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Health Costs Following Motor Vehicle Accidents: The Role of Posttraumatic Stress Disorder

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This pilot study examined whether posttraumatic stress disorder (PTSD) was associated with increased health costs following severe injury caused by motor vehicle accidents. Three groups of injury survivors were created from a larger sample—PTSD only, no-PTSD–low physical function, and no-PTSD–high physical function—and these groups were compared on health cost outcomes at 12 and 24 months. The presence of PTSD was associated with increased total health costs for both Year 1 and Year 2. However, PTSD, per se, did not independently contribute to total health costs. This study suggests that ongoing physical health problems must be considered in order to accurately assess the unique contribution that PTSD makes to health costs in the physically injured population.

There is a growing body of literature highlighting a close relationship between posttraumatic stress disorder (PTSD) and poor physical health (e.g., Schnurr & Green, 2004). Many studies report that PTSD (relative to no PTSD) is associated with lowered physical health status (e.g., Zatzick et al., 1997) and a greater utilization of health care services for physical health problems (e.g., MacDonald, Chamberlain, & Long, 1995). It is no surprise therefore that PTSD has been associated with increased health service costs (Walker et al., 2003).

Serious physical injury is responsible for more cases of PTSD in the general community than are most other traumatic events (e.g., Breslau et al., 1998). Few studies, however, have examined the impact of PTSD on health costs following such injuries. In one of the few studies, Chan, Air, and McFarlane (2003) examined health costs following motor vehicle accidents (MVA) and found that PTSD significantly contributed to increased overall health costs. However, this study failed to address the relationship between PTSD and the injuries sustained from the MVA. Although the majority of evidence suggests a weak (if any) relationship between the initial severity of the injury and subsequent PTSD (Mayou, Bryant, & Ehlers, 2001; Zatzick et al., 2002), the relationship between persistent medical problems and PTSD appears to be much stronger (Ehlers, Mayou, & Bryant, 1998). Thus, the level of persistent physical injury must be considered when examining unique health costs associated with PTSD in this population.

The aim of this study was to examine the relationship between physical health, mental health, and health service costs in injury survivors. To do this, data from a longitudinal study that examined mental health outcomes following physical injury were linked with health cost data. In order to control for the close relationship between PTSD and physical injury outcome, three groups were created from the sample of study completers: (a) a group with PTSD at 12 months postinjury (PTSD group), (b) a comparison group with no psychopathology and high physical functionality at 12 months (no-PTSD–high physical function),

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and (c) a comparison group with no psychopathology and low physical functionality at 12 months (no-PTSD–low physical function). Health service use costs were then compared across groups.

Method

Participants

Participants for this research were drawn from a longitudinal study of psychiatric outcomes following severe injury (O'Donnell, Creamer, Pattison, & Atkin, 2004). Participants were admitted consecutively to a Level 1 trauma service from 1999 to 2001, and had either no traumatic brain injury or mild traumatic brain injury. Of the 363 participants in the original study, 255 had been involved in an MVA. The mean age of the 255 participants was 37.32 years ($SD = 13.95$), and 67% were male. Their initial hospital stay was an average of 10.80 days ($SD = 9.34$) in duration and the mean Injury Severity Score (ISS; Baker, O'Neil, Haddon, & Long, 1974) was 14.26 ($SD = 9.62$). The ISS is derived from the Abbreviated Injury Scale (AIS; American Association for Automotive Medicine, 1990), an anatomically based system that classifies individual injuries by body region. A mean ISS of 14.26 falls within the moderate range ($10 <$ ISS score < 15) of injury severity (American College of Surgeons, 2004).

Measures

12-Month Health Outcomes

All 255 participants were assessed at 12 months postinjury for PTSD and other psychopathology. PTSD was diagnosed using the Clinician-Administered PTSD Scale (CAPS; Blake et al., 1998) for the *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)*. Affective, anxiety, and substance use disorders were assessed using the relevant modules of the Structured Clinical Interview for *DSM-IV* (SCID-IV; First, Gibbon, Spitzer, & Williams, 1996). Both structured clinical interviews were administered via telephone, which has been shown to be a valid administration strategy for the CAPS and SCID-IV (Aziz & Kenford, 2004; Cacciola, Alterman, Rutherford, McKay, & May, 1999). The structured clinical interviews were conducted by two mental health clinicians. Mental and physical health were measured by the Medical Outcomes Study 12-Item Short-Form Health Survey (SF-12; Ware, Kosinski, & Keller, 1995). The SF-12 is composed of two factors; the Physical Component Summary (PCS) and the Mental Component Summary (MCS), which measure limitations in physical functioning and in mental health, respectively. A lower score indicates a greater degree of dysfunction.

