Spinal Cord (2013) 51, 260–266

www.nature.com/sc

REVIEW

The influence of depression on physical complications in spinal cord injury: behavioral mechanisms and health-care implications

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Study Design: This study is a literature review and a proposed conceptual model.
Objectives: The objective of this study is to develop a conceptual model to explore the relationship between the presence of depressive symptoms and secondary physical complications such as pressure ulcers, urinary tract infections and autonomic dysreflexia in spinal cord injury (SCI).
Setting: Community setting for individuals with SCI.
Methods: A conceptual model explaining the mechanism underlying the relationship between depression and secondary physical SCI complications was developed based on the International Classification of Functioning, Disability and Health (ICF). A literature review was conducted to develop the model and to identify potential mechanisms responsible for the association.
Results: A conceptual model based on ICF was created, informed by the literature discussing the link between depression and secondary physical SCI complications. Evidence in the literature was located that supports both a causal connection between depression and increased physical complications and/or the potential mechanisms mediating that connection.
Conclusion: The proposed model can be utilized to encourage further research on the influence of depression on SCI outcomes and the importance of prompt and effective identification and treatment of depressive symptoms. Additional research is needed to assess the relationship between depression and secondary physical SCI complications, and to test the validity of the model.
Spinal Cord (2013) **51,** 260–266; doi:10.1038/sc.2013.3; published online 18 February 2013

Keywords: spinal cord injury; depression; complications; pressure ulcers; conceptual model; International Classification of Functioning, Disability and Health

INTRODUCTION

Individuals sustaining a spinal cord injury (SCI), their families and health-care providers often report concerns about depression following the injury. Given the profound disability that can result from SCI, the emergence of depressive symptoms is not surprising. Some authorities go so far as to describe depression as an 'inevitable' experience at some point after the occurrence of SCI.[1] Although recognizing the well-known direct burdens of depression, this paper explores impacts of a more indirect nature, particularly the association between depression and physical complications secondary to SCI. Recent studies have demonstrated the increased likelihood of having more health conditions, higher levels of depression and anxiety symptoms, worse pain, lower self-esteem and lower participation in individuals with SCI compared with a matched non-SCI sample.[2] To guide researchers in targeting important linkages for further exploration or intervention, a conceptual model describing the relationship among these variables is needed. Therefore, the objective of this paper is to develop a conceptual model to explore the relationship between the presence of depressive symptoms and secondary physical complications such as pressure ulcers (PUs), urinary tract infections and autonomic dysreflexia in SCI.

Determining the presence of depression in SCI entails characterization of *depressive symptoms* in an individual, or a formal *diagnosis of depression* according to standardized criteria.[3] Both approaches depend on subjective assessments of depression made by the individual with SCI, family members or clinicians, sometimes with the aid of a depression inventory. As there are no definitive biological tests for depression, there is a potential for it to be misdiagnosed. Furthermore, it may be difficult to determine whether the presence of disruption of appetite, vitality or sleep patterns should be attributed as secondary complications of the injury to the spinal cord or as classic symptoms of depression, which can lead to difficulty in determining the actual prevalence of depression among the SCI population.[4]

Although the heterogeneity and other challenges in depression epidemiology must be acknowledged, the reported prevalence of depression among individuals with SCI has been well characterized, generally falling in the range of 20–30% or two to three times higher than the general population.[5–7]

The 'natural history' of depression in SCI at a population level remains a matter of debate. Some studies conclude that people with long-term SCI are not more depressed than the general population,

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Received 6 July 2012; revised 4 January 2013; accepted 13 January 2013; published online 18 February 2013

whereas other research finds elevated depression rates 7–10 years post injury.[8] Confirmation of the general timeline would allow for calibration of resources required at critical junctures in the SCI-care continuum. For instance, a 3-year longitudinal study in Australia observed an increase in depressive symptomatology at 6 months post discharge. The authors suggested that this phenomenon may be driven by 'the many challenges and unknowns faced by persons with SCI in the transition phase from hospital to community living'.[8]

Regardless of the prevalence and natural history of depression in individuals with SCI, there is no question that it has a serious impact on the affected individuals and their families. Moreover, depression represents a substantial health-care burden—one that is initially driven by the need to provide treatment.[7] On the other hand, there is evidence that depression is often *undertreated* in individuals with SCI.[6] Apart from the impact on the quality of life, the potential result of suboptimal treatment of depression is increased direct costs to the health system because of more outpatient encounters and the addition of inpatient care if symptoms become severe.[9]

The purpose of this paper is to develop a conceptual model to explore the relationship between the presence of depressive symptoms and secondary physical complications.

