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Psychosocial responses to spinal cord injury as predictors of pressure sores¹

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ABSTRACT. Pressure sores are a preventable, but common, secondary complication of a spinal cord injury (SCI). Research is limited concerning the influence of psychological factors in the development of pressure sores. The purpose of our *ex post facto* study was to examine the role that emotional responses and coping strategies play in moderating the relationships between demographic and SCI-related medical variables and the frequency and severity of pressure sores. Ninety-five individuals, who sustained a sudden-onset SCI, completed a self-report questionnaire sent to the population of patients that received post-injury rehabilitation services at a rehabilitation center in the southern U.S. Multiple regression analyses indicated that depression significantly predicted pressure sore severity, whereas disengagement-coping significantly predicted pressure sore occurrence (although in the opposite direction than expected). An interaction of time since injury and depression influenced both pressure sore occurrence and severity. These results have important implications for rehabilitation professionals in the clinical evaluation and treatment of persons with SCI.

KEYWORDS. Spinal cord injury. Pressure sore. Depression. Coping. *Ex post facto* study.

RESUMEN. La úlcera por presión es una complicación secundaria común, aunque previsible, de la lesión de la médula espinal (LME). La investigación sobre la influencia

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de los factores psicológicos en el desarrollo de las úlceras por presión es limitada. El objetivo de nuestro estudio *ex post facto* fue examinar el rol de las respuestas emocionales y estrategias de afrontamiento en la moderación de la relación entre las variables médicas demográficas y relacionadas con la LME y la frecuencia y severidad de las úlceras por presión. Noventa y cinco individuos con LME de aparición súbita completaron un cuestionario autoinformado enviado a la población de pacientes que han recibido un servicio de rehabilitación después de la lesión en un centro de rehabilitación en el sur de los Estados Unidos. Análisis de regresión múltiple indicaron que la depresión predijo de forma significativa la severidad de la úlcera por presión, mientras que el afrontamiento por abandono predijo su ocurrencia (aunque en la dirección opuesta a la esperada). La interacción del tiempo desde la lesión y la depresión influyeron tanto en la ocurrencia como en la severidad de las úlceras por presión. Estos resultados tienen importantes implicaciones para los profesionales de la rehabilitación, evaluación clínica y tratamiento de las personas con LME.

PALABRAS CLAVE. Lesión de la médula espinal. Úlcera por presión. Depresión. Afrontamiento. Estudio *ex post facto*.

When a sudden-onset spinal cord injury (SCI) occurs, there are often multiple levels of trauma to address, including acute medical issues, new functional limitations, psychological reactions (*e.g.* anger, anxiety, depression, and denial about the permanency of the condition), distressing memories related to the traumatic event causing the SCI, and possible role changes caused by the SCI (Livneh and Antonak, 1997; Martz and Livneh, 2007). Several types of medical threats or secondary complications can accompany the occurrence of a SCI, including spasticity, pain, autonomic dysreflexia, and pressure sores (Cardenas and Warms, 2006). The purpose of this research is to examine whether specific psychological variables, namely, psychosocial reactions to SCI and coping strategies, predict the frequency and severity of pressure sores.

Pressure sores (also known as decubitus ulcers or pressure ulcers; hereafter denoted as PS) can cause a wide range of problems, which may lead to additional disabilities, including amputations (Krause, 1998a). For decades, clinicians viewed the development of PS as «inevitable» after the onset of SCI. The current medical view is that PS are a common (Haisma *et al.*, 2007), but fundamentally avoidable problem after the onset of SCI (Senelick, 1998), especially when individuals are engaged in health-promoting behaviors and avoidance of harmful, self-destructive behaviors, such as the use of drugs and alcohol (Krause, 1996). Yet, PS can be life-threatening, even with the best medical care (Krause, 1996; Yarkony and Heinemann, 1995), which is one reason why additional research on prevention is needed.

When a sudden-onset SCI occurs, it may be dually traumatic for individuals: both as a psychological trauma and a medical trauma and hence, may result in «co-morbid» or co-existing disorders. Individuals may experience a range of psychological reactions to SCI over months and years (Livneh and Antonak, 1997). Because PS are one secondary complication of SCI that often are medically preventable or treatable and because the

cooperation of an individual with SCI is needed to prevent PS from developing (Yarkony and Heinemann, 1995), research is needed to explore what, if any, effects do psychological reactions and processes have on decreasing the development of PS after SCI onset. While excellent medical research is available about how to prevent PS and some of the medical-related risk factors (Chen, De Vivo, and Jackson, 2005; Garber, Rintala, Hart, and Fuhrer, 2000) and health-related behaviors (Krause and Broderick, 1998; Krause, Vines, Farley, Sniezek, and Coker, 1998), there is a paucity of research about the influence of psychological factors on preventing the secondary complications of PS (Anderson and Andberg, 1979; Elliott, Bush, and Chen, 2006; Temple and Elliott, 2000). Hence, the purpose of this research is to examine whether selected psychological variables (coping strategies and reactions to the onset of and experience of SCI) predict the occurrence and severity of PS among individuals with SCI.

The present research is distinct from previous work (*e.g.* Elliott *et al.*, 2006) that examined the relationship between problem-solving coping and PS by the present study's broader focus on the relationships between: a) a wide range of coping strategies and b) reported psychosocial experiences following SCI and the occurrence and severity of PS. In addition, Elliott and colleagues' study focused on problem-solving orientation and skills, but did not purport to measure individuals' coping.

Occurrence of pressure sores after SCI

Data from the SCI model systems indicate that the instances of PS averaged 31.90% among individuals with SCI across 20 years of available data (Yarkony and Heinemann, 1995). When examining data from 834 individuals with SCI in England, Whiteneck *et al.* (1992) found that among the 19,000 medical diagnoses given to people with SCI, the most frequently occurring diagnosis was a pressure sore.

Fuhrer, Garber, Rintala, Clearman, and Hart (1993) investigated PS among 140 individuals with SCI living in the community and found that 33% of the sample had at least one pressure sore and of that number, 42.20% of the individuals, representing 13.60% of the total sample, had a severe pressure sore (classified in 4 stages, for which Stage III and IV were considered severe). In a study that examined life adjustment among 1017 individuals with SCI, Krause (1998a) found that 46% of participants had at least one pressure sore.