Health Costs

The Transport Accident Commission (TAC) is a state-government owned organization in Victoria, Australia that provides *no fault* treatment cost compensation for injuries that arise from MVAs. Twelve- and twenty four- months health costs were obtained from TAC and included four categories of costs: hospital, medical, paramedical, and psychiatric. The total health cost score referred to in this study was a composite score of hospital, medical, paramedical, and psychiatric costs. The psychiatric cost score was calculated by summating all psychological and psychiatric costs incurred postdischarge from the acute hospital setting.

Data Analysis

Participant consent was obtained for the original longitudinal study but this consent did not extend to health cost data. Therefore, to maintain confidentiality the TAC provided health cost data for each individual in each of the three groups without providing information that could be used to identify individuals. As a consequence, even though PTSD scores, SF-12, and health cost data were available for each participant, it was not possible to link any particular individual's PTSD score or SF-12 data to his or her health cost data. This had implications for data analysis (see below).

The three groups were created on the basis of participants' PTSD status and their level of physical functioning at 12 months. PTSD status was assessed by the CAPS and physical functioning was as measured by the PCS of the SF-12. The PTSD group ($n = 17$) comprised individuals who met diagnostic criteria for PTSD. The (two nonequivalent) nonpsychopathology comparison groups were created using a mean split on the PCS to designate a high physical functioning group (no-PTSD–high physical function, $n = 18$) and a low physical functioning group (no-PTSD–low physical function, $n = 18$). Both comparison groups were similar to the PTSD group in terms of age, gender, and ISS, and did not meet criteria for PTSD, major depressive episode (MDE), anxiety disorders, substance use disorders, or subsyndromal MDE/PTSD. Examining MCS (mental health) and PCS (physical health) scores confirmed that the groups differed on physical and mental health levels as intended. MCS scores for the PTSD

group ($M = 27.20$, $SD = 4.57$) were significantly lower than those for both the no-PTSD–high physical function group ($M = 52.71$, $SD = 7.18$), $t(29) = 12.21$, $p < .001$, and the no-PTSD–low physical function group ($M = 46.08$, $SD = 12.67$), $t(33) = 5.77$, $p < .001$. The two comparison groups were not significantly different on MCS scores, t (26.91) = 1.93, *ns*. The no-PTSD–low physical function group had significantly lower PCS scores than the no-PTSD–high physical function group, $t(34) = 4.53$, $p < .001$. Interestingly, the PTSD group ($M = 32.04$, $SD = 8.50$) had PCS scores significantly lower than the no-PTSD–high physical function group ($M = 47.90$, $SD = 8.82$), $t(39) = 5.42$, $p < .001$, but not significantly different from the no-PTSD–low physical function group ($M = 33.62$, $SD = 10.05$), $t(33) = 0.50$, *ns*.

Two repeated measures analysis of variance procedures were conducted to examine changes in health costs over time (within-subjects effect) between groups (between-subjects effect), one for total costs and one for psychiatric costs. As the group sizes were small, eta-squared estimates were also calculated to provide an indication of power.

Results

Consistent with the literature, the correlation between PTSD and initial injury severity (ISS) was not significant ($r = .01$), although that between PTSD and 12-month physical health (PCS) was significant ($r = -.27$).

Table 1 shows all the total and psychiatric (as well as the hospital, medical, and paramedical) health costs for Years 1 and 2 postinjury for each of the three groups.

For total health costs there were significant main effects for time, $F(1,50) = 98.52$, $p < .001$, $\eta^2 = .66$, and group, $F(2,50) = 4.81$, $p = .05$, $\eta^2 = .16$, but not for the interaction of time and group, $F(2,50) = 1.31$, $p = .278$, $\eta^2 = .05$. Hence, these results indicated that total health costs decreased over time for all groups in a similar fashion and that health costs varied between the groups. Post hoc Scheffe tests revealed that total health costs of the PTSD group were significantly higher than those of the no-PTSD–high physical function group ($p < .05$), but not significantly different from those of the no-PTSD–low physical function group. There was no significant difference between the total health costs of the comparison groups.