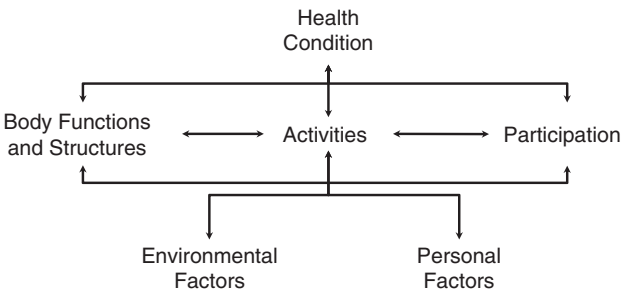
CONCEPTUAL MODEL DEVELOPMENT

Focused research on the synergistic effect of depression on physical complications is beginning to emerge for chronic conditions other than SCI, notably diabetes.[10,11] In fact, a comprehensive theoretical model consistent with the central theme in this paper has been recently constructed for diabetes.[12] Similarly, the 2007 analysis of a cross-sectional survey of adults with SCI entailed the construction of a conceptual model that incorporated self-efficacy in relation to the maintenance of health. Although not occupied with depression *per se*, the researchers in that project did observe that 'the presence of physical secondary complications in people with SCI reflects a complex interplay of numerous factors'.[13]

Such models were consulted, along with common disability frameworks such as the International Classification of Functioning, Disability and Health (ICF), self-management and rehabilitation, in order to develop a conceptual model that can assist in explaining the mechanisms linking depression and elevated rates of secondary complications among individuals with SCI.

The SCI-specific model in this paper focuses on protective behaviors acting over a shorter time rather than on those taking decades to unfold.[14] For instance, the recognized (but relatively long) trail from depression in SCI to higher smoking rates to cardiovascular disease will not be explored here.[15] This sort of scoping decision allows the paper to highlight the more certain health and economic gains that are achievable over the short term. Again, with a view to not overcomplicate the model, a decision was made to focus on the basic influence of depression on protective behaviors rather than attempting to trace that influence through other psychosocial categories or cognitions, such as distress, appraisals, coping and adjustment.[16]

The model described below is informed by other models in the field of chronic disease management and the ICF.[17] The aim of the ICF architects was to provide a standard language for classifying the changed functioning that results from compromised health. The ICF incorporates three levels of functioning: the body or a body part, the person as a whole and the individual in a particular social context. These three levels are summarized as Body Structures/Functions, Activities and Participation, respectively (see Figure 1).[17] From the start, the categorization system for Activities and Participation has been combined in the ICF; for the purposes of the model in the current paper, an attempt was made to tease them apart.



ICF = International Classification of Functioning, Disability, and Health

Figure 1 Integration of functioning, disability and health in the ICF. Source: WHO.[17]

