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Pain, Depression, and Physical Functioning Following Burn Injury

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Abstract

Objective—Little is known about how pain and depression after burn injury may influence long-term outcomes such as physical functioning. This prospective study examined associations between pain, depression, and physical functioning in a sample of burn injury survivors.

Design and Participants—Questionnaires assessing pain, depression, and physical functioning were completed by 64 (52% of original sample) adult burn survivors shortly after discharge from burn care and at 1- and 2-year follow-ups.

Results—Pain and physical functioning improved over the 2 years of the study, whereas depression levels were stable. Pain and depression were associated with poorer physical functioning over time, but associations varied according to the time span under consideration. Also, the association between pain and physical functioning was strongest among persons with higher depression scores.

Conclusions—Pain and depression may contribute independently to compromises in physical functioning. The co-occurrence of pain and depression represents even greater risk for reduced physical functioning over time among burn survivors.

Keywords

pain; depression; burn injury; functioning; quality of life

Advances in emergency services and acute burn care in recent decades have led to extraordinary improvements in survival rates following burn injury. Nearly 95% of the approximately 40,000 persons who are hospitalized for burn injuries annually in United States will survive (American Burn Association, 2007). Much greater variability is found when outcomes beyond survival are considered. For example, depression is well recognized as a significant problem following burn injury (Fauerbach et al 2007; Patterson et al., 1993). For most burn survivors, average scores on depression indices fall within the mild to moderate range (Choniere, Melzack, Rondeau, Girard, & Paquin, 1989; Thombs, Haines, Bresnick, Magyar-Russell, Fauerbach, & Spence, 2007; Wiechman et al., 2001). However, moderate to severe symptoms of depression have been found in 18% to 45% of burn survivors years after their physical injuries have healed (Pallua, Künsebeck, & Noah, 2003; Thombs et al., 2007; Wiechman et al., 2001).

Pain is another serious problem for burn survivors, particularly during the early phases of burn care when open wounds are being subjected to debridement and movement therapies (Summer, Puntillo, Miaskowski, Green, & Levine, 2007). In addition, pain remain a concern for years after burn injury wounds have closed Choniere and colleagues (1989) found ongoing pain concerns 35% of a sample of burn survivors who were at least 1 year after injury. Similarly, Dauber, Osgood, Breslau, Vernon, and Carr (2002) found that 52% of burn survivors who were

an average of 10 years after injury reported the presence of pain. Of those with pain, 45% reported that pain interfered with their daily lives (Dauber et al., 2002). Malenfant and colleagues (1996) found pain in over 36% of their sample and demonstrated that pain prevalence, did not vary greatly between 1 and 4 years after injury. Although noting that the average severity of pain was mild (3.4 on a 0–10 visual analogue scale) among burn survivors, Malenfant and colleagues (1996) point out that pain severity varied widely both within and between patients. For example, 19% of their sample reported average pain as severe.

Pain and depression obviously represent suffering for burn patients; thus, these conditions deserve attention in research and clinical settings. In addition, both pain and depression have been associated with other negative outcomes among burn patients. For example, two studies have demonstrated that elevated pain during -hospitalization for burn injuries is associated with poorer adjustment and reduced physical functioning up to 2 years after discharge from the hospital (Patterson, Tininenko, & Ptacek, 2006; Ptacek, Patterson, Montgomery, & Heimbach, 1995). Depression has been associated with reduced physical function (Thombs et al., 2007) and change in physical health over time (Thombs, Bresnick, Magyar-Russell, Lawrence, McCann, & Fauerbach, 2007) among burn patients.

