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Online family problem-solving for pediatric traumatic brain injury: Influences of parental marital status and participation on adolescent outcomes

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Abstract

OBJECTIVE—To examine the moderating effects of parent marital status and participation on efficacy of an online family problem-solving intervention for pediatric TBI.

METHODS—Participants were 132 adolescents (12–17 years) who had sustained a recent (<6-months) TBI and their parent/s. Participants were randomly assigned to the intervention (Counselor Assisted Problem-Solving, CAPS) or an internet-resource control condition (IRC). CAPS was designed to support families in the initial phase following TBI, by teaching problem-solving skills and addressing common challenges. To examine the moderating effect of parent marital status, participants were divided into four-groups (i.e., CAPS married-household, CAPS unmarried-household, IRC married-household, and IRC unmarried-household). Family income and caregiver education were controlled in analyses.

RESULTS—Parent marital status moderated treatment effects on adolescent externalizing behavior problems. Adolescents from married households in CAPS displayed fewer behavior problems at 6 and 18-months post-baseline compared to adolescents from unmarried households in CAPS. Among married CAPS families, there were no differences in outcomes among families where one or two parents actively participated.

CONCLUSIONS—Web-based interventions for pediatric TBI, such as CAPS, are a viable option for some though not all families. Further research is needed to investigate factors that influence efficacy in order to match families to the most beneficial treatments.

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Keywords

pediatric traumatic brain injury; closed head injury; parent-child relations; pediatrics; adolescent outcomes; treatment outcomes

Pediatric traumatic brain injury (TBI) is a leading cause of acquired disability in childhood¹ and can result in a range of short- and long-term challenges for adolescents and their families. Emergent externalizing behavior problems such as aggression, conduct problems, and oppositional defiant behaviors² are particularly common among children/adolescents who have sustained moderate to severe TBI.^{3,4,5} These behaviors can result in negative life trajectories, which contribute to the over-representation of adolescents with TBI in juvenile justice settings.⁶ Li and Liu's² systematic review of behavioral outcomes following pediatric TBI found evidence that for some children/adolescents, behavioral problems that emerge following TBI tend to abate within a few years,³ however, for others, these problems may persist or even increase over time.^{5,7,8,9}

In addition to impacting adolescent behavior and functioning, pediatric TBI has been found to affect parent/caregiver and family functioning. For example, parents/caregivers of children and adolescents with TBI report higher levels of stress and poorer family functioning compared to parents of non-injured children.¹⁰ Parents of children with TBI also report higher levels of stress and anxiety compared to parents of children with orthopedic injuries,¹¹ indicating unique qualities of pediatric TBI that negatively influence parent and family functioning.

Despite the prevalence of pediatric TBI and the significant impact on adolescents and their families, many adolescents/families impacted by escalating behavior problems post-TBI do not receive services that could support their functioning.^{12,13} This is likely due in part to the paucity of interventions specifically targeting the unique needs of this clinical population. Limited access to care may also restrict engagement in services. Specifically, families who are already burdened with their adolescent's behavior and medical needs, as well as associated time and financial costs, may find it difficult to access office-based psychosocial interventions. Traditional barriers to accessing services, such as living in rural areas or lack of transportation, are likewise relevant to families affected by TBI, particularly those from lower income backgrounds. As such, office-based interventions that could improve adolescent and parent/family functioning may not be readily accessible to a large portion of families impacted by pediatric TBI.

Web-based interventions that families can access from their own home may be particularly suited to the unique needs of adolescents with TBI and other pediatric conditions. Indeed, families of other pediatric populations such as survivors of pediatric cancer indicate a preference for psychosocial interventions that do not require visits to a facility (e.g., those delivered via phone or internet).¹⁴ With the aide of technology, families are able to connect with clinicians via Skype (or other web-conferencing tools), and access services and web content from wherever they have access to the internet, including their own home. This approach effectively reduces barriers associated with travel time and transportation. According to the Pew Research Center,¹⁵ 85% of adults in the US ages 35 years and older

use the internet or have a smartphone, and the rate among adults ages 18–34 years is 99%; these figures suggest that web-based interventions are accessible to a wide range of families. Despite the potential advantages of web-based interventions and relative ease of access, a recent Cochrane Review¹⁶ found just four web/technology-based interventions for children, adolescents, and families impacted by pediatric brain injury.

