Parent Ratings of Behavioral Functioning After Traumatic Brain Injury in Very Young Children

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Objective The behavioral ratings of preschoolers who sustained traumatic brain injury (TBI) prior to the age of 2 years and a typically developing group were compared; predictors of behavioral functioning were examined.

Methods Eighty-two 3-year-olds comprised mild TBI (n = 31), moderate/severe TBI (n = 20), and typically developing (n = 31) groups, with Child Behavior Checklist (CBCL) as the primary outcome measure.

Results Groups differed on the CBCL Withdrawal Scale. No differences emerged in the proportion of children demonstrating clinical elevations, with average mean scores for each group. Exploratory analyses yielded no differences between inflicted, non-inflicted, and typical groups. Glasgow Coma Scale and Self-Report Family Inventory Leadership predicted Externalizing Problems; developmental level predicted Internalizing Problems.

Conclusions After early TBI, preschoolers did not differ from one another or a matched comparison group in behavioral ratings; however, it may be premature to infer that preschoolers do not evidence behavioral dysfunction after early TBI.

Key words Behavioral ratings post traumatic brain injury; preschool traumatic brain injury; traumatic brain injury.

Traumatic brain injury (TBI) can have a devastating impact on the lives of individuals of all ages. Children who sustain TBI are often faced with significant disruptions to development, particularly if they are in critical stages of skill acquisition when the injury occurs. The trauma associated with an injury can create significant stress for both the child and the family. This burden can be profound and may exacerbate impairment or negative outcomes.

Research concerning the developmental outcomes of infants, toddlers, and preschoolers after TBI is limited. Available literature suggests that TBI in young children may affect academic, motor, and cognitive functions, with impairments often persisting long after the injury occurred (Anderson et al., 2001). Furthermore, the type of TBI (i.e., inflicted vs. non-inflicted) may dictate the severity of subsequent sequelae. For example, inflicted TBI (e.g., shaken baby/shaking-impact syndrome, physical abuse) appears to result in more significant limitations than deficits observed in non-inflicted TBI (e.g., falls, motor-vehicle accidents, pedestrian injuries) (Ewing-Cobbs et al., 1997; Kennan, Hooper, Wetherington, Nocera, & Runyan, 2007). The age of young children who sustain inflicted TBI, their neurological vulnerability, and the associated diffuse nature of the injury all likely contribute to these negative outcomes (Ewing-Cobbs, Duhaime, & Fletcher, 1995).

One functional domain that appears to be vulnerable to TBI is behavioral functioning. Positive behavioral functioning reflects age-appropriate thoughts and actions. When behavioral functioning is impaired, children lack...
the resources to interact optimally with others and their environment. A number of behavioral impairments have been reported in school-age children after TBI including social problem-solving deficits (Janusz, Kirkwood, Yeates, & Taylor, 2002), internalizing behaviors (Kirkwood et al., 2000), and increased psychiatric disorders (Brown, Chadwick, Shaffer, Rutter, & Traub, 1981). Variables such as developmental stage (Dennis, Gugler, Roncadin, Barnes, & Schachar, 2001), severity of injury (Anderson et al., 2001; Janusz et al., 2002; Kinsella, Ong, Murtagh, Prior, & Sawyer, 1999), socioeconomic status (Taylor et al., 2001; Yeates et al., 2004), and preinjury functioning (Schwartz et al., 2003) significantly predict social–behavioral outcome in the school-age population following a TBI.

**Behavioral Functioning Following TBI in the Preschool Years**

In contrast to the extensive research on school-age TBI, literature regarding the behavioral outcomes following preschool TBI is limited. It is difficult to predict the exact nature of behavioral functioning after preschool TBI due to the variability in emergent social and behavioral functioning during this developmental stage. Variables such as young age at injury, a relative lack of time to build good skills for coping with trauma, and disruptive family factors, particularly in cases of abuse, would likely affect behavioral functioning in a negative fashion. These variables may exert an influence on behavioral domains even above and beyond what is observed in older children due to the disruption of typical developmental trajectories for social and behavioral functioning.