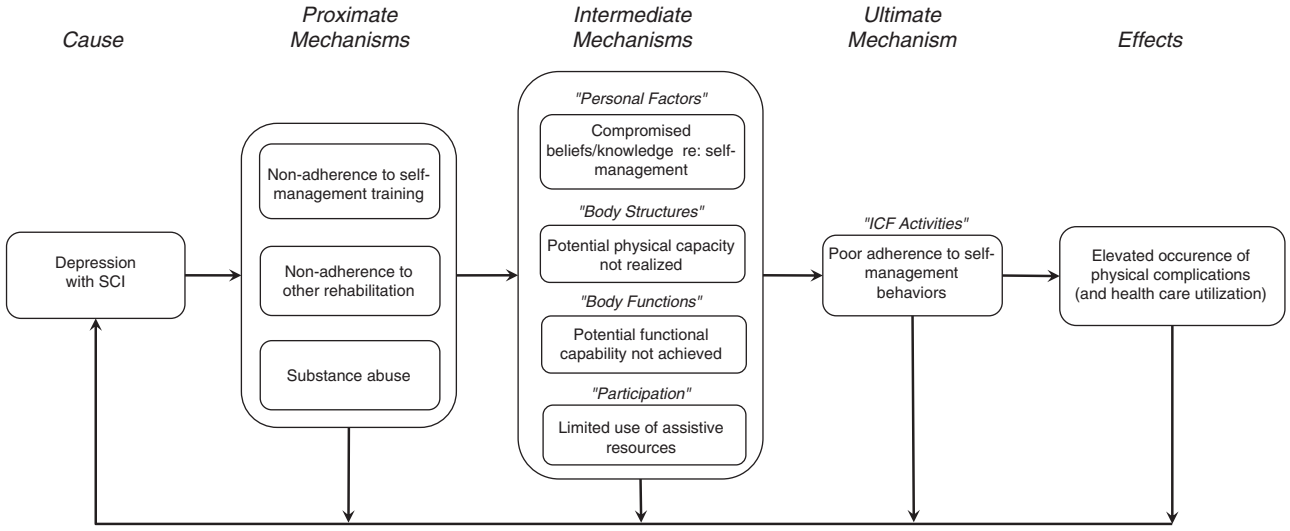
In the presence of a health condition, all three levels of functioning described in the ICF may be impaired. In fact, core data sets specific to health conditions have been generated for a variety of conditions, including SCI.[18] The moderating effect of environmental factors is commonly acknowledged and included in these core sets. However, it is actually the personal factors identified by the ICF, including other health conditions, general fitness, coping styles, overall behavior pattern and psychological assets,[19] that are more pertinent to the present model, given its emphasis on patient-driven mechanisms.

The specific use of ICF elements in the posited model becomes evident when stepping through the sequence of mechanisms in reverse order (see Figure 2). First, the ultimate causal mechanism considered in the model is poor adherence to self-management behaviors that are pertinent to preventing the emergence and/or progression of a physical complication. This model component matches well with the ICF category of personal *Activities*.

Continuing to work in reverse order through the model, there are four other sets of influences that arguably interact with the quality of self-management behaviors. With some interpretation, it is possible to map these intermediate mechanisms onto ICF components as follows:

- *Personal Factors*: These include the beliefs, attitudes and knowledge to enable self-management activities, irrespective of the degree of physical/functional recovery achieved in the individual with SCI. It should be noted as well that these factors include the construct self-efficacy or 'a person's estimate of his or her capacity to orchestrate performance on a specific task'.[20]
- *Body Structures*: These include the physical capacity to enable self-management activities, irrespective of beliefs, attitudes and knowledge. This refers to any true organic improvement of damaged tissue in SCI and is included here for completeness more than because of any strong progress in this area of medicine.
- *Body Functions*: These include the functional capability to enable self-management activities, irrespective of beliefs, attitudes and knowledge. This notably includes the reversal or amelioration of neurological impairment in the individual with SCI.
- *Participation*: This includes active involvement in specific life situations (for example, accessing the medical system, joining peer groups) that facilitates access to physical aids reinforcing self-care (such as specialized seating cushions) and practical supports from other people that will complement self-care.

Although there continues to be discussions about how to operationally distinguish Activities and Participation,[21] from the start 'the



SCI = Spinal Cord Injury
ICF = International Classification of Functioning, Disability, and Health

Figure 2 Relationship between depression and other SCI complications. Conceptual model: patient-level mechanisms and effects.

ICF maintained a conceptual distinction between the 2 dimensions'.[22] As indicated above, the present model proposes a unique way to incorporate the latter dimension. In the ICF grid, Participation usually entails more generic social contexts such as work and recreation. However, active engagement in health care and in peer support groups has been specifically included in inventories, such as the Assessment of Life Habits,[23] that are used to measure participation in disabling conditions such as SCI. Identifying a moderating effect specific to participation in the health-care system is also consistent with the broader literature on the effects of depression.[24,25]

The set of mechanisms in the model most proximate to the experience of depression (and furthest removed from the final effect of increased complications) are informed by three other frameworks commonly used in chronic disease care.