Although past studies have clearly shown that pain and depression have prospective associations with physical functioning, much less is known about how these conditions might interact as predictors of functioning among survivors of burn injuries. Cognitive-behavioral theories of pain, depression, and functioning have emphasized that certain cognitive processes associated with pain and depression may make the co-occurrence of these conditions especially deleterious to functioning. For example, persons with pain and depression show enhanced memory for negative self-referent pain and illness information as compared with persons with pain who are not depressed (Pincus, Pearce, McClelland, & Isenberg, 1995). Vlaeyen and Morley (2004) have noted that co-occurring pain and depression may activate cognitive processes or “stop-rules” that guide a person toward completing or terminating a task. For example, following stop rules, a person may terminate a functional activity as soon as he or she no longer enjoys the task, perhaps due to pain perceptions. Understanding associations between pain, depression, and physical functioning is critical because burn survivors have considerable difficulties in returning to personal, social, and community roles after their injuries have healed (Costa et al., 2003; Esselman et al., 2001).

In summary, medical advances have ensured that the number of persons living with burn injuries will continue to increase, making it critical to learn more about how physical functioning is affected by common complications such as pain and depression. This study examined associations between pain and depression shortly after discharge from burn care and physical functioning at 1 and 2 years after discharge from burn care. We hypothesized that both pain and depression would independently be associated with physical functioning at 1 and 2 years after burn care. In addition, we hypothesized that the interaction of pain and depression would account for additional variation in postburn physical functioning. Specifically, we hypothesized that associations between pain and physical functioning would be strongest among burn survivors with higher levels of depression.

Method

Participants and Procedure

Study participants were adult burn survivors who received inpatient care at a regional burn center. Patients were eligible to participate in the study if they (a) were between ages 18 and 60 years, (b) spoke English, (c) were not experiencing acute suicidality or psychosis, and (d) were hospitalized for burns requiring at least 5 days of inpatient care. Patients were approached by a research study nurse within 48 hr of admission to the inpatient burn center to formally

provide consent to participate in the study and to collect medical and demographic information. After discharge, questionnaires were mailed to patients' homes at 1-month, 1-year, and 2-year time points. Of the 122 enrolled, 105 (86%) returned complete questionnaire packets at Year 1, and 64 (52%) returned complete questionnaire packets at Year 2.

Measures

Demographic information was collected from patients at the time of consent. Medical information including total body surface area (TBSA) of the burn injury was collected from the medical chart after consent was received. Mailed questionnaires included the following measures.

Physical functioning—Physical functioning was measured using the Physical Health scale of the Short-Form 36 Health Survey (SF-36; Ware, Snow, & Kosinski, 2000). The SF-36 is a 36-item self-report measure of physical and psychosocial functioning that has demonstrated good internal consistency and high test–retest reliability and validity through associations with other psychosocial indices (Ware et al., 2000). The Physical Health scale is scored from the following SF-36 subscales that reflect different aspects of functioning during the prior 4 weeks: Physical Functioning, Role Limitations Due to Physical Problems, and General Health Perception. For the purposes of this study, the Bodily Pain subscale was not used in calculating Physical Health scale scores. Physical Health scores range from 0 to 100, with higher scores representing better functioning.

Pain—The SF-36 (Ware et al., 2000) Bodily Pain subscale was used to measure pain severity and interference experienced during the prior 4 weeks. Respondents indicate how severe their pain has been in the prior 4 weeks on a 5-point scale where 1 means *not at all* and 5 means *very severe*. Similarly, the degree of pain interference with normal activities is rated on a 5-point scale where 1 means *not at all* and 5 means *extremely*. The two ratings are used to generate a score ranging from 0 to 100, with higher scores reflecting lower pain. For example, a score of 100 indicates no pain, and a score of 0 indicates the most severe pain possible on the scale. The Bodily Pain subscale of the SF-36 has demonstrated good reliability and validity (Ware et al., 2003).

Depression severity—The Beck Depression Inventory (BDI; Beck, Steer, & Garbin, 1988) is a 21-item questionnaire assessing symptoms of dysphoria that have been experienced in the past week. The reliability and validity of this measure are well established (Richter, Werner, Heerlein, Kraus, & Sauer, 1998). The BDI yields scores ranging from 0 to 63, with higher scores indicating greater depression severity.

Statistical Analyses

Distributions and residual plots of all variables were examined for assumptions of models, skewness, and influential data points. These examinations showed no serious violations of assumptions. Pearson correlations, *t* tests, chi-square analyses, and analyses of variance were used to examine associations between demographic and medical factors and key study variables.