Anderson et al. (2001) studied the relationship between injury severity and behavioral outcome in children between the ages of 2 and 12 years who had sustained a TBI. Behavior ratings by parents on the Rowe Behavioral Rating Inventory indicated neither preinjury differences between groups nor a significant effect of severity on outcome measures with behavior profiles of 80% of the children falling in the normal range of functioning. In another study, Anderson et al. (2005) found group differences on the Personality Inventory for Children, with children (ages 2–7 years) in the moderate and severe TBI groups showing more problems with the Internalization and Somatic Symptoms Scales than the mild TBI and control groups.

While some studies have included young children in samples with older children (Anderson et al., 2001; Fletcher, Ewing-Cobbs, Miner, Levin, & Eisenberg, 1990), studies have not focused specifically on behavioral outcomes in preschool children injured in infancy and very early childhood. To address this question, the current study compared parent ratings on the Child Behavior Checklist (CBCL) of children at age 3 years who sustained mild and moderate/severe TBI prior to the age of 2 years to a group of typically developing children aggregated on age, gender, race, and maternal education.

Despite the lack of literature that has directly examined the effects of TBI on the behavioral outcomes of children injured at very young ages, existing literature guided the hypotheses of this study. First, TBI in very young children has been shown to have a negative impact on multiple areas of development (Anderson et al., 2001; Donders & Ballard, 1996; Kinsella et al., 1999; Max et al., 1998; Schwartz et al., 2003). Second, literature suggests disruptions to behavioral functioning after TBI in school-aged children (Brown et al., 1981; Fenwick & Anderson, 1999; Green, Foster, Morris, Muir, & Morris, 1998; Janusz et al., 2002; Kirkwood et al., 2000; Max et al., 1998). Third, a diathesis-stress model provides a framework for understanding how characteristics of the illness, the child, and the environment interact to affect a child’s psychological outcomes related to illness (Burke & Elliott, 1999). This model has been studied in children and adolescents with epilepsy (Wagner, Smith, Ferguson, Horton, & Wilson, 2009), depression (Morris, Ciesla, & Garber, 2008), diabetes, asthma, and cystic fibrosis (Carpentier, Mullins, Wagner, Wolfe-Christensen, & Chaney, 2007), and juvenile rheumatoid arthritis (Wagner, Chaney, Hommel, Andrews, & Jarvis, 2007). This model has not been previously examined with respect to the young pediatric TBI population, but we might expect to see affective disruption (i.e., internalizing symptoms) and behavioral dysregulation (i.e., externalizing behaviors) as potential outcomes post-injury.

**Other Factors Contributing to TBI**

Developmental level (Anderson et al., 2001; Donders & Ballard, 1996; Ewing-Cobbs et al., 1995, 1997; Kennan et al., 2007; Kinsella et al., 1999; Max et al., 1998; Schwartz et al., 2003) and injury severity (Schwartz et al., 2003; Taylor et al., 2002) appear to impact child behavior post-injury. In addition, maternal education has been shown to impact child outcomes in cognition (Kesler et al., 2008) and language (Qi, Kaiser, Milan, & Hancock, 2006).

In the current study, it was hypothesized that (a) children with moderate/severe TBI would receive more impaired behavioral ratings than children in the mild TBI and typically developing groups, and (b) that a higher proportion of children in the mild and moderate/severe TBI groups would receive behavioral ratings that
were at or above the 90th percentile (T-score ≥63) relative to a group of typically developing children, based on parent ratings of behavioral functioning. Additionally, two exploratory analyses were conducted. The goal of the first was to examine whether differences existed between inflicted and non-inflicted TBI, and the goal of the second was to explore potential predictors of behavioral outcomes after early TBI.

Methods

Participants

Participants included 51 preschoolers who sustained TBI prior to the age of 2 years and a group of 31 typically developing children with no identified developmental delays or frank neurologic impairment (Table I). The study was approved by the Institutional Review Board at the University of North Carolina. All participants were invited to participate and enrolled for participation in accordance with university Institutional Review Board procedures. Parents provided written informed consent for their child’s participation while each child provided verbal and/or behavioral assent.