Pressure sores after SCI are estimated to range between 30 to 40% during acute care or post-injury rehabilitation, and between 8 to 30% among individuals with SCI who reside in the community (Consortium for Spinal Cord Medicine, 2000). The National Spinal Cord Injury Statistical Center's (2005) data ($N = 23,683$) indicated that 10.60% of individuals with SCI had PS during rehabilitation. The above information reflects that PS is a frequent, but treatable, secondary condition related to SCI.

Socio-demographic and disability-related predictors of pressure sore development

Several studies have been conducted that examined the association between PS and demographic and disability-related variables. Fuhrer *et al.* (1993) investigated multiple aspects of PS among 140 individuals with SCI living in the community. They found a significant difference between the group with PS and those without sores on both a

motor index scale, for which those with a PS had lower scores on both motor index and functional independence measures. Fuhrer and colleagues also found in this sample that significantly more African-American individuals than Caucasian individuals had PS. In addition, there was a significant difference in age of onset of SCI among the categories of severity of PS, with a younger mean age of onset for those with PS stages I or II (less severe), as compared to those with PS stages III or IV (more severe).

Yarkony and Heinemann (1995) conducted a logistic regression analysis of PS development using data from the SCI model system database. The results indicated that none of the demographic and disability-related variables in their study (*i.e.* etiology of the SCI, level and completeness of SCI, motor and cognitive functioning, age, race, education, gender, employment) predicted PS development. Post, de Witte, van Asbeck, van Dijk, and Schrijvers (1998) found no difference in the number of PS reported by type of SCI (*i.e.* paraplegia versus tetraplegia), nor by incomplete versus complete injury status.

Among 1017 individuals with SCI, Krause (1998a) found that two disability-related variables were significantly related to the existence of PS: level of injury, for which a higher level of injury was related to a greater likelihood of developing PS, and the completeness (*i.e.* permanent loss) of an injury, where complete injuries were related to a greater likelihood of developing PS. Supporting Krause's findings, Elliott (1999) found that individuals with a complete SCI were almost ten-fold more likely to have a PS than individuals with an incomplete SCI, and Herrick, Elliott, and Crow (1994) found that a higher level of injury was associated with a greater likelihood of a PS.

McColl, Charlifue, Glass, Lawson, and Savic (2004) found that women with SCI reported significantly more «days down from pressure ulcers» than men. In their longitudinal three-year study, Elliott *et al.* (2006) found that the occurrence of PS among individuals with SCI was positively associated with age. In this study, men were more likely to have PS than women. The completeness of a SCI also was significantly related to the existence of PS.

Several studies have found that one particular disability-related characteristic - time since injury (TSI) - was related to pressure sore development (Chen *et al.*, 2005; Garber *et al.*, 2000; Herrick *et al.*, 1994; Krause and Broderick, 1998). Krause and Broderick found that TSI was a significant predictor of recurrent PS among 826 individuals with SCI. Chen and colleagues, examining a sample of 3,361 individuals with SCI, found a significant increase in the total number of PS (stage II or greater) with the longer time post-injury (ranging from 1-to-15 years). Garber and co-workers found that among 118 men with SCI, TSI was reported to be a significant predictor of pressure sore existence in the first phase of the study and in a 3-year follow-up study. In contrast to these findings, in a discriminant function analysis that examined problem-solving and secondary complications among 53 individuals with SCI, Herrick *et al.* (1994) found that a lesser TSI was significantly correlated with a greater likelihood of a pressure sore. In the aforementioned longitudinal study, Elliott *et al.* (2006) observed that the instances of PS typically occurred more frequently in the first year and then decreased over the three-year period of the study, which concurs with Herrick *et al.* (1994) study.

The above conflicting findings about the roles that socio-demographic and disability-related variables have in the development of PS suggest that more research is needed in this area. Further, the lack of strong associations between socio-demographic and disability-related variables (*e.g.* severity of injury) and PS also suggests the need to investigate whether psychological variables may play a contributory role as risk or protective factors in the development of PS. Indeed, Krause and Broderick (1998) advised that problem-solving and coping variables need to be investigated in the context of pressure sore development. Elliott *et al.* (2006) also suggested that socio-demographic and disability-related variables «may have less predictive value once cognitive-behavioral characteristics are taken into account» (p. 75) and thus, psychological variables should be included when examining predictors of PS.

Psychological factors related to pressure sores

Limited data are available on the possible role that psychological factors play in the development of PS, yet the possible association has been noted for decades. Kerr and Thompson (1972) commented that for individuals with SCI who repeatedly return to the hospital with PS, their psychological problems should take precedence over their biological ones, because their psychological states may be contributing to the development of PS, such as by lack of self-care.

Anderson and Andberg (1979) investigated whether psychosocial factors played a role in the existence of PS, noting that the existence of PS is not evenly distributed among the population of individuals with SCI. They did not find support for their «mechanical skin-problem model,» which proposed that the greater severity of disability (*i.e.* tetraplegia) would be related to more PS. Instead, they found that individuals with tetraplegia or paraplegia, who were able to maintain the integrity of their skin, had higher levels of life satisfaction, responsibility for skin care, and self-concept than those who had a history of PS (measured in number of days lost per year due to PS). Individuals with lower levels of life satisfaction, responsibility for skin care, and self-concept were found to have persistent PS problems. This research suggests that psychological factors heavily influence the development of PS.

McColl and Rosenthal (1994) found that depression was significantly and negatively related to emotional support and positively to the presence of health complications, which included PS. They reported that their sample of individuals with SCI had an average of almost three health complications, in addition to the SCI. Post *et al.* (1998) found that the existence of PS was significantly associated with scores on the physical dimension of functional status (*i.e.* higher scores, which reflected poorer functioning, among individuals reporting PS) and the total score on life satisfaction (*i.e.* higher scores, reflecting greater satisfaction, among individuals reporting no PS).