The few randomized clinical trials (RCT) of web-based interventions for children/families impacted by pediatric TBI have shown promising outcomes. However, child/adolescent and family characteristics influence efficacy of these interventions indicating that subsets of families may be more likely to benefit than others.^{17–19} For example, an RCT of a web-based parenting intervention for parents of young children with TBI (Internet-based Interacting Together Everyday, Recovery After Childhood TBI, I-Interact) found that parents with lower incomes experienced greater reduction in psychological distress, compared to parents with higher incomes.^{18,20} Similarly, a study of a web-based family problem solving intervention for adolescents ages 11 – 18 years (Teen Online Problem-Solving, TOPS) found that family income moderated treatment effects, with lower income parents reporting greater declines in adolescent behavior problems.²¹ Prior publications from the current intervention, referred to as Counselor Assisted Problem Solving (CAPS) reported moderating effects of family income, with CAPS having more positive effects in reducing parent psychological distress for lower-income caregivers.²² Adolescent age was also related to treatment efficacy, with older but not younger adolescents showing positive effects of CAPS in reducing externalizing behavior problems.²³ Variability in outcomes across differing child/family characteristics underscores the need to identify families that are most likely to benefit from web-based interventions.

However, other potential moderators of the responsiveness to these interventions, such as parent marital status and parental engagement in treatment, remain unexplored. In the child development literature, being raised in a single-parent home has been linked to increases in child behavior problems, though this relationship diminishes after taking other factors into account, such as family income and parent mental health.²⁴ Marital status has also been found to have a small but significant effect on both attrition and treatment outcomes following parent training interventions for child behavior problems in non-TBI samples.²⁵ It was recently estimated that 25% of children in the US are growing up in single-mother households, and another 8% in single-father homes.^{26,27} These figures underscore single-parent led families as a sizable demographic warranting research attention, particularly given the relationship between marital status and child behavioral outcomes. One study examining family composition found that the presence of a parental partner living in the home (e.g., spouse, cohabiting partner) was associated with a lower risk for the development of behavioral problems at 3-months and 1-year after pediatric TBI; however, this protective impact was no longer significant 2-years post-injury.²⁸ Less is known about the effect of parent engagement on the emergence of behavior problems after pediatric TBI, as studies have generally included just one primary caregiver.

The purpose of this study was to examine the moderating effects of parent marital status (i.e., married vs single-parents) on the efficacy of the CAPS intervention for adolescents with TBI (Counselor Assisted Problem Solving; CAPS). Given literature suggesting a

protective function of two-parent led homes on adolescent behavioral outcomes, we expected that CAPS would be more beneficial in reducing adolescent externalizing behavior problems in single-parent homes compared to married households. In addition, we were interested in examining whether parent engagement (i.e., one versus two-parents in married households actively participating in sessions) would influence efficacy. Given limited literature on parent engagement and pediatric TBI outcomes, these latter analyses were exploratory in nature.

Method

Participants

Participants were recruited from three large tertiary children's hospitals and two general hospitals with Level 1 Trauma Centers. All locations were in central and western areas of the United States. Adolescents aged 12–17 years admitted for TBI were screened to participate, and inclusion criteria included: 1) hospitalization of at least one night due to TBI, 2) lowest Glasgow Coma Scale (GCS) score of 12 or below, or evidence of brain injury visible on computerized tomography (CT) or magnetic resonance imaging (MRI), 3) English as the main language spoken in the home, and 4) residence within a 3-hour drive from the hospital. Exclusion criteria included: 1) non-blunt head trauma, 2) history of child abuse, 3) parent hospitalization for a psychiatric disorder in the previous 12-months, 4) adolescent not residing in the family home, and 5) family living in an area that does not support high speed internet service. Adolescents with moderate or severe intellectual disability prior to injury were also excluded, as were adolescents who had not recovered sufficiently within the recruitment window to verbally participate in the study. A total of 308 adolescents were screened to participate of which 52 did not meet inclusion criteria, 72 were ineligible due to not being contactable within the 6-month recruitment period post-injury, and 52 declined to participate. The remaining 132 adolescents (aged 12 to 17 years: $M=14.47$ years, $SD=1.62$; 67% male) and their caregivers who provided consent completed the baseline assessment. Enrollment, group assignment, and attrition are detailed in the consort diagram presented in Figure 1. The study was approved by institutional review boards of all participating centers and was registered with clinicaltrials.gov (assigned number: NCT00409448).