Enrollment in the TBI group was based on prospective sampling from all nine hospitals in North Carolina with a pediatric intensive care unit in 2000 and 2001. Keenan et al. (2003) identified 152 children who had sustained serious or fatal TBI prior to the age of 2 years. Families of the 112 surviving children were invited to enroll in a follow-up telephone interview study at 1 and 2 years post-injury. They were subsequently invited to enroll their children in the home visit follow-up at 3 years of age. This follow-up consisted of developmental testing and parent ratings, the results of which are described in the current study. Demographic characteristics of families who participated in the home visit were similar to those who were eligible but did not participate (see Keenan et al., 2007). The 51 children described in the current analyses reflect the number of participants in the home visit portion of the follow-up, with the exception of one participant who was excluded due to missing data on the CBCL.

Preschoolers who did and did not participate in the home visit portion of the study were comparable on variables such as rates of inflicted injury, gender, ethnicity, Glasgow Coma Scale (GCS) scores, age at injury, maternal age, maternal marital status, and maternal education level. See Keenan et al. (2007) for a detailed description of these variables.

Children who sustained a non-penetrating TBI documented by CT scan, MRI scan, or neuropathology (Keenan et al., 2003) were eligible for the study. Exclusionary criteria included presence of skull fractures without intracranial injury. TBI severity was based on GCS scores at time of injury, whereby scores of 3–8 signified severe injury (n = 10), 9–12 indicated a moderate injury (n = 10), and 13–15 reflected mild injury (n = 31). Mechanism of injury (i.e., inflicted vs. non-inflicted) was determined by the treating team at each hospital. Rates of inflicted and non-inflicted injury were similar, with 26 participants (51% of the TBI Group) having experienced an unintentional injury and 25 an inflicted injury.

Children in the typically developing group (n = 31) were recruited from preschools and daycare centers in central North Carolina and southeastern Virginia. Participants were aggregately matched to the TBI sample by maternal education, gender, race, and age. None of these children had a reported history of neglect, abuse, or other trauma, and none had received a diagnosis of a neurodevelopmental, neurological, or other medical disorder, per parent report.

Measures

The CBCL (1.5–5 years) (Achenbach & Rescorla, 2000) is a parent- or caregiver-completed rating scale that measures

### Table I. Demographic Variables for the Mild TBI, Moderate/Severe TBI, and Typically Developing Groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mild TBI (1)</th>
<th>Moderate/Severe TBI (2)</th>
<th>Typical (3)</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronological age***</td>
<td>3.33 (.38)</td>
<td>3.25 (0.27)</td>
<td>3.68 (0.35)</td>
<td>3 &gt; 1, 3 &gt; 2</td>
</tr>
<tr>
<td>Mullen ELC***</td>
<td>89.35 (18.82)</td>
<td>63.65 (15.98)</td>
<td>94.32 (18.71)</td>
<td>3 &gt; 2, 1 &gt; 2</td>
</tr>
<tr>
<td>Maternal education*</td>
<td>4.61 (1.20)</td>
<td>4.60 (1.05)</td>
<td>5.03 (1.20)</td>
<td>NS</td>
</tr>
<tr>
<td>Caucasians</td>
<td>19 (63.33)</td>
<td>6 (30.00%)</td>
<td>17 (58.4%)</td>
<td>NS</td>
</tr>
<tr>
<td>Females</td>
<td>17 (34.84%)</td>
<td>7 (35.00%)</td>
<td>11 (35.48%)</td>
<td>NS</td>
</tr>
<tr>
<td>Age at injury (in years)</td>
<td>0.49 (0.57)</td>
<td>0.81 (0.62)</td>
<td>-</td>
<td>NS</td>
</tr>
<tr>
<td>Time since injury*</td>
<td>2.81 (.33)</td>
<td>2.45 (0.69)</td>
<td>-</td>
<td>1 &gt; 2</td>
</tr>
</tbody>
</table>

Note: NS: non-significant.

*Maternal education was coded as follows: 1: < 7th grade; 2: 9th grade; 3: 10th or 11th grade; 4: high school graduate; 5: partial college; 6: college graduate; 7: post graduate.