Krause (1998a) found that life adjustment was significantly and negatively correlated with PS severity and days impacted by PS. Krause *et al.* (1998) found that suicide ideation and suicide attempts were risk factors for hospitalization due to PS. Although these researchers did not measure specific psychological variables in their study, these associations may reflect a psychological state of negative affectivity (*i.e.* depression, anxiety, anger), in which individuals maintain health behaviors that negate self-care

practices needed to prevent PS. In a different study, a comparison between individuals with and without PS indicated that individuals without PS had higher scores on 6 of the 7 Subjective Well-Being scales (Krause, 1998b), including engagement, and lower scores on negative emotions and health problems than those who had PS.

Widerström-Noga, Felipe-Cuervo, Broton, Duncan, and Yeziarski (1999) found that greater feelings of sadness were significantly associated with a higher frequency of PS among individuals with SCI living in the community. Finally, Smith, Guihan, LaVela, and Garber (2008) also reported a positive association between depressive symptoms and reporting of PS. Research by Temple and Elliott (2000) indicated that the occurrence of psychological disorders (as measured by the Millon Clinical Multiaxial Inventory; Millon and Davis, 1996) were not associated with the existence of PS among two groups of individuals with SCI. In contrast, Lidal and colleagues' (2007) retrospective study among 387 individuals with sudden-onset SCI indicated that the highest relative risk (RR) of death was the existence of pre-injury psychiatric disease (RR = 7.17). The researchers concluded that greater attention should be directed to co-morbidity (*e.g.*, co-existing physical and psychological disorders) and treatable factors among those with SCI.

Coping, adaptation, and pressure sores

While there are many definitions of coping, one of the most well-known ones views coping as «constantly changing cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person» (Lazarus and Folkman, 1984, p. 141). Compared to coping, psychosocial adaptation to SCI can be viewed as a longer-term outcome that reflects psychological equilibrium, and emotional, cognitive, and behavioral acceptance of the existence of SCI (Livneh, 2001; Livneh and Antonak, 1997).

There is little research on the relationship between PS and psychosocial coping, although there is some solid empirical research on coping with SCI (see Livneh, 2000, and Martz and Livneh, 2007 for a review). Elliott (1999) examined demographic and 5 social problem-solving variables as predictors of pressure-ulcer development among individuals with SCI. He found that only completeness of the SCI, and none of the problem-solving variables, significantly predicted a pressure-ulcer diagnosis. In a different study, Elliott *et al.* (2006) also investigated the association of 5 forms of problem-solving abilities -using the Social Problem-Solving Inventory-Revised (SPSI-R; D'Zurilla, Nezu, and Maydeu-Olivares, 2002) - and the occurrence of PS among individuals with SCI. When analyzing their longitudinal data, they found that the use of rational problem-solving at discharge from an in-patient rehabilitation unit significantly predicted a lower likelihood of occurrence of pressure ulcers in the subsequent 3 years. A path analysis supported the inverse association between problem-solving abilities (a composite of all 5 subscales of the SPSI-R) and the occurrence of pressure ulcers, indicating that the greater the problem-solving abilities, the less likely the occurrence of PS.

While solid research exists on coping with and adapting to SCI as separate topics, little research has been conducted that examined the associations between coping with and adaptation to SCI. Martz, Livneh, Priebe, Wuermsler, and Ottomanelli (2005) examined predictors of psychosocial adaptation among individuals with SCI and found that

negative emotional responses (*e.g.* depression, anxiety), disengagement-type coping (*e.g.* disability denial, avoidance), and the severity and impact of disability were related to lower levels of adaptation. This study did not examine the association with PS. An unpublished analysis of the SCI data ($N = 317$) that were used in Martz *et al.* (2005) study indicated that there was a significant correlation (using Spearman's rho for non-parametric data) between the existence of PS in the past month and anxiety ($r = -.142$, $p < .018$, using a pressure sore coding of 1= yes and 2= no). The result reflected that greater anxiety was significantly associated with the existence of a PS. There were 2 additional variables, reflecting psychosocial adaptation, which exhibited a trend toward significant correlations with the existence of PS: depression ($r = -.115$, $p < .055$) and externalized hostility ($r = -.116$, $p < .053$). These preliminary findings suggest that the relationship between PS and psychosocial factors is worthy of further study.

In view of the paucity of research on the association between PS and psychological factors, and the life-threatening impact that PS may have on SCI survivors, the purpose of this *ex-post facto* research (Montero and León, 2007; Ramos-Álvarez, Moreno-Fernández, Valdés-Conroy, and Catena, 2008) was to examine whether specific psychological variables, namely, psychosocial reactions to SCI and coping strategies predict the frequency and severity of PS. In view of the fact that neither the occurrence of PS, nor the employment of coping strategies can be experimentally manipulated, an *ex-post facto* design appears to be best suited for carrying on the objectives of this study. It is hypothesized that proactive (*i.e.* engagement) coping strategies, which focus on SCI-related issues, will be associated with lower occurrence and lower severity of secondary complication of PS among individuals with SCI. It is also hypothesized that passive (*i.e.* disengagement) coping strategies and non-adaptive psychosocial reactions will be associated with higher occurrence and higher severity of the secondary complication of PS among individuals with SCI.

Hypotheses

- Greater levels of negative psychosocial reactions to SCI (depression) will predict a higher occurrence of and a higher severity of pressure sores (PS). In the absence of empirical data on the relationship between a second negative reaction to SCI (anxiety) and PS, we merely sought to examine the relationship between the two, but offer no hypothesis on the nature of this relationship.
- Greater levels of «engagement-type» coping (*e.g.* problem-solving, planning, seeking social support) will predict a lower occurrence of and a lower severity (stage) of PS.
- Greater levels of «disengagement-type» coping (*e.g.* venting, self-blame, denial) will predict a higher occurrence of and a higher severity (stage) of PS.

Because of the mixed results pertaining to the influence of organismic (socio-demographic and disability-related) characteristics and psychological variables on the development of PS, an additional research question was posed, namely: Do psychological variables (reactions, coping strategies) moderate the influence of organismic variables (age, gender, SCI severity, and time since injury) on the occurrence and severity of PS?

Method

Participants

The sample under investigation consisted of individuals who had incurred a sudden-onset SCI and who received services at a rehabilitation center in the southern U.S. Of the 635 individuals with spinal cord injuries who were sent a letter inviting them to participate, 8 were reported as deceased, and 74 surveys were returned as undelivered; out of 553 that were delivered, 95 responded (17% response rate). A series of power analyses were conducted and they revealed that an adequate sample size considering both $\alpha = .05$ and $.10$; power = .80; effect size = .15 –medium level for 6-8 variables in multiple regression analysis (MRA)– would be in the range of 85 to 98 participants.