Procedure

Soon after enrollment, study personnel blind to group assignment visited families in their home and completed baseline measures with adolescents and their parent/s. Baseline visits were conducted within 7-months of injury ($M=108$ days post-injury, $SD=53.39$). Families were randomly assigned (stratified by sex and race) to CAPS ($n=65$) or Internet Resources Comparison (IRC) conditions ($n=67$) described below. Families received a sealed envelope containing their group assignment after completing the baseline visit. Follow-up visits and data collection were conducted again 6-months, 12-months, and 18-months after baseline. Families in both groups were provided a computer, internet service, and a web-camera at the baseline assessment. This ensured that study personnel remained blind to treatment condition (at baseline and follow-up visits), and families in the CAPS and IRC groups had equal access to web-based resources.

Intervention conditions

Counselor-Assisted Problem-Solving Intervention (CAPS) Intervention—CAPS

is a web-based family centered problem-solving intervention designed to support adolescents and their parents within the first year following pediatric TBI. Given the family focus on the intervention, at least one parent was required to participate with their adolescent, and when there was a second parent/caregiver, they were also encouraged to participate, as were siblings living in the home. The program consisted of 8 core sessions addressing topics such as strategies to stay positive, problem solving, and staying organized. Families were also able to select up to 4 of 8 supplemental sessions based on their family's needs. Supplemental sessions included topics such as sleep hygiene, social skills, life after high school, and sibling issues.

The initial staying positive and problem solving sessions were grounded in D'Zurilla and Nezu's²⁹ problem-solving therapy model. Other core and supplemental sessions were developed based on needs identified in focus groups with adolescents and families affected by pediatric TBI, dialogue with service providers, and review of literature on the needs and outcomes of adolescents who have sustained a TBI. A key feature of the intervention was teaching adolescents and their families a 5-step problem-solving process (Aim, Brainstorm, Choose, Do, and Evaluate) to solve problems and achieve aims identified by the adolescent and family.

The first session took place in the family home with all subsequent sessions taking place via Skype. The first in-person session enabled the counselor to orient the family to the program and provide education on how to access sessions and use the web-camera. Subsequent sessions consisted of self-guided web content (i.e., psychoeducation, videos, and activities) that adolescents and their families accessed prior to their biweekly Skype session with their counselor.

All four study counselors were licensed clinical psychologists who participated in an intensive two-day training. Treatment fidelity and adherence was promoted through weekly supervision sessions and the use of a detailed manual providing step-by-step instructions on how to facilitate each session, and manage issues that may arise. Families were assigned to one counselor for the duration of the intervention. CAPS was designed to be completed within 6-months, with sessions taking place once every two weeks, and a final wrap-up session scheduled at 6-months.

The Internet Resource Comparison (IRC)—Families in the IRC condition were provided access to a web page that listed links to online resources pertaining to TBI including local and national chapters of the Brain Injury Association as well as sites specific to pediatric TBI such as the Brain Injury Partners and the Center on Brain Injury Research and Training. While families were not provided access to the web content of the CAPS intervention, information on the sites linked to the IRC website included some common topics such as working with the schools and handling stress.

Measures

Background and demographics—Primary caregivers participated in a background interview, and provided information about family income, relationship status, level of education, and employment status.

Adolescent emotional and behavioral functioning

Child and Adolescent Functional Assessment Scale (CAFAS): The CAFAS³⁰ is an examiner administered structured parent interview that is scored by trained raters. The CAFAS assesses adolescent functioning across 8 domains (e.g., school, home, community, and thinking). Functioning in each domain is assigned a score of 0 (no impairment), 10 (mild impairment), 20 (moderate impairment), or 30 (severe impairment). Scores across the 8 domains are totaled, yielding a Global Rating which ranges from 0 to 240. Global Rating scores of 50 and below are considered to be in the unimpaired range. The CAFAS has been widely used in pediatric research, and has established validity and strong interrater reliability. In this study, all CAFAS interviews were recorded and 10% were rated by two separate raters; with a resulting overall interrater reliability of 95%.