*p ≤ .05; **p ≤ .01; ***p ≤ .001.
the behavior of preschool children relative to age-expectations. CBCL scores are reported as T-scores with a mean (M) of 50 and a standard deviation (SD) of 10, with higher T-scores reflecting more severe difficulties. The CBCL has been established as having good reliability and validity (Rescorla, 2005). For the current study, problematic behavior was defined by scores ≥ 90th percentile (i.e., a T-score ≥ 63) on the CBCL.

Developmental functioning of the TBI and typically developing groups was assessed through standardized, individual assessments using the Mullen Scales of Early Learning (Mullen, 1995). The Mullen yields an overall developmental quotient, the early learning composite (ELC), from scores on scales measuring visual reception, fine-motor skills, expressive language, and receptive language. The developmental quotient is a standard score with M = 100 and SD = 15, with higher scores reflecting more intact development. Test–retest reliability of the Mullen was .76 for the cognitive scales for the 25–56 months age group.

The Self-Report Family Inventory (SRFI) (Beavers, Hampson, & Hulgus, 1990) is a 36-item scale that assesses an individual’s current perception of his or her family’s functioning in the domains of Family Health/Competence, Conflict, Cohesion, Expressiveness, and Directive Leadership. Each item is rated on a 5-point Likert Scale ranging from “Fits our household very well” to “Doesn’t fit our household at all”. Reliability and validity have been deemed adequate. The SRFI was included in data analyses to provide a measure of the relationship between family functioning and behavioral outcomes after TBI. Including the SRFI in the current study allowed for the measurement of the effects that TBI can have on a family, and provides information about child’s family environment post-TBI. Reliability coefficients for the SRFI range from .84 to .88 for the entire scale (Beavers, Hampson, & Hulgus, 1985), with test–retest coefficients varying by scale and ranging from .41 to .89 (Beavers et al., 1990). Validity for the tool has been documented in relationship to other family assessment measures, such as FACES II and FACES III (Hampson, Hulgus, & Beavers, 1991).

**Procedures**

After study enrollment, a home visit was scheduled for a date near the child’s third birthday. During this home visit, a developmental evaluation and parent ratings were completed. All parent respondents were females, and most were biological mothers (64.7%). Adoptive parents comprised 13.7% of the respondents; 11.8% of the respondents were foster parents related to the child; and 3.9% were non-related foster parents.

Recruitment of the typically developing group targeted parents of children from the community (e.g., daycares, preschools, Head Start centers). Parents were provided with information about the study and invited to enroll their children. If parents provided written permission for their child’s participation, the child completed a developmental assessment at the preschool or daycare or in a testing room at a local child development clinic. Parents completed their questionnaires at home, over the phone, or during their child’s assessment. Most respondents in the typically developing group were biological mothers (80.7%), but several fathers (9.7%) and one grandmother (3.2%) also completed questionnaires. Two of the questionnaires in this group were completed by adoptive mothers (6.5%).

**Data Analysis**

Preliminary analyses compared the TBI and typically developing groups on the aggregate matching variables (e.g., age, gender, race, maternal education), and on Mullen ELC.

To address the first question of group differences, scores on the composite and individual scales of the CBCL for the mild and moderate/severe TBI groups were compared to those of the typically developing group using ANOVA procedures with an alpha level of .01. Because these outcome variables correlate strongly with one another (i.e., test items may load on more than one of these scales), separate ANOVAs were selected over a MANOVA test. A Pearson’s Chi-square analysis was implemented to address the second question pertaining to the incidence of parent-reported behavior dysfunction in the three TBI groups.

Exploratory analyses were conducted with ANOVAs to determine if any differences were present between the inflicted TBI, non-inflicted TBI, and typically developing groups on Internalizing, Externalizing, and Total Problem Scales of the CBCL. For a second exploratory research question, multiple regression analyses were conducted. Predictor variables were selected to be entered into each of three exploratory regression equations for the main summary variables of the CBCL because of available research implicating them as potentially important predictors of behavioral functioning. These three variables included developmental status (Mullen ELC), maternal education, and injury severity (GCS).