This sample consisted mainly of men (71.30%), which is a typical proportion in SCI populations. The average age of participants ranged from 17 to 85 years ($M = 47.50$, $SD = 17.60$). The formal education of this sample was 12.80 years, $SD = 1.80$ (*i.e.* some post-high school education). The majority reported a marital status of not-married (*e.g.* single, divorced, or widowed; 59.60%), followed by married (40.40%). The participants of this study described themselves as Caucasian (67%) or non-Caucasian (33%). The work status reported by participants was 16.10% employed and 83.90% not employed.

The causes of the spinal cord injury were reported as 51.10% motor vehicle accident, 16% falling, 13.80% other, 8.50% gunshot, 5.30% tumor, and 5.30% diving. The age at the time of spinal cord injury ranged from 14 years to 81 years ($M = 39.40$, $SD = 18.04$, Median = 37.50). The duration of the disability ranged from 0 to 39 years ($M = 7.50$, $SD = 6.80$). The level of SCI was categorized into tetraplegia (T1 up through C levels; 50%) or paraplegia (T2 down to L/S levels; 50%).

While some of the surveyed sample did not return the questionnaires, the respondents appear to be representative of the traumatic SCI population that is served by the study center (77% men; 58% Caucasian; 45.30% with a high school education, and 15.50% above high school education; 59.10% not married at the time of SCI; cause of spinal cord injury: 55.70% motor vehicle accident, 22.60% falling, 12.20% violence, 6.50% sports, including diving; mean age at the time of injury: 38.20 years ($SD = 17.50$); level of injury at the time of rehabilitation discharge: 66% tetraplegia).

The average number of PS in the past month (frequency) was $M = .23$ ($SD = .63$), Median = 0. In response to the question, «*What is the estimated total number of PS you have had since your SCI onset?*» participants reported a mean total number of PS of 2.27 ($SD = 4.77$) Median = 0. In response to the question, «*What is the severity of the worst pressure sore that you have had in the past month?*» (*i.e.* on a scale of 0-4, for which 0 is no pressure sore, 1 is minimal/surface, and 4 is the deepest pressure sore), the average of participants' responses was a minimal/surface severity ($M = .52$, $SD = 1.18$). In response to the question «*If your spinal cord injury was caused by a traumatic accident, did you lose consciousness at time of injury?*» 53.80% said no, 46.20% said yes.

In response to the question about the total number of traumatic events, «*In your lifetime, how many extremely traumatic and/or life-threatening events have you experienced that are not associated with the occurrence of your spinal disorder?*» (examples include being robbed, being a hostage, being raped, being in car accidents

or natural disasters), participants responded with an average of greater than one ($M = 1.40$, $SD = 1.20$). When asked if the SCI occurrence was the most traumatic event that they ever experienced, 70.10% said yes, whereas 29.90% said another event was more traumatic. Of this sample, 94.70% indicated no military service, while 5.30% reported that they served in the military.

Procedure

Approval of the proposed research was obtained from 2 Institutional Review Boards before beginning the study. Participants were recruited in the following manner. Hospital records and the rehabilitation hospital's SCI research database were screened to determine eligibility for participation in this investigation. The inclusion criteria consisted of being an adult (*i.e.* $e \geq$ age 18), and having received in-patient rehabilitation services following spinal cord injury at the study center. No other restrictions existed for demographic variables, such as gender or ethnicity. A single exclusion criterion was used for selection of respondents. Participation in this study was restricted only to those individuals with SCI whose injury was not associated with a predominant traumatic brain injury.

The individuals who met eligibility requirements were sent a packet of information, including a brief written overview of the study, consent form, demographic questionnaire, a battery of self-report measures, and a return envelope. Documents clearly explained to potential participants the associated minimal risks for taking part in this investigation, as well as the established procedures for maintaining the anonymity of participant and the confidentiality of personal health information. Individuals, who returned their signed consent form and completed questionnaires, were included in the study. Incentives in the form of \$5 gift cards were sent to participants when they returned the packet. The data were de-identified when entered into the database to ensure respondent confidentiality, and all documents were stored in a secure location on the premises of the collection site.

Instruments

Information on the existence of PS was assessed on the demographics form, along with the standard demographic questions (*e.g.* gender, ethnicity). The presence of PS was measured as the frequency of new PS in the past month. The severity of PS was measured by a 0-4 scale (see Participants section). This scale is based on the severity categorization of a pressure sore (stage 1 as minimal skin effects and stage 4 as the most destructive type of pressure sore); these 4 stages are commonly used to categorize the severity of PS (Consortium for Spinal Cord Medicine, 2000; Shea, 1975; Yarkony, 1994).

The following self-report psychological instruments were mailed to all potential participants as part of the assessment battery.

- Adaptation to disability was measured by the Reactions to Impairments and Disability Inventory (RIDI; Livneh and Antonak, 1990). The RIDI is a 60-item, multidimensional measurement instrument that uses a Likert scale with a 4-point range 1 (*the reaction is never experienced*) up to 4 (*the reaction is frequently experienced, 10 or more times a month*) with 8 subscales: *Shock, Anxiety,*

Denial, Depression, Internalized Anger, Externalized Hostility, Acknowledgment, and Adjustment. The Cronbach coefficient alpha values have been reported to be the following for the eight subscales: *Shock* = .77; *Anxiety* = .79; *Denial* = .70; *Depression* = .79; *Internalized Anger* = .79; *Externalized Hostility* = .80; *Acknowledgment* = .75; and *Adjustment* = .83 (Livneh and Antonak, 1997). In this sample, the Cronbach coefficient alpha values of the two subscales that were used were the following: *Anxiety* = .81; *Depression* = .84. Data on this measure's construct validity and test-retest reliability indicate that scores on the RIDI appear to adequately reflect psychosocial adaptation to CID, as well as demonstrate temporal stability over short periods of time (Livneh and Antonak, 1997, 2008).