Hierarchical regressions were used to examine associations between pain, depression severity, and functional outcomes (the Physical Functioning subscale from the SF-36). Two sets of regression equations were conducted. In the first set, 1-year physical functioning served as dependent variable, with pain and depression severity at 1 month serving as independent variables. In these regression equations, physical functioning measured at 1 month, gender, and TBSA were entered as control variables. Pain and depression severity were entered in one step as independent variables. In the final step of the model, an interaction term of Pain ×

Depression was entered to test for hypothesized moderating associations: Depression was hypothesized to function as a moderator of the association between pain and physical functioning. Similarly, in the second set of regression equations, 2-year physical functioning was the dependent variable, and 1-year values of pain, depression severity, and the interaction term of Pain $\times$ Depression were the independent variables, controlling for 1-year physical functioning, gender, and TBSA in the first step of the equation. Recommendations of Baron and Kenny (1986) were followed in tests of moderation.

Results

We compared participants excluded for incomplete data with respondents with complete data on demographic, pain, and functional outcomes available for analysis to help evaluate the representativeness of our sample. We used *t* tests for continuous data (age, TBSA, depression severity, physical functioning) and chi-square tests for categorical variables (gender, ethnicity, marital status, education, employment status). Participants with complete data did not differ from those with incomplete data on categorical or continuous study variables.

Demographic and Medical Characteristics

Demographic and medical characteristics of the sample are shown in Table 1. TBSA and demographic variables including age, marital status, ethnicity, employment, and education were not significantly related to depression, pain, or physical functioning (all *ps* > .25). However, women showed BDI scores higher than men at all time points (all *ps* < .001). Descriptive statistics for key study variables are displayed in Table 2. Depression scores did not change between 1 month after burn care, 1-year, and 2-year time points. Physical functioning and pain scores increased from 1 month to 1 year after burn care (all *ps* < .01), but did not increase between the 1-year and 2-year time points. In other words, physical functioning improved and bodily pain decreased, between 1 month after burn care and 1-year follow-up.

Regression equations involving associations between pain and depression at 1 month after burn care and physical functioning at 1 year after burn care are shown in Table 3. In equations controlling for gender, TBSA, and 1-month values of physical functioning, depression scores at 1 month after burn care were significantly associated with physical functioning at 1 year after burn care ($\beta = -.26, p < .05$). In these equations, higher depression scores were associated with lower physical functioning at 1 year after burn care. Pain scores at 1 month after burn care and the interaction of Pain $\times$ Depression at 1 month after burn care were not significantly associated with physical functioning at 1 year.

Regression equations involving associations between pain and depression at 1 year after burn care and physical functioning at 2 years after burn care are shown in Table 4. In equations controlling for physical functioning at 1 year after burn care, pain scores at 1 year after burn care were significantly associated with physical functioning ($\beta = -.25, p < .05$) scores at 2 years after burn care. In these equations, worse pain was associated with lower physical functioning. Depression scores at 1 year after burn care were not significantly associated with functional outcomes at 2 years after burn care. In the third step of the equations shown in Table 4, the interaction term of Pain $\times$ Depression at 1 year was a significant contributor of unique variance in 2-year physical functioning. The interaction term of Pain $\times$ Depression contributed an additional 8% of unique variance in physical functioning ($\beta = -.29, p < .05$).

In summary, the significant interaction in these results suggested that the associations between pain scores at 1 year and physical functioning at 2 years after burn care varied according to level of depression at 1 year. To graphically depict the nature of the interaction reported in Table 4, we substituted values 1 *SD* above and below the means for pain and depression into the final regression equation. Because the SF-36 Bodily Pain subscale is scored such that high

scores indicate lower pain, body pain scores were reversed in this figure to avoid confusion surrounding the meaning of high pain and high depression scores. The resulting regression lines constructed from these predicted values are shown in Figure 1. The figure demonstrates graphically that the associations between pain and physical functioning at 2 years after burn care were strongest among persons with higher depression.