One or two additional variables that were significantly correlated with one of the three CBCL summary scores were also considered for inclusion in the regression
equations. Preliminary analyses examined correlations between variables selected a priori and the three CBCL summary scores. These variables included family and demographic variables (e.g., maternal education, family functioning, gender, race); child variables (e.g., developmental level, age); and injury-related variables (e.g., mechanism of injury, severity of injury, loss of consciousness >3 days, age at injury, time since injury). Variables most correlated with the CBCL summary scales were included as predictor variables in separate regression equations for each scale. It was hypothesized that overall developmental level and injury severity would emerge as significant predictors of behavioral outcome on the CBCL.

**Results**

**Preliminary Analyses**

Preliminary analyses (Table I) revealed significant between-group differences on the ELC of the Mullen Scales of Early Learning, $F(2, 79) = 18.85$, $p < .001$. Follow-up testing with Tukey’s HSD test revealed differences between the typically developing and moderate/severe groups ($p < .001$), as well as between the mild and moderate/severe groups ($p < .001$). The mean score for the moderate/severe group fell in the very low range, indicating significant impairments, while the typically developing group obtained a mean score in the average range. The moderate/severe group also demonstrated significantly lower overall development than the mild group, whose scores were in the low average to average range.

These group differences in IQ, which were not evident on demographic factors such as maternal education, are similar to those reported previously as consequences of early TBI (Ewing-Cobbs et al., 1997). Consequently, differences in IQ were conceptualized as a consequence of TBI, rather than a confounding factor for the purposes of analyzing behavioral outcomes post-injury. Additionally, significant group differences emerged for the mean age at testing, an effect that was likely related to the challenges of recruitment. The TBI groups each were 4–5 months younger than the typically developing group, a difference of age that was not expected to influence scores systematically.

**Group Differences on the CBCL Scales**

Three separate analyses of variance were run to determine whether the mild, moderate/severe, and typically developing groups differed from one another on the composite scales of Internalizing, Externalizing, and Total Problems on the CBCL. Given the size of the groups, analyses of the CBCL outcome scores had the power to detect a change of half a SD between groups.

No significant group differences emerged for Internalizing Problems, $F(2, 79) = 1.86$, $p < .16$, Externalizing Problems, $F(2, 79) = 1.52$, $p < .23$, or Total Problems, $F(2, 79) = 2.10$, $p < .13$ (Table II). Visual inspections of composite scores suggest that the behavioral functioning of all the groups fell in the normal range across domains. Analysis of individual CBCL scales did not yield significant differences between groups, except in the area of Withdrawal, where the moderate/severe TBI group was rated as having significantly more withdrawal behavior compared to the mild TBI and typically developing groups (Table II). Effect sizes for most of these comparisons fell in the weak range (.02–.47; Table II). Effect sizes for withdrawal, however, fell in the strong range for the comparisons between the mild and moderate/severe TBI groups and between moderate/severe TBI and typically developing groups.

**Inflicted TBI versus Non-inflicted TBI versus Typically Developing Group**

Additional exploratory analyses were run to compare the inflicted TBI, non-inflicted TBI, and typically developing groups on demographic variables. Chi-square analyses did not reveal significant differences between the inflicted, non-inflicted, and typically developing groups with respect to gender, race (minority/non-minority), or maternal education. Groups differed on their overall Mullen ELC score, with children in the inflicted TBI Group performing lower than both the non-inflicted and typically developing groups on the Mullen Scales of Early Learning, $F(2, 79) = 8.25$, $p < .01$. Groups also differed on age at testing, with both the inflicted and non-inflicted TBI groups being significantly younger than the typically developing group at time of the assessment, $F(2, 79) = 11.99$, $p < .01$.

Three one-way ANOVAs were run to compare the behavior ratings of children with inflicted TBI, with non-inflicted TBI, and in the typically developing comparison group. Groups did not differ on any of the three primary CBCL scales of Internalizing Problems, $F(2, 79) = 1.619$, $p = .205$, Externalizing Problems, $F(2, 79) = 14.06$, $p = .251$, or Total Problems, $F(2, 79) = 2.094$, $p = .130$.