Child Behavior Checklist: The CBCL is a parent-report measure of adolescent mood and behavior. The Externalizing Behavior Problems scale, which was used in this study, captures severity of externalizing behavior problems (e.g., hyperactivity and aggression). Scores are reported at T-values with higher scores indicating higher levels of severity. A T-score of 63 is at the 90th percentile and in clinical settings a T-score of 70 and higher (>97th percentile) is considered clinically elevated, whereas scores falling between 65 and 69 are in the borderline clinical range.³¹ The CBCL has been recommended for use by the Pediatric TBI Common Data Elements workgroup³² and is widely used in research with other pediatric clinical and non-clinical samples.

Analyses

Families were separated into the following four-groups for analyses- Group 1: IRC single-parent home ($n=26$), Group 2: IRC married home ($n=40$), Group 3: CAPS single-parent home ($n=21$), Group 4: CAPS married home ($n=42$). Three primary caregivers who reported cohabiting with a partner were excluded from analyses (2 CAPS; 1 IRC). This decision was made due to conflicting literature on whether family stability and outcomes of adolescents from cohabiting families are more similar to those from married or single-parent homes.^{33,34} Single-parent families included parents who reported being divorced ($n=24$), separated ($n=6$), and never married ($n=14$). Among adolescents who spent time in two different households (e.g., children of divorced parents), single-parent household status was designated based on marital status of the parent in the household that the adolescent spent the most time, which was the home of the caregiver who participated in the intervention. In this sample, most primary caregivers in single-parent homes reported receiving no financial support from another parent (i.e., 60% CAPS and 62% IRC). All self-identified primary caregivers were mothers (i.e., biological, step, or adoptive), with the exception of one father (CAPS single-parent family). Primary caregivers in CAPS from both married and single-

parent households reported no change in marital status from baseline at the 6, 12 or 18-month visits.

One-way analysis of variance and Chi-square tests were used to examine group differences at baseline. General linear mixed-models (GLMM) analyses were used to examine differences in trajectories of adolescent outcomes across time for the four groups based on treatment assignment and parent marital status. The final models included the interaction of group by visit (i.e., baseline and 6, 12, or 18-months post-baseline); when a significant interaction between group and visit was present, post-hoc analyses examined differences of adolescent outcomes at 6, and 18-month post baseline. The 6 and 18-month time points were selected to capture differences immediately after the completion of the intervention and at the furthest data point post-injury. False discovery rate (FDR) adjustments were used to correct for multiple a priori contrasts. GLMM is suited to longitudinal data and has the advantage of including data from all participants, even if a family was not evaluated at each assessment point. Given prior research documenting effects of adolescent age, parent education, and family income on outcomes in TBI samples,^{18,20–23} we controlled for these variables by including them as covariates in the final models. All statistical analyses were conducted using SAS version 9.1.3.

Results

Group differences at baseline: One-way analysis of variance and chi square tests showed no between group differences at baseline for child age, sex, and age at injury, as well as time since injury, injury severity, and parent education. There were significant between group differences for child race and median family income at baseline, with Black/African American and single-parent households having lower incomes compared to married households. Please see Table 1 for a summary of these results and demographics by group. There were no significant between group differences for scores on the CAFAS or CBCL at baseline, and no significant differences in number of sessions completed for single-parent and married households in CAPS.

Mixed-models analyses: As depicted in Figure 2, there was a significant group X visit interaction for CAFAS scores ($p < .005$). Post-hoc analyses using false discovery rate (FDR) adjustments (for six planned comparisons; i.e., Group 1 vs. 3, Group 2 vs. 4; Group 3 vs. 4; at 6 and 18-months post-baseline) revealed that at 6-months, adolescents from married homes in CAPS had significantly lower CAFAS scores compared to adolescents from single-parent households in CAPS ($p < .005$). This trend continued at 18-months, with adolescents from married households in CAPS having lower CAFAS scores compared to adolescents from single-parent homes in CAPS ($p < .005$). In addition, adolescents from married households in CAPS were also displaying lower CAFAS scores relative to adolescents from married households in the IRC condition ($p < .01$). There were no significant differences in scores between adolescents from unmarried families in the CAPS and IRC groups at the 6 and 18-months visits.