Discussion

Pain and depression are notorious risk factors for functional disruption following burn injury. The present study has refined our understanding of functioning following burn injury by suggesting that (a) associations between pain, depression, and physical functioning may vary according to the time frame under consideration; and (b) pain and depression may have interactive effects on physical functioning following burn injury.

Between the month following discharge from burn care and the 1-year follow-up, pain and physical functioning appeared to improve and then remain stable up to 2 years after acute burn care. By contrast, mean depression scores in this sample were stable between 1 month, 1 year, and 2 years after burn care. Similarly, two prior reports from our research group have suggested that psychological distress is stable from the time of discharge from burn care to 2 years after the burn injury (Patterson et al., 2006; Wiechman et al., 2001). In addition, the Burn Model Systems study (Patterson, 2007), sponsored by the National Institute on Disability and Rehabilitation Research, found that pain levels decreased over the course of 1 year after burn injury, whereas suicidal ideation remained fairly stable (Edwards et al., 2007a). These patterns are curious because we might expect pain and depression to assume similar courses in a population because of bidirectional influences of these two conditions. In this regard, the present results may mirror prior findings that psychological distress after burn injury is not entirely attributable to the injury and its effects. Instead, a number of investigators have shown that psychological distress in the months and years following burn injury may be a function of vulnerabilities that were in existence prior to the burn injury, such as psychopathology (Patterson et al., 2006; Ward et al., 1987) and personality traits involving the tendency to experience negative affect (Lawrence & Fauerbach, 2003).

Our hypotheses regarding associations between pain, depression, and physical functioning were partially supported. Higher depression scores at 1 month after burn care were associated with poorer physical functioning at 1 year after burn care. By contrast, pain at 1 month after burn care was not associated with physical functioning at 1 year. Findings reversed when pain and depression at 1 year were examined as predictors of 2-year physical functioning. Pain at 1 year after burn care, but not depression, was associated with physical functioning at 2 years after burn care. In addition, the interaction of pain and depression at 1 year was associated with physical functioning at 2 years after burn care. These findings suggest that associations between pain, depression, and functional outcomes vary according to time since burn care. Depression appeared to be a better prospective predictor of functioning in the first year following burn injury, whereas pain and the interaction of pain and depression emerged as predictors of functioning only in the second year following burn injury. These findings might be interpreted in light of the demonstrated improving course of most pain scores over time in this sample. Those pain problems that did remain for years after burn injury could possibly reflect the development of complex chronic pain problems and related functional impairments.

The present results are comparable to past research. Edwards and colleagues (2007b) have previously reported that depression is a prospective predictor of functioning after burns in a large-scale study with follow-ups at 1 and 2 years after burn injury. Patterson and colleagues (2006) found that both pain and mental health at the time of discharge from burn care were prospectively associated with emotional and physical functioning at 1- and 2-year follow-up

points. In contrast with these two studies, the present research did not find pain and depression to consistently predict physical functioning over time points, likely because of methodological differences. The most critical difference between present research and past studies was the inclusion of both pain and depression in predictive models. This was especially important in revealing that pain and depression can interact toward explaining variance in 2-year physical functioning. Results suggested that the combination of pain and depression may be especially deleterious for physical functioning among burn patients. Similar findings have consistently been found in other medical populations, according to major literature reviews spanning decades of research (Bair, Robinson, Katon, & Kroenke, 2003; Banks & Kerns, 1996; Romano & Turner, 1985). Cognitive processes have been proposed to explain the demonstrated links between pain, depression, and physical functioning. For example, depression and pain may heighten the perceived threat of functional activities, resulting in cessation or avoidance of activities (Vlaeyen & Morley, 2004). Cognitive errors, such as catastrophizing, may serve to exaggerate the threat value of pain and the inadequacy of coping resources, subsequently affecting activity levels and functioning (Pincus & Morley 2001; Sullivan et al., 2001).