**Frequency of Clinical Elevations in the TBI Group**

Chi-square tests were used to determine whether the frequency of children whose parents rated their behavior at or above the 90th percentile on the CBCL (T-Score ≥63) differed by group membership (Table IV in supplementary material online). For the CBCL summary scores, the groups again did not differ in the frequency with which
Parents reported Internalizing Problems, $\chi^2(2) = 3.61$, $p < .16$; Externalizing Problems, $\chi^2(2) = 2.91$, $p < .23$; or Total Problems, $\chi^2(2) = 1.3$, $p < .94$. On individual clinical scales, the groups did not show any significant differences.

Predictors of Behavioral Outcomes in Preschool TBI

In addition to key TBI-related variables (e.g., GCS), the Internalizing Problem Scale significantly correlated with developmental level (i.e., Mullen ELC) and maternal education. Consequently, only Mullen ELC, maternal education, and GCS were included in the model. The regression equation yielded Mullen ELC as the sole significant predictor of Internalizing Problems on the CBCL (Table III). The composite score of Externalizing Problems significantly correlated with maternal education and the Leadership Scale of the SRFI. Therefore, this model included Mullen ELC, maternal education, GCS, and the SRFI Leadership Scale. When taken together in the regression model, both the GCS and the SRFI Leadership Scale emerged as significant predictors of Externalizing Problems on the CBCL. Only maternal education significantly

Table II. Comparison of the CBCL Findings Across the Three Groups

<table>
<thead>
<tr>
<th></th>
<th>Mild TBI ($n = 31$)</th>
<th>Moderate/Severe TBI ($n = 20$)</th>
<th>Typical ($n = 31$)</th>
<th>F-value*</th>
<th>Group comparison</th>
<th>Effect size (for the ANOVA)</th>
<th>Effect size (for each group comparison)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBCL summary scales</td>
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</tr>
<tr>
<td>Internalizing Problems</td>
<td>51.42 (10.12)</td>
<td>53.70 (8.64)</td>
<td>48.06 (11.93)</td>
<td>1.86</td>
<td>NS</td>
<td>.045</td>
<td>-0.19</td>
</tr>
<tr>
<td>(47.71–55.13)</td>
<td>(49.66–57.74)</td>
<td>(43.69–52.44)</td>
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</tr>
<tr>
<td>Externalizing Problems</td>
<td>53.68 (10.71)</td>
<td>51.80 (13.69)</td>
<td>48.39 (12.23)</td>
<td>1.52</td>
<td>NS</td>
<td>.037</td>
<td>0.15</td>
</tr>
<tr>
<td>(47.75–57.61)</td>
<td>(45.39–58.21)</td>
<td>(43.90–52.87)</td>
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</tr>
<tr>
<td>Total Problems</td>
<td>53.35 (9.80)</td>
<td>52.95 (10.18)</td>
<td>48.03 (12.73)</td>
<td>2.10</td>
<td>NS</td>
<td>.050</td>
<td>0.03</td>
</tr>
<tr>
<td>(49.76–56.95)</td>
<td>(48.19–57.71)</td>
<td>(43.36–52.70)</td>
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<tr>
<td>CBCL clinical scales</td>
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<tr>
<td>Emotional reactivity</td>
<td>55.61 (6.62)</td>
<td>55.80 (6.80)</td>
<td>54.58 (7.13)</td>
<td>0.26</td>
<td>NS</td>
<td>.006</td>
<td>-0.03</td>
</tr>
<tr>
<td>(53.19–58.04)</td>
<td>(52.62–58.98)</td>
<td>(51.97–57.19)</td>
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<tr>
<td>Anxious/Depressed</td>
<td>53.71 (4.22)</td>
<td>52.90 (4.69)</td>
<td>52.77 (5.90)</td>
<td>0.30</td>
<td>NS</td>
<td>.008</td>
<td>0.14</td>
</tr>
<tr>
<td>(53.27–57.57)</td>
<td>(51.17–56.13)</td>
<td>(50.73–55.47)</td>
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<tr>
<td>Somatization</td>
<td>54.42 (6.05)</td>
<td>54.85 (7.25)</td>
<td>54.16 (6.21)</td>
<td>0.07</td>
<td>NS</td>
<td>.002</td>
<td>-0.07</td>
</tr>
<tr>
<td>(52.20–56.64)</td>
<td>(51.46–58.24)</td>
<td>(51.88–56.44)</td>
<td></td>
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<td></td>
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<tr>
<td>Withdrawal**</td>
<td>54.42 (5.78)</td>
<td>60.60 (9.38)</td>
<td>54.19 (6.52)</td>
<td>6.00</td>
<td>.004</td>
<td>.132</td>
<td>-0.95</td>
</tr>
<tr>
<td>(52.30–56.54)</td>
<td>(56.21–64.99)</td>
<td>(51.80–56.38)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Sleep problems</td>
<td>57.39 (8.33)</td>
<td>54.60 (6.94)</td>
<td>55.97 (7.99)</td>
<td>0.75</td>
<td>NS</td>
<td>.019</td>
<td>0.35</td>
</tr>
<tr>
<td>(54.16–60.62)</td>
<td>(51.35–57.85)</td>
<td>(53.04–58.90)</td>
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<tr>
<td>Attention</td>
<td>56.23 (6.83)</td>
<td>56.90 (8.53)</td>
<td>54.10 (8.52)</td>
<td>1.19</td>
<td>NS</td>
<td>.029</td>
<td>-0.08</td>
</tr>
<tr>
<td>(53.72–58.73)</td>
<td>(52.91–60.89)</td>
<td>(51.91–56.29)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggression</td>
<td>56.71 (8.27)</td>
<td>55.35 (8.51)</td>
<td>54.00 (7.75)</td>
<td>0.86</td>
<td>NS</td>
<td>.021</td>
<td>0.18</td>
</tr>
<tr>
<td>(53.68–59.74)</td>
<td>(51.37–59.33)</td>
<td>(51.16–56.84)</td>
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</tbody>
</table>