For psychiatric costs there was a significant main effect for group, $F(2,50) = 7.80$, $p < .01$, $\eta^2 = .24$, but not for time, $F(1,50) = 0.92$, $p = .343$, $\eta^2 = .02$, or the interaction of time and group, $F(2,50) = 2.94$, $p = .062$, $\eta^2 = .10$. Hence, overall psychiatric costs did not decrease significantly over time, regardless of group. However, post hoc tests showed that psychiatric costs for the PTSD group were significantly higher than both the no-PTSD–high physical function group ($p < .01$) and the no-PTSD–low physical function group ($p < .05$). Psychiatric costs did not differ significantly between the two no-PTSD groups.

Discussion

In the current study of MVA injury survivors, individuals with PTSD had significantly higher total health costs than individuals without PTSD. This, however, must be interpreted cautiously in the context of a very close

Table 1. Mean Scores and Standard Deviations for Health Costs in Australian Dollars Between PTSD and Comparison Groups

	PTSD (n = 17)		No-PTSD–High Physical Function (n = 18)		No-PTSD–Low Physical Function (n = 18)	
Costs	*M*	*SD*	*M*	*SD*	*M*	*SD*
Year 1 total	47,133	35,498	25,526	15,706	43,572	27,595
Year 2 total	12,203	11,425	1,181	2,059	8,080	6,354
Year 1 psychiatric	1,739	1,639	116	410	469	768
Year 2 psychiatric	1,540	1,434	194	823	887	1,535
Year 1 hospital	22,133	19,527	13,970	9,778	23,338	17,207
Year 2 hospital	1,341	2,328	31	130	1,941	2,435
Year 1 medical	12,259	10,210	7,534	5,831	11,583	8,576
Year 2 medical	2,614	2,634	521	1,026	2,637	2,296
Year 1 paramedical	11,003	14,420	3,906	3,830	8,182	6,422
Year 2 paramedical	6,708	8,727	435	725	2,615	2,399

Note. PTSD = posttraumatic stress disorder; Medical costs = medical costs incurred outside hospital admission excluding psychiatry; Paramedical = nonmedical health costs (e.g., physiotherapy, occupational therapy) excluding psychology; Psychiatric = psychology and psychiatry costs.

association in the current data between PTSD and low physical functioning at 12 months. The observation that the 12-month physical functioning of the PTSD group was similar to that of the low physical functioning group suggests an interrelationship between mental and physical health. Importantly, total health costs for the PTSD group were not significantly different from those of the low physical functioning group, suggesting that PTSD, per se, did not make a significant independent contribution to total health costs. This is somewhat surprising given the strong body of literature that shows that PTSD is associated with an increase in health service use and costs. Typically, however, these results have been reported for noninjured PTSD populations. It may be that any lowering of physical outcome (and associated increased health care costs) as a function of PTSD is inconsequential relative to ongoing persistent medical problems associated with severe physical injury.

Not surprisingly, PTSD made a significant contribution to psychiatric costs over time, although, even in the PTSD group, mental health treatment costs remained relatively low. Individuals with PTSD had significantly higher psychiatric costs than both comparison groups at 12 months, and these costs remained relatively stable over the 2-year period.

This study is limited by its small sample size and the large variations in health costs. Furthermore, the lack of individual-level health cost data prevented us from carrying out more powerful regression analyses. Our findings need to be replicated in larger samples where an individual's health cost and mental health outcome data are linked. The rate of PTSD in this study represents the lower end of the prevalence spectrum compared with other studies, and this has been discussed in a previous publication (O'Donnell et al., 2004).

In conclusion, although previous literature supports the notion that PTSD is associated with poor physical health outcomes and increased health service costs, the findings from this study suggest that caution is warranted. The current research suggests that the relationship between physical and mental health is complex and further population-specific studies are required before firm conclusions can be drawn about the health costs associated with PTSD. It may be speculated that the increased health service use costs reported among individuals with PTSD but no physical injury are attributable to somatization and a tendency towards nonspecific physical symptoms. In those with PTSD and severe physical injury, however, the costs of nonpsychiatric treatments are so high that the additional impact of health service use driven by the psychiatric condition is less detectable.

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