There are a number of limitations that should be considered when interpreting results of this study, most having to do with how well the present results might apply to other populations, constructs, and settings. First, use of postal survey methods raises questions of generalizability because a limited subset of the population is sampled and conditions under which the questionnaires were completed are unknown. Future studies might show improved response rates by recruiting participants in routinely attended clinical settings and supervising the administration of questionnaires. Furthermore, such methods would allow for the use of methods other than self-report for variables of interest. This study used well-known self-report measures of pain and depression, but results could differ in studies using other measures or methods such as clinical interviews. For example, depressive disorder diagnoses may show very different associations with pain and physical functioning. The demographic diversity of this sample was representative of the urban area in which the study was conducted, but was relatively limited compared to some areas of the United States.

Results of this study provide a better understanding of the importance of pain and depression toward physical functioning after burn injury. Clinicians caring for burn patients should remain vigilant for comorbid pain and depression as a possible marker for poorer functional recovery. Moreover, the assessment and treatment of these conditions are adversely affected by their co-occurrence (Banks & Kerns, 1996). Additional research is sorely needed to improve methods of understanding, assessing, and treating comorbid pain and depressive following burn injury.

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Figure 1. Associations between pain at 1 year after burn care and physical functioning at 2 years after burn care, by depression status.

Table 1

Demographic and Medical Variables (n = 64, 52% of Original Sample)

Variable	Statistic
Mean (<i>SD</i>) age at time of burn (<i>SD</i>)	40.51 (15.44)
Mean (<i>SD</i>) TBSA	16.78 (14.68)
Male (%)	78.00
Ethnic group (%)	
White	82.7
Hispanic/Chicano	4.4
Black	5.0
Native American	3.3
Asian	2.7
Other	1.9
Marital status (%)	
Married	39.4
Living with partner	2.5
Single	54.1
Other	4.0
Education (%)	
Grade 11 or lower	17.9
High school	53.1
Vocational/technical school	9.4
College graduate	5.5
Graduate degree	2.4
Unknown	11.7
Employment at time of injury (%)	
Working	61.4
Not working	27.4
Homemaker/caregiver	0.8
Retired	8.6
Unknown	1.8

Note. TBSA = total body surface area of burn.

Table 2

Descriptive Statistics for Key Study Variables Over Time (n = 64)

Variable	1 month		1 year		2 years	
	M	SD	M	SD	M	SD
Depression, men	10.33	9.37	8.37	8.48	9.67	9.81
Depression, women	15.43	11.94	13.58	12.48	15.13	14.39
Physical functioning	29.7	8.6	47.1	10.5	47.5	10.5
Bodily pain	27.1	20.4	67.0	24.9	67.8	28.2

Table 3

Associations Between Pain and Depression at 1 Month and Physical Functioning at 1 Year After Burn Injury (n = 64)

Variable	Multiple <i>R</i>	<i>B</i> (<i>SE</i>)	ΔR^2	<i>F</i> of <i>R</i> ²
Step 1	.11		.11	2.43
Gender		.07 (.14)		
TBSA		.22 (.13)		
Physical functioning, 1 month		.24 (.13)		
Step 2	.21		.09	3.25 *
Pain		.17 (.19)		
Depression		-.26 (.13) *		
Step 3	.21		.00	.09
Pain $\times$ Depression		.04 (.13)		

Note. $F(6, 58) = 2.32^*$. TBSA = total body surface area of burn injury.

* $p < .05$.

Table 4

Associations Between Pain and Depression at 1 Year and Physical Functioning at 2 Years After Burn Injury (n = 64)

Variable	Multiple <i>R</i>	<i>B</i> (<i>SE</i>)	ΔR^2	<i>F</i> of <i>R</i> ²
Step 1	.18		.18	3.86*
Gender		.20 (.11)		
TBSA		.16 (.12)		
Physical functioning, 1 month		.33 (.13)**		
Step 2	.22		.04	5.41*
Pain		.25 (.13)*		
Depression		.07 (.12)		
Step 3	.30		.08	5.41*
Pain × Depression		.29 (.12)*		

Note. $F(6, 58) = 3.53$. TBSA = total body surface area of burn injury.

* $p < .05$.