- Coping was assessed by the Brief COPE Scale (Carver, 1997). The Brief COPE Scale is a 28-item instrument that uses a Likert scale - 4 point range, from 1 (*I have not been doing this at all*) to 4 (*I have been doing this a lot*) and that includes 14 coping subscales, each of which contained 2 items. Data provided by Carver on the Brief COPE scale, which is a derivative of the original COPE Scale, indicate that the subscales of this measure possess adequate internal reliability and criterion-related validity estimates. An exploratory factor analysis (EFA) was conducted on the subscales of the Brief COPE Scale, in order to facilitate interpretation of this study's results. An initial principle-components analysis, followed by both varimax and oblimin rotations (the latter explored the assumption that the factors might be correlated), was performed on the 14 subscales. The results from both analyses indicated 3 factors with eigenvalues greater than one, explaining 54.36% of the variance of the Brief COPE scale. Inspection of the item-content suggested that Factor 1 involved coping through engagement and consisted of these subscales: *Self-distraction, Active coping, Substance use, Positive reframing, Planning, Humor and Acceptance* (due to lack of content fit, the substance-use subscale was dropped from this factor). Factor 2 reflected disengagement-type coping and consisted of these subscales: *Denial, Behavioral disengagement, Venting, and Self-blame*. Factor 3, which indicated social support, consisted of these subscales: *Emotional support, Instrumental support, and Religion*. The three factors were correlated in following manner: engagement and disengagement, $r = .09$, engagement and social support, $r = -.18$, disengagement and social support, $r = .09$. Although no a priori hypotheses were formed regarding the possible relationship of factor 3 (social support) and PS frequency or severity, all three Brief COPE-extracted factors were used to investigate the influence of coping strategies on PS severity and frequency.

Results

The research questions were approached through a series of multiple regression analyses. Prior to examining the research questions, a factor analysis was conducted on the Brief COPE Scale to examine its factorial structure within this sample of people with SCI (reported above). Following this analysis, the skewness and kurtosis for each variable were examined. Only the *Time Since Injury* (TSI) variable was found to violate

normality assumptions, and thus, only one transformation was conducted on the variables. A square root transformation rendered the transformed variable acceptable (skewness = .33, kurtosis = .74).

The scores on both dependent variables, a) presence of PS in the past month and b) severity of PS during past month, were collapsed into dichotomous categories that provided enough data for analyses: to scores of 0 for: a) no occurrence of PS in last month, or b) severity level of PS judged to be below minimal, indicating severity of 0, and scores of 1 for: a) presence of least one PS in the past month or b) level of PS severity graded from 1 (*minimal*) to 4 (*deepest*) during the past month. The zero order correlation matrix of the 11 variables included in the study (pressure sore presence, pressure sore severity, gender, age, SCI level, time since injury, anxiety, depression, engagement coping, disengagement coping, and social support coping) is displayed in Table 1.

TABLE 1. Means, standard deviations, and zero-order correlations of the 11 variables included in the study.

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1. Press Sore per Month	.23	.63	1										
2. Press Sore Severity	.52	1.18	.81**	1									
3. Gender	-	-	.20	.16	1								
4. Age	47.47	17.61	-.04	-.08	.20	1							
5. SCI level	1.50	.50	-.13	-.11	-.15	-.12	1						
6. Time Since SCI	2.46	1.20	.26*	.23*	.08	-.01	-.08	1					
7. Anxiety	14.35	5.20	-.03	.03	-.16	-.26*	.10	.08	1				
8. Depression	14.60	5.43	.10	.22*	-.11	-.12	.14	.21*	.65**	1			
9. Engagement	32	7.18	.00	.04	-.06	-.37**	.06	-.11	.04	-.02	1		
10. Disengagement	13.14	4.88	-.08	.10	-.03	-.24*	.05	.09	.47**	.62**	.11	1	
11. Social support	16.14	4.63	-.06	-.03	-.14	-.06	-.20	-.18	-.03	-.22*	.44**	.03	1

Note. ** Correlation is significant at the .01 level (2-tailed). * Correlation is significant at the .05 level (2-tailed).

Results from the first-order correlation matrix of the study variables indicated the following significant correlations: a) PS frequency in the past month – $n = 0$ vs. $n \geq 1$; hereafter referred to as presence of PS – was positively correlated with TSI ($r = .26, p < .05$) and b) severity of PS in the past month – severity = 0 vs. some reported level of severity (1 to 4); hereafter referred to as perceived severity during the past month – was positively correlated with both TSI ($r = .23, p < .05$) and depression ($r = .22, p < .05$). Among the independent variables, statistically significant positive correlations were found between the following: TSI and depression, anxiety and depression, anxiety and disengagement, and depression and disengagement. Statistically significant negative correlations were found between the following independent variables: age and anxiety, age and engagement, and age and disengagement. The absolute magnitude of

correlations ranged from .21 (between TSI and depression) to .65 (between anxiety and depression); see Table 1.

Four (2 sets) forward, hierarchical multiple regression analyses were performed. One set had presence of PS (0 or 1) as the dependent variable, and the second set had the perceived severity of PS as the dependent variable. Each regression contained the same blocks of independent variables that demonstrated meaningful relationships with the dependent variable either in this study (*i.e.* statistically significant correlations) or were implicated by empirical findings of prior investigations reported in the literature. These variables consisted of: a) demographic variables (gender and age); b) disability-related variables (time since injury –TSI- and SCI level); c) psychosocial responses to injury (anxiety and depression); and d) coping with SCI strategies (the 3 factors of engagement, disengagement, and social support). When supported by the resultant findings, interactions among organismic variables (blocks 1 and 2) and SCI-triggered psychosocial variables (blocks 3 and 4) were further explored. Only three variables were found to be significantly correlated with either of the two PS outcome measures, namely, TSI, depression, and disengagement coping. Two separate interactions were tested, based on the results of zero-order correlations. The first consisted of an interaction between TSI and depression, and the second consisted of an interaction between TSI and disengagement.