Note: Data presented as M (SD), with lower scores reflecting more intact behavioral ratings. NS: non-significant.

*df = 2, 79 for all scales except Sleep problems (df = 2, 76 due to missing data).

*p ≤ .05; **p ≤ .01; ***p ≤ .001.
correlated with the Total Problem summary scale. Thus, no new variables were added to this model. None of the variables included in the model emerged as significant predictors of the CBCL Total Problem score.

Discussion

In contrast to literature suggesting behavioral impairment post-injury (Brown et al., 1981; Janusz et al., 2002; Kirkwood et al., 2000), results of the current study are consistent with findings showing average behavioral ratings (Anderson et al., 2001; Fay et al., 1994; Fletcher et al., 1990; Kinsella et al., 1999). A more thorough understanding of why the results of these studies vary is important for accurately conceptualizing how TBI impacts behavioral development in early childhood, for developing appropriate interventions and treatments, and for predicting which children will evidence dysfunction.

One possibility for the lack of group differences is that preschool TBI groups truly show no impairments in their behavioral functioning after sustaining injuries as infants and very young children. If this scenario were true, it would suggest either that no behavior difficulties emerge after early TBI, or behavioral problems are present, but diminish during this time. The issue of recovery is critical when following children of any age after a TBI. If improvements in behavior occurred during the recovery period, such results would be encouraging, and would underscore the importance of close monitoring during the recovery period.

A second explanation for the similarity between the groups on the CBCL might be related to an interaction between skill acquisition and the task and environmental demands that a 3-year-old faces. During the preschool years, children are developing many important skills. For example, preschoolers are not expected to have sophisticated executive functioning and rely instead on the structure within their environment. Therefore, for areas of behavior that preschoolers have not yet developed, effects of the TBI may lie dormant until the school years when children are presented with increasingly demanding tasks.

A third important element to consider is that the current study was based solely on parent report of behavior in the home and did not include direct observation of the child’s behavior. Many different factors may have the potential to affect parents’ ratings of their children post-injury. After a serious, potentially life-threatening TBI, parents would likely experience feelings of relief that their child had survived and potentially feelings of guilt over the injury. These feelings might cause parents to be more forgiving and/or tolerant of subsequent misbehavior and noncompliance. It is also possible that parents may consider misbehavior injury-related and beyond the child’s control. Additionally, many parents may lack knowledge about typical child development and not realize the impact of the TBI on development.