Analysis of the externalizing behavior problems scale of the CBCL revealed a significant group X visit interaction ($p < .005$), as illustrated in Figure 3. Post-hoc analyses using false discovery rate (FDR) adjustments (for six planned comparisons as detailed above) revealed that at 6-months, CBCL scores of adolescents from married homes in CAPS were significantly lower than adolescents from both single-parent households in CAPS and married families in the IRC condition (all p 's $< .05$). At 18-months, adolescents from married households in CAPS continued to show significantly lower CBCL scores relative to adolescents from single-parents homes in CAPS. There were no significant differences in scores between adolescents from unmarried families in the CAPS and IRC groups at the 6 and 18-months visits.

Follow-up analyses—In order to examine the influence of parent participation on adolescent outcomes, we divided adolescents from married families in CAPS into two groups. Group 1 consisted of families where two parents participated in most sessions ($n=20$) and Group 2 consisted of married households where just one parent participated in most sessions ($n=22$). GLMM analyses were run similar to those comparing across four groups above. We found no significant group X visit interaction for CAFAS scores and no differences between the two groups any time point. While there was a significant group X visit interaction for CBCL scores, there were no main effects with no significant between group differences at any of the four visits.

Discussion

In this study, we examined the effects of parent marital status and parent participation on outcomes of a web-based intervention (i.e., CAPS) for adolescents who had sustained TBI and their families. Given that children/adolescents from single-parent households are at higher risk of externalizing behavior problems, we expected our intervention to have the greatest impact on this subset of families. Contrary to our expectations, adolescents from single-parent households did not experience gains for the intervention and tended to have the worst outcomes over the three follow-up visits. Single-parent households tend to have lower incomes than married households (as was noted in this sample) and a number of RCTs of web-based intervention for TBI have found that lower-income families tend to benefit the most from these interventions.^{18,20,21} Indeed, a study reporting on parent outcomes from this project found a moderating effect of family income with lower-income parents in the CAPS intervention experiencing the greatest improvements in psychological functioning.²² Family income was controlled in our analyses and our findings suggest that adolescents from single-parent households may not be poised to benefit from this intervention as much as the general population of lower income families including married households.

One potential explanation for our unexpected findings pertaining to marital status is that the intervention began within 6 months of injury, and it is possible that single parents experience high burden of injury at this early stage post-TBI due to frequent medical appointments and the need to manage injury burden, job, and home responsibilities on their own. Consequently, these single parents may have struggled to engage in the intervention and implement new plans while simultaneously balancing their other responsibilities and challenges. Married parents, who are able to share the burden of injury and other household

demands, may have been better positioned to participate and benefit from an intervention soon after TBI. These findings raise questions regarding the optimal timing of psychosocial interventions post TBI and whether treatment receptivity varies as a function of family characteristics. Single parents may be better able to benefit from family problem-solving training later in recovery after some of the acute demands have resolved. Alternatively, single parents may be better served by treatments that support their own problem-solving and coping rather than focusing on the parent-adolescent dyad.

The possibility that participation was viewed as an additional burden by single parents is also supported by data on study attrition. While there were similarities in overall attrition across the CAPS and IRC condition (i.e., 25% for CAPS and 21% for IRC), a closer look at attrition among the subgroups examined in this study showed that attrition tended to be much higher among single-parent households, particularly those in the CAPS intervention. Specifically, single-parent households randomized to CAPS had an attrition rate of 47%, while married households in CAPS has an attrition rate of about 19%. Among IRC families, single-parent led families had an attrition rate of 30% compared to 12% among two-parent families in the IRC condition. Differential attrition rates by marital status suggest that this is an area warranting further investigation. Indeed, rather than excluding or delaying participation of single-parent families, developing strategies to keep single-parent families engaged may help improve their outcomes. With regard to parent participation, we found no differences in outcomes among married families in CAPS where one or two parents participated in most sessions.