Prior to entering the interaction block (#5) items, the following steps were taken: a) data from each MRA were inspected for potential multicollinearity threats (using SPSS Variance Inflation Factor –VIF– procedure), and b) the variables that were studied for their possible interaction effects on PS (TSI, depression, and disengagement) were all centered to further minimize multicollinearity threats. Results obtained from the VIF analysis indicated no multicollinearity concerns (all VIF values ranging from 1.16 to 2.71 well within the $.10 < VIF < 10$ range; Pedhazur, 1997).

The results of the first multiple regression analysis on perceived severity of PS, including the interaction term between TSI and depression, indicated a significant final model, $R^2 = .23$, $F_{(10, 79)} = 2.33$, $p < .018$. In step 1, the demographic variables were entered into the equation, and this step failed to explain a significant amount of variance in perceived severity of PS, $R^2 = .03$, $F_{(2, 87)} = 1.44$, $p = ns$ (see Table 2). In the second step, disability-related variables were entered into the equation, and this step did not significantly increase the explained variance of perceived severity, $R^2 \Delta = .05$, $F\Delta_{(2, 85)} = 2.38$, $p = ns$. In the third step, psychosocial responses (depression and anxiety) to injury were entered and did not add significantly to the variance in perceived severity, $R^2 \Delta = .05$, $F\Delta_{(2, 83)} = 2.52$, $p < .087$. It should be mentioned, though, that in a model including only these three sets of variables (prior to adding steps 4 and 5), depression was found to contribute significantly to the variance in perceived severity ($\beta = .31$, $t = 2.19$, $p < .03$). In the fourth step, the coping variables were added, and did not contribute to a significant change in perceived severity variance, $R^2 \Delta = .02$, $F\Delta_{(3, 80)} = 0.7$, $p = ns$. In the fifth and final step, the interaction term was added (depression \times time since injury). The interaction term was found to contribute significantly to the variance in perceived severity of PS during the past month, $R^2 \Delta = .08$, $F\Delta_{(1, 79)} = 7.67$, $p < .007$. The influence of depression on PS severity was therefore moderated by time since injury. More specifically, level of depression played a more prominent role in its relationship to PS severity among those with longer duration of SCI.

TABLE 2. Hierarchical regression analysis summary for predictors of pressure sore severity.

Predictor variable	R^2	Adj. R^2	$R^2 \Delta$	$F \Delta$	Sig. $F \Delta$	β	β Sig.*
Step 1							
Age	.03	.01	.03	1.44	.24	-.17	.14
Gender						.18	.10
Step 2							
Time since injury (TSI)	.08	.04	.05	2.38	.10	.18	.10
SCI level						-.16	.13
Step 3							
Anxiety	.14	.07	.05	2.52	.09	-.10	.48
Depression						.31	.07
Step 4							
Engagement coping	.15	.06	.02	.54	.66	-.11	.40
Disengagement coping						-.11	.39
Social Support coping						.25	.06
Step 5							
Interaction of TSI and depression	.23	.13	.08	7.67	.01	.32	.01

Note. **b* Significance reflects information from step 5 of the multiple regression analysis.

The second multiple regression analysis model, which included the interaction term of TSI and disengagement coping, was not found to contribute significantly to the variance in PS perceived severity; hence, it will not be discussed further.

The results of the second set of analyses regressed presence of PS (in the previous month) of PS (the dependent variable) on the same set of variables as before. The first model of this set entered the interaction of TSI and depression at the fifth step. This model yielded an overall statistically significant finding, $R^2 = .21$, $F_{(10, 79)} = 2.09$, $p < .04$. In step 1, the demographic variables were entered into the equation, and did not explain a significant amount of variance in presence of PS, $R^2 = .04$, $F_{(2, 87)} = 1.82$, $p = ns$ (see Table 3). In the second step, disability-related variables were entered into the equation, and this step did not significantly increase the explained variance in PS presence, $R^2 \Delta = .06$, $F\Delta_{(2, 85)} = 2.79$, $p < .067$. In the third step, the psychosocial responses (anxiety and depression) to injury were entered and did not significantly added to change in PS presence variance, $R^2 \Delta = .01$, $F\Delta_{(2, 83)} = .46$, $p = ns$. In the fourth step, the coping variables were added, but did not contribute significantly to change in PS presence variance, $R^2 \Delta = .06$, $F\Delta_{(3, 80)} = 2.02$, $p = ns$. In the fifth and final step, the interaction term was added (depression \times time since injury), and its contribution approached statistical significance in the variance of PS presence, $R^2 \Delta = .04$, $F\Delta_{(1, 79)} = 3.69$, $p < .059$. Although the value of this interaction (TSI and depression) failed to reach the traditionally adopted level of statistical significance ($\beta = .23$, $p < .059$), it did demonstrate a similar trend to the earlier finding, in which respondents with higher levels of depression and longer TSI reported greater perceived severity of PS than those whose TSI was of shorter duration. Of interest was also the finding that with all predictors in the final (fifth) equation, disengagement coping contributed significantly to the variance in PS presence ($\beta = -.21$, $t = -2.40$, $p < .019$).

The results of the fourth regression, which was the second regression analysis on PS presence (in the previous month) of PS with an interaction term of TSI and disengagement

coping, indicated that the model was not significant and thus, will not be discussed further.

TABLE 3. Hierarchical regression analysis summary for predictors of pressure sore frequency (per month).

Predictor variable	R^2	Adj. R^2	$R^2 \Delta$	$F \Delta$	Sig. $F \Delta$	β	β Sig.*
Step 1							
Age	.04	.02	.04	1.82	.17	-.19	.12
Gender						.22	.04
Step 2							
Time since injury (TSI)	.10	.06	.06	2.79	.07	.21	.05
SCI level						-.15	.17
Step 3							
Anxiety	.11	.05	.01	.46	.63	-.02	.86
Depression						.28	.10
Step 4							
Engagement coping	.17	.08	.06	2.02	.12	-.10	.44
Disengagement coping						-.32	.02
Social Support coping						.19	.15
Step 5							
Interaction of TSI and depression	.21	.11	.04	3.69	.06	.23	.06

Note. * β Significance reflects information from step 5 of the multiple regression analysis.