Limitations of this study may have also impacted findings. One potential limitation relates to the settings from which children were recruited. In this study, the children in the typically developing group were recruited from preschools and daycares, while children in the TBI groups were not ascertained from these settings. This difference may have affected the range of behavior that could be demonstrated and observed in these settings, thus limiting CBCL responses. Additionally, the amount and type of early intervention services received by the TBI group is unknown. Furthermore, while this population-based study includes a participant group larger than many other studies of very young children after TBI, a larger sample size may have permitted detection of group differences, especially given the variability among participants in the typically developing group on outcome measures. It is also important to note that this study had the power to detect a difference of one-half a SD, or a moderate effect size. A moderate effect size can have meaningful implications clinically, particularly in the cases of children whose scores fall near the cut points. For example, half a SD is clinically meaningful, particularly for scores that hover near clinical cut points. If we assume a normal distribution of scores and no change in SD, this type of moderate effect size would result in >20% of TBI cases scoring beyond the normative 90th percentile.
Another limitation of the current study is that the moderate and severe TBI groups were combined due to a small sample size, which may have obscured differences in either the severe or moderate TBI group independently. Of the 112 surviving children included in the parent study, only 52 participated in the home visit follow-up, and 51 were included in the current analyses. Although families who did and did not participate in the home visit follow-up were not significantly different on demographic variables, it is possible that selection bias may have impacted findings, with families experiencing more difficulty parenting their children not choosing to participate in the study. Additionally, while this study used a comparison group of typically developing preschoolers to compare to the TBI group, it did not include a clinical control group. Although the inclusion of this type of group would have offered no advantage in this study given our current findings, it could offer the advantage of determining behavioral differences in the TBI group above and beyond what would be expected for children sustaining other injuries and trauma in future studies. Future research may also wish to consider the relationship between language development and behavioral ratings, particularly given the current findings of increased withdrawal in children with moderate/severe TBI.

In examining key variables as predictors of behavioral outcomes, this study found that overall development predicted Internalizing Problems, and that GCS and the SRFI Leadership Index were significant predictors of Externalizing Problems. The finding that GCS predicted Externalizing Problem scores is consistent with a broad base of pediatric TBI literature implicating severity of injury in influencing outcome (Brown et al., 1981; Dennis et al., 2001; Janusz et al., 2002; Kinsella et al., 1999; Max et al., 1998; Schwartz et al., 2003; Taylor et al., 2002). It is surprising, however, that injury severity was not predictive of Internalizing or Total Problems. The emergence of the SRFI Leadership Index as a significant predictor of Externalizing Problems in the regression model supports research by Yeates et al. (2004) with a school-age population. Their study found that poor family functioning exacerbated poor social outcomes in a TBI group relative to an orthopedically impaired group. The Leadership Index taps a family’s recognition of a clear family leader and the strength of leadership from adults in the family. Families with strong leaders may set clearer and more consistent limits, providing structure and control that might help prevent problem behaviors. Similarly, Kinsella et al. (1999) found that family variables, such as whether the primary caregiver had a partner and coping variables (e.g., ability to cope, parent reaction to injury), significantly predicted child behavioral outcome acutely; however, these findings were not sustained over time. In families with single parents, it is possible that leadership scores were high (i.e., with only one adult in the home, the role of leader was easily established), but organization may have been low. Such a situation would make the relationship between leadership scores and externalizing behaviors less clear.

The current study found no significant group differences in behavioral functioning on the summary scales of the CBCL, most of the individual scales, or when inflicted versus non-inflicted subgroups were examined. More research is warranted to confirm these findings, particularly longitudinal studies that would determine whether the more structured, academically demanding environment of school brings latent behavioral impairments to the surface. In addition to longitudinal studies, treatment studies would also provide useful information about the efficacy of interventions on recovery. It would be helpful in future research to determine if intensive early intervention services soon after injury ameliorate the impact of TBI on behavioral functioning.

Supplementary Data

Supplementary data can be found at: http://www.jpepsy.oxfordjournals.org/

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