Caregivers of children with severe TBI reported increased injury-related stress and burden across multiple contexts (i.e., concerns regarding the injured child, spouse or partner, siblings, relationships with other family members), whereas caregivers of children with mild TBI only reported increased stress with spouse or partner. These findings suggest that severe TBI is associated with more pervasive injury-related stress than is less severe TBI. Although injury-related stress declined significantly over time across groups, it never fully resolved, particularly among caregivers of children with severe TBI.

Consistent with prior research, social environmental factors proved to be an important correlate of injury-related stress.³⁷ Greater interpersonal resources, fewer chronic stresses, and fewer negative life events were associated with lower levels of injury-related burden regardless of the nature or severity of the injury. Fewer chronic stresses and fewer negative life events were also associated with lower levels of distress over time in the sample as a whole. These findings suggest that caregivers with more stressful lives are also more vulnerable to the burden arising from traumatic injury. Although lower levels of child adaptive functioning were related to greater overall family burden and parental distress, the

adverse effects of TBI on families remained significant even when controlling for this factor. Given that adaptive behavior skills are adversely affected by TBI,^{5,8,18,22} this result suggests that factors other than the child's independence and ability to function contribute to negative effects on families. Possible culprits include disruptions in family routines or roles due to injury and the psychological impact of injury on family members. Child behavior or cognitive problems due to TBI that are not manifest in deficits in adaptive behavior might also have adverse effects on families.

By having interpersonal resources such as supportive relationships and a well-functioning family may be particularly important in buffering against the elevated stress and burden that accompanies severe TBI. Specifically, having a well-functioning family buffered against the acute injury-related burden of severe TBI, although these protective effects diminished at 12- and 18-month postinjury. Similarly, good family functioning and high levels of interpersonal resources served to protect families from the acute elevations in psychological distress often associated with severe TBI. In contrast, caregivers of children with severe TBI lacking such resources experienced elevated distress in the initial weeks and months after the injury. Consistent with previous research, the protective effects of the social environment on caregiver well-being were greatest after severe TBI.¹⁰⁻¹³ These findings suggest that caregivers without such supports may be especially vulnerable to injury-related burden and distress after severe TBI.

The current findings have important implications for facilitating caregiver adaptation after early childhood TBI. They suggest that many families adapt well in the first 18-month postinjury, and thereby may require only limited intervention or support. However, caregivers of children with severe TBI and few interpersonal supports may benefit from ongoing support or intervention, particularly in the initial weeks and months after the injury. Moreover, we do not know if families will continue to adapt well further out from injury as a child's longer term deficits and rate of recovery become more certain. The results suggest that it is appropriate to tailor rehabilitation programs to the families most likely to need them.³⁸

These findings must be interpreted in the context of several important limitations. First, because all data were based on caregiver—typically maternal—report, associations between social environmental risk and protective factors and caregiver outcomes may be attributable in part to common method (shared-rater) variance. Additionally, the numbers of participants with severe and mild TBI were relatively small, thereby reducing statistical power as well as the generalizability of the findings. However, the sample size in this study is similar or larger than in other longitudinal studies of pediatric TBI. Although the study benefited from a prospective, longitudinal design, and multivariate statistical analyses that enabled us to retain participants missing data from 1 or more follow-ups, differential attrition rates in TBI and orthopedic injury groups raises another potential concern. Finally, because we examined the relationship of preinjury social environmental factors to caregiver adjustment over time, the findings fail to provide information regarding how postinjury changes in the social environment influence caregiver burden and distress. Future research should examine the reciprocal relationships between interpersonal stresses/resources and caregiver adjustment over time to address this issue.

Taken together, the findings provide new information regarding the effects of early childhood TBI on caregiver burden and distress over time. They confirm prior research with older children regarding the importance of social environmental factors, particularly family functioning and interpersonal resources, on family adjustment over time after severe TBI. The current results also point to the possibility of identifying acutely caregivers and families who are likely to benefit from more intensive intervention. Future research is necessary to further clarify the interplay between changing social environmental risk and protective factors and caregiver adaptation over time.

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Figure 1.

A, Estimated mean levels of injury-related family burden across assessments on the Family Burden on the Family Burden of Injury Interview (FBII) at a high level of family dysfunction on the Family Assessment Device—General Functioning scale (FAD-GF). B, Estimated mean levels of injury-related family burden across assessments on the Family Burden on the Family Burden of Injury Interview (FBII) at a low level of family dysfunction

on the Family Assessment Devise—General Functioning scale (FAD-GF). TBI, traumatic brain injury; OI, orthopedic injury.

Table 1

Sample Demographic, Injury, and Medical Characteristics by Group

	Severe TBI, (n = 23)	Moderate TBI, (n = 63)	Mild TBI, (n = 13)	OI, (n = 117)
Age at injury (yr)				
Mean	5.0	5.0	4.6	5.1
SD	1.0	1.2	1.1	1.1
Males, n (%)	16 (70)	37 (59)	6 (46)	67 (57)
Nonwhite race, n (%)	7 (30)	22 (35)	6 (46)	27 (23)
Census median family income in thousands of dollars				
Mean	54.3	57.0	51.4	63.9
SD	15.8	26.3	26.9	23.4
Maternal education, n (%)				
2 yr high school	6 (26)	10 (16)	1 (8)	8 (7)
High school degree/GED	10 (44)	24 (38)	7 (54)	45 (39)
2 yr college	6 (26)	11 (18)	3 (23)	23 (20)
4 yr college	1 (4)	12 (19)	2 (15)	29 (25)
Graduate degree	0 (0)	6 (10)	0 (0)	12 (10)
Single parent households ^a , n (%)	7 (30)	18 (29)	6 (46)	19 (16)
Cause of injury ^{a,b} , n (%)				
Transportation	13 (57)	21 (33)	5 (39)	10 (9)
Bicycle crash	0 (0)	3 (5)	1 (8)	7 (6)
Fall	8 (35)	35 (56)	75 (4)	92 (79)
Other	2 (9)	4 (6)	0 (0)	8 (7)
Length of hospital stay in days ^{a,c}				
Mean	10.2	2.5	1.0	1.3
SD	19.0	1.9	0.4	1.0
NISS total ^a				
Mean	13.5	15.1	7.5	7.0
SD	8.6	7.9	6.2	2.7
NISS nonhead related ^a				
Mean	1.4	2.3	1.9	7.0
SD	2.1	5.2	2.6	2.7
Lowest GCS score ^a				
Mean	3.8	13.4	13.6	—
SD	1.7	2.0	0.5	—
Neuroimaging abnormalities ^{a,d} , n (%)	15 (65)	50 (80)	0 (0)	0 (0)
Coma duration ^{a,c} , n (%)				
None	0 (0)	63 (100)	13 (100)	117 (100)
24 hr	15 (75)	0 (0)	0 (0)	0 (0)
>24 hr	5 (25)	0 (0)	0 (0)	0 (0)

TBI, traumatic brain injury; OI, orthopedic injury; M, Mean; SD, standard deviation; NISS, New Injury Severity Score; GCS, Glasgow Coma Scale.

^aSignificant difference between groups at $p < 0.05$.

^bInjuries due to “other” causes included those related to sports and recreation, rough-housing, and falling objects.

^cTBIs (3 severe, 1 moderate) transferred from outside hospital after initial trauma stay. Circumstances of original hospitalization are not all known.

^dAbnormality was absent in the mild TBI and OI groups by definition.