Discussion

The role of emotional responses and coping strategies in the development of PS have been examined in the SCI literature for over 30 years (*e.g.* Anderson and Andberg, 1979; Elliott *et al.*, 2006; Herrick *et al.*, 1994; Krause, 1996, 1998a; McColl and Rosenthal, 1994). In this study, we sought to expand on this body of literature by investigating, in more depth, the role that emotional responses and coping strategies play in moderating the relationships between demographic and SCI-related medical variables and the development (*i.e.* frequency and severity) of PS. The analyses indicated that the first hypothesis specifying that a greater level of depression, in this sample of people with SCI, would predict a higher occurrence (collapsed into absence *vs.* presence) of PS and higher severity (collapsed into no PS *vs.* some degree of severity) of PS was partially supported. Depression significantly predicted perceived severity of PS ($r = .22$, $p < .05$), but failed to significantly predict presence of PS during past month ($.10$, $p = ns$). This positive association between depression and PS perceived severity ($\hat{a} = .31$, $p < .065$) was maintained, albeit no longer significantly, following the regression analysis and after controlling for several organismic variables. Findings on the relationship between the second negative psychosocial reaction (anxiety) and PS indicated that the two were unrelated in the present sample, for both PS presence ($r = -.03$) and perceived severity ($r = .03$). The finding that the development of PS is associated with depression is consistent with earlier reports (McColl *et al.*, 2004; McColl and Rosenthal, 1994; Smith *et al.*, 2008).

The second and third hypotheses addressed the relationships between a) engagement-type coping and PS and between b) disengagement-type coping and PS,

proposing that the former group of coping modalities will be associated with lower occurrence and less severe manifestation of PS, while the latter group will be associated with higher occurrence and more severe degree of PS. Engagement-type coping typically encompasses more direct, problem-solving, and plan-setting strategies. Disengagement-type coping, in contrast, includes strategies that seek mostly to regulate stressful emotions (*e.g.* venting emotions, self-blame, mental disengagement) and removing oneself, physically and/or cognitively from the stressful situation (*e.g.* avoidance, denial) (Martz and Livneh, 2007; Zeidner and Endler, 1996). In this study, however, our second hypothesis was not supported. Engagement coping was not related to the presence or perceived severity of PS. These findings are consistent with results reported by Elliott (1999) where social problem-solving strategies (*e.g.* engagement-like coping) were independent of PS development, but they differ from results of a later, longitudinal study by Elliott *et al.* (2006) in which a composite score of social problem-solving abilities (that includes problem orientation) predicted a lower rate of future PS development. Three possible reasons for the discrepant findings among the three studies may include: a) the cross-sectional nature of the present study, in contrast to Elliott *et al.* longitudinal design; b) the differential empirical structure of engagement coping in these studies; and c) Elliott *et al.*'s focus on social problem-solving and problem orientation, unlike the present study's usage of a broader definition of engagement-type coping (*i.e.* active coping, use of humor, acceptance, positive reframing).

The third hypothesis (increased disengagement coping will predict PS presence and perceived severity) failed to demonstrate statistically significant level at the zero-order level. However, when employing the hierarchical multiple regression model, results suggested that after controlling for the variance introduced by socio-demographic variables (step 1), SCI-related variables (step 2), and psychological reactions (step 3), disengagement-coping (step 4) did contribute significantly to the variance in PS presence ($\beta = -.32, p < .02$). In other words, and contrary to our expectations, increased employment of disengagement coping was associated with lower presence (but not perceived severity) of PS. This seemingly unexpected trend indicates that, in our sample and contrary to clinical acumen, individuals with SCI who engaged in avoidance (behavioral disengagement), denial, self-blame, and emotional venting, reported lower presence of PS. Because our COPE Brief-based disengagement factor was composed of these four separate scales (strategies), it was not immediately apparent which of these strategies contributed more to the variance in PS presence. In reviewing the correlation matrix between PS presence and the 14 COPE Brief scales (available upon request from the authors), it was found that PS presence was most notably correlated with emotional venting ($r = -.14, p = ns$). Emotional venting was comprised of two items that reflected an effort to express negative feelings, thus suggesting an active, yet diffuse, coping effort to deal with negative life-stressors that have may also been generalized to confronting stress engendered by potential repercussions of developing PS. Further contributing to this line of thought is the observation (from this study's zero-order correlations) that survivors of SCI, who adopt disengagement coping more readily, despite reporting higher levels of depression ($r = .62, p < .001$), also reported higher levels of anxiety ($r = .48, p < .001$) and in addition, were younger ($r = -.24, p = .01$). Although

speculative, it can be argued that increased physiological and behavioral activity (higher anxiety) and increased metabolic and energy levels (younger age) may be a contributing factor to reduced susceptibility to PS development, because the occurrence of PS has often been linked with decreased physical activity and passivity (Consortium for Spinal Cord Medicine, 2000; Krause, 1996). It should also be noted that lack of behavioral adherence to self-care regimens is distinct from disengagement coping, because the latter reflects both active measures on a cognitive and emotional level (including the «giving up» part of behavioral disengagement), in contrast to the former, which indicates that individuals have not been following medical protocol by their actual behaviors.

The marginal association between disengagement coping and PS presence found in this study may also be traced to the former partial inclusion of avoidance and denial strategies. It can be speculated that individuals with SCI who adopt these strategies continue, when physically possible, to engage in greater number of pre-injury daily routines, thereby increasing activity level; they may also refuse to comply with medical advice that prescribes more cautious and limited activities following the injury (Goldbeck, 1997; Krause, 1996), thus limiting predisposition to PS development. Using Krause's (1996) «bi-dimensional risk behavior model» that contains 2 axes of health behaviors and self-destructive behaviors, such individuals could be categorized as either have a) High positive health behaviors - Low negative self-destructive behaviors or b) High positive health behaviors – High negative self-destructive behaviors (*i.e.* «work hard, play hard», p. 64). Both of these categories suggest individuals who lead active lifestyles after SCI onset, yet differ on the risky types of behaviors that they perform.