Another possible explanation of the findings among single-parent households relates to possible parenting inconsistency between homes. Specifically, among single-parent households, the intervention was offered to primary caregivers in the home where adolescents spent most of their time. A number of adolescents from single-parent homes had contact with another caregiver (and household), and it is possible that by offering the intervention to just one parent, differences in expectations between households were accentuated, resulting in increased conflict and adolescent behavior problems. Moreover, inconsistencies in parenting between households may have limited adolescent progress and also been a factor accounting for the high attrition rates among single-parent households.

Findings from this study need to be considered in the context of a number of limitations. First, families were recruited regardless of whether the adolescents who sustained a TBI demonstrated post-injury behavior problems. Intervention effects may have been larger had we excluded adolescents without elevated behavior problems at baseline. A second limitation is the relatively small sample of adolescents with severe TBI included in this study (about 40%). Children with more severe TBI are at higher risk of developing post-TBI behavior problems,⁵ and differences between the CAPS and IRC groups may have been more pronounced with a sample of more severely injured adolescents. A third limitation was that among adolescents from single-parent households who may have also spent time in another household (e.g., children of divorced parents), the intervention was only offered to the primary caregiver in the home that adolescents spent the most time. As such, inconsistencies in parenting and expectations between homes may have impacted intervention efficacy for this group of adolescents. A limitation related to the study design is

that families in the IRC condition did not have the same level of contact with research staff; hence the lesser attention received by this group, rather than the guidance and counseling received by the families in the CAPS conditions, may have contributed to group differences. Despite these limitations, this study is among the first to examine factors related to the efficacy of an interventions for pediatric TBI in the context of a randomized controlled trial and findings have implications for future studies with similar populations.

In summary, adolescents who have sustained a TBI are at heightened risk for post-injury externalizing behavior problems, which in turn may have adverse longer-term consequences for adolescents and their families. Interventions that address adolescent mood and behavior in the acute phase post-TBI may help to buffer escalating problems in adolescent behavior and family functioning. Web-based interventions such as CAPS may be a viable option for some families in the acute phase following injury but may not be a good match for all families. Findings from our study underscore the need to further investigate adolescent and family factors that may influence efficacy of interventions for pediatric TBI, in order to match families to treatments that will be most beneficial to them.

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Figure 1.
CAPS Randomized Controlled Trial CONSORT Flow Diagram

Figure 2. Depicts changes in CAFAS scores from baseline to 6-month, 12-month, and 18-month visits for the four study groups.

Figure 3.

Depicts changes in scores on the externalizing behaviors scale of the CBCL from baseline to 6-month, 12-month, and 18-month visits for the four study groups.

Table 1**Summary of Demographic Variables for Groups at Baseline**

	IRC single-parent (n=26)	IRC married (n=40)	CAPS single-parent (n=21)	CAPS married (n=42)	P-value*
Age at baseline (SD)	15.02 (1.75)	15.01 (1.81)	14.29 (1.48)	14.86 (1.75)	0.43
Age at injury (SD)	14.73 (1.74)	14.67 (1.82)	14.02 (1.54)	14.53 (1.74)	0.49
Time since injury at baseline (in years)	0.30 (0.13)	0.29 (0.14)	0.27 (0.15)	0.34 (0.17)	0.29
Gender (% Female)	38.46	37.50	28.57	33.33	0.88
Child Race/Ethnicity					
White	65.38	92.50	57.14	90.48	<0.05
Black/African American	30.77	5.00	28.57	2.38	
Mixed/Other	3.85	2.50	14.29	7.14	
TBI Severity (%)					
Moderate TBI	73.08	52.50	61.90	59.52	0.41
Severe TBI	26.92	47.50	38.10	40.48	
Primary Caregiver Education (%)					
High School or less	57.69	42.50	52.38	35.71	0.29
Some College & higher	42.31	57.50	47.62	64.29	
Income (%)					
< 40K	69.23	27.50	71.43	14.29	<0.05
40K–89,999	30.77	32.50	23.81	45.24	
>90K	0.00	40.00	4.76	40.48	
Number of CAPS sessions completed	n/a	n/a	8.25	8.85	0.33

Note: Numbers in parentheses are standard deviations

* p-values are based on Chi-square tests or F tests