Finally, we also sought to investigate the moderating influence of psychological reactions and coping strategies on the relationship between selected organismic variables (age, gender, SCI severity, and time since injury) and the frequency and severity of PS. The only organismic variable that was found to be linked to the existence of PS was TSI ($r = .26, p < .05$ with PS frequency; $r = .23, p < .05$ with PS severity), thus replicating findings from earlier studies (Chen *et al.*, 2005; Garber *et al.*, 2000; Krause and Broderick, 1998). We, therefore, examined the interactive effect of TSI and depression on PS presence and perceived severity. The multiple regression analyses indicated that an interactive effect exists between TSI and depression in its influence on PS perceived severity ($\beta = .32, p < .01$) and, to a lesser degree, on PS presence ($\beta = .23, p < .06$). The results, therefore, suggest that the interaction of TSI and depression has a notable influence on PS outcomes: for those with a longer time since the onset of SCI, depression had a greater influence on the perceived severity of PS (and also suggests a similar trend in influencing the presence of PS). Based on these findings, it can be argued that although TSI and depression, individually, predict PS perceived severity (and to a lesser degree PS presence), it is their interaction effect that may be of interest to researchers and clinicians.

Implications for rehabilitation professionals

Rehabilitation professionals can integrate this study's findings on the importance of the interaction of TSI and depression in several ways. First, clinical awareness can be heightened to encourage clinicians to pay careful attention to individuals who have

had their SCI for a long time and who also have depression; our findings suggest that these are the individuals who may be at the greatest risk for more severe PS. It is possible that individuals who are undergoing depressive reactions regarding their disabilities will experience a behavioral spiral, in which the helplessness and hopelessness (symptoms of depression) will create poor self-care behaviors. They may have mentally given up hope about managing their disability or have been overwhelmed by the required health maintenance. Further, they may have failed to seek medical help once their PS occurred (*e.g.* due to helplessness caused by depression), consequently permitting PS to become more severe and priming them for the onset of secondary complications several or even many years after the onset of their SCI. Thus, it must be repeatedly emphasized to these individuals that PS are a common and treatable problem after the onset of SCI (Senelick, 1998) and what steps that individuals with SCI can take when they occur. Professionals can note research (*e.g.* Kennedy, 2008; Kennedy, Duff, Evans, and Beedie, 2003; Kennedy, Taylor, and Hindson, 2006) that discusses psychosocial interventions that are tailored to help individuals with SCI cope with their disabilities. Summaries of the limited number of clinical interventions, as reported in the Spinal Cord Injury Rehabilitation Evidence (Eng *et al.*, 2008) indicate that both cognitive behavior therapy (CBT) and affective counseling interventions have demonstrated positive impact on psychosocial outcomes after SCI.

Krause (1996) proposed several recommendations for the prevention of secondary conditions with SCI. He noted that due to limited clinical resources, educational programs should be tailored to individuals at high risk for secondary conditions, due to their high scores on the negative self-destructive behaviors. This could include individuals who have high positive health behaviors and high negative self-destructive behaviors, because their high-risk behaviors make them susceptible to further injuries, alcohol or drug abuse, or poor impulse control, according to Krause. Further, he suggested that individuals, who exhibit qualities that could be classified as having low positive health behaviors and high negative self-destructive behaviors, will be the most challenging for the rehabilitation team to handle. Krause suggested the educational interventions be tailored specifically to individuals at risk, according to their profile on his bi-dimensional risk behavior model. If clinicians realize that individuals are at high risk, they may provide a referral to SCI counseling groups, or create counseling interventions that focus on altering specific psychological viewpoints (*e.g.* perceived control over health outcomes; Craig, Hancock, Chang, and Dickson, 1998) and depressive thinking (Radnitz, 2000).

Implications for future research

Given the preliminary findings of an interaction between duration (*i.e.* TSI) of SCI and depression on PS development, future research should further examine the nature of this relationship and that of other non-adaptive reactions to SCI (*e.g.* anger) and TSI. Using a longitudinal research design, research can be conducted on factors that may be influencing the impact of depression during a longer course of injury and how these conditions combine to heighten the risk of severe PS.

Research should also examine the impact of other psychological (*e.g.* self-concept, locus of control), social (*e.g.* family cohesiveness, social support), and behavioral

factors (*e.g.* smoking, use of alcohol) on the nature of the TSI-depression interaction. These may be additional sets of moderating factors that might influence the development of PS.

Limitations

The findings of this study should be interpreted with caution. First, this research was cross-sectional and thus, no causal associations between variables (*e.g.* depression and PS development) can be made. Second, the response rate was lower than typically reported in the literature. This could be a result of the functional limitations associated with SCI that may have influenced the ability of potential participants to respond. Third, it could be that some of the participants in this study reported psychological reactions to the secondary complications of PS, instead of to the onset of SCI. However, this concern is mitigated by the wordings of the various study instruments that specifically directed respondents to consider their reactions to SCI, and not to PS. Fourth, all data in this study were obtained by self-reported measures and could therefore have been susceptible to both conscious and implicit distortions. Fifth, the low number of reported PS frequency and severity scores among our study respondents resulted in highly skewed distributions, necessitating a change in our scoring system into a dichotomous one (*i.e.* yes *vs.* no), thus resulting in loss of potentially valuable data.

Finally, care also must be taken in clinically interpreting the results. For example, Brown (1992) noted that the existence of SCI-triggered PS (as well as urinary tract infections and other secondary complications) may cause increased fatigue and apathy among people with SCI, which may be mistakenly viewed as part of a depressive reaction to disability.

Conclusion

In this study, we sought to investigate the relationships of whether two sets of psychological factors (reactions to the onset of SCI and coping strategies) predict the development of PS, as exemplified by the presence and perceived severity of the latter, after controlling for the influence of demographic and disability-related variables. Our findings revealed that at the zero-correlation level, only time since injury (with both PS presence and perceived severity) and depression (with PS perceived severity only) showed a positive and statistically significant relationship with PS. Following hierarchical multiple regression analyses, however, it was found that an interaction effect of TSI and depression significantly predicted PS perceived severity and to a lesser extent also PS presence, such that depression exerted a stronger influence (correlationally, although not necessarily causally) on PS under longer TSI, but not under shorter TSI conditions.

A final, and unexpected, finding was that disengagement coping, although not statistically significant in its relationship with PS when viewed at its zero-correlation level, was a statistically significant predictor of PS presence after controlling for participants' age, gender, TSI, and SCI level. More specifically, increased use of disengagement coping was found to predict lower presence of PS. Several reasons, ranging from clinical to psychometric, for this unexpected finding, were considered in the paper.

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