First, the *self-management* framework[26] leverages the assumption that there is a set of patient-driven behaviors or activities that can reduce physical complications in SCI, and that these activities may themselves be impeded in depressed individuals. Individuals with SCI who have higher self-efficacy demonstrate better mental health[16] and less secondary complications.[13] Furthermore, recent work has shown that depressive symptoms correlate more strongly with self-efficacy than with participation.[27] As low self-efficacy may be viewed as a symptom of depression, or could be the result of depression, it is clear that further research into the relationship between self-management and self-efficacy, as well as other personal factors, is warranted to explore the dynamics of how people may manage in either the presence or absence of depression.

Next, various aspects of *rehabilitation* have a bearing on the conceptual model. For instance, there is a direct connection between rehabilitation and self-management. Indeed, fostering attitudes and skills to support self-management are important agendas in SCI rehabilitation.[28] However, there are other rehabilitation goals and modalities that are likely to mediate the effect of depression on secondary complications. These include the various aspects of functional recovery that are critical after SCI, as well as the continuing quest for 'the cure'. If the experience of depression interferes with rehabilitation efforts, then capacity and capability will be compromised, thereby impeding the potential to prevent complications—even in people with SCI who are motivated to stay healthy.

Substance abuse is the third proximate mechanism incorporated in the model. Misuse of substances such as alcohol and drugs is a frequent comorbidity of depression, including depression following SCI.[29] It is easy to conceive how substance abuse could interfere with an individual's adherence to health-protective behaviors.[30] Studies have found that post-SCI alcohol abuse, in particular, is associated with an increased risk of PU occurrence.[31,32]

Finally, the conceptual model incorporates a feedback loop reflecting the idea that certain complications (or perhaps the underlying mechanisms) are themselves risk factors for depression in SCI.[33] This raises the possibility of a 'downward spiral', where both depression and the related effects become progressively worse.

For the sake of simplicity, a variety of other potential feedback mechanisms were omitted from the model. For instance, there is evidence that the active use of both peer mentors and physical aids by individuals with SCI enhances self-efficacy, thereby increasing the likelihood of adherence to other self-management behaviors.[34,35] Studies have also shown the reverse to be true, that self-efficacy is a predictor of participation in helpful social contexts by those with SCI.[27]

EVIDENCE REVIEW: LITERATURE SEARCH

To inform and refine model development, an electronic search was undertaken. Evidence related to this model was evaluated in two parts. First, evidence related to the association between depression and physical complications of SCI was investigated. This entailed a Medline search based on a variety of key words, including the following: ('spinal cord injury' AND 'depression') AND ('complications' OR a specific physical complication, including 'pressure ulcer', 'urinary tract infection', 'bowel dysfunction', 'autonomic dysreflexia', 'pain'). Electronic searches were augmented by hand-searching the

references in pertinent papers, using the 'related articles' search in Medline, and by searching the publication history of key authors. Studies were reviewed based on title and abstract by two reviewers (DW/LMT). Full-text versions of studies evaluating a link between depression and secondary complications in individuals with SCI were then evaluated for inclusion by both reviewers.

Following this, a secondary literature search was guided by preliminary understandings of the behavioral mechanisms mediating the influence of depression. This entailed searching the SCI literature based on the following key words: ('depression' OR 'complications') AND ('self-management' OR 'self-efficacy' OR 'self care' OR 'rehabilitation' OR 'substance abuse'). The model was informed by similar projects for other chronic conditions (for example, diabetes), as well as by the expertise of the authors regarding frameworks critical to the fields of disability and disease management. Supplemental searching and review of studies of interest were handled in the same manner as above. No limits were placed on the date of publication or the type of study. All English language studies evaluating a potential connection between depression and rates of secondary complications, either directly or through mechanisms proposed in the model, were eligible for inclusion.

In total, 10 papers were identified that presented evidence related to the proposed model (Table 1).

Studies focusing on the relationship between depression following SCI and elevated rates of physical SCI complications appear to be limited. Most recently, a poster presentation at the 2012 ASIA Annual Scientific Meeting analyzed the few instances of other complications observed among 124 depressed individuals with SCI.[36] The small sample size may explain the fact that neither comorbidities nor secondary health conditions were significantly associated with 'levels of depressive symptomatology'. An alternate approach would have been to start with a more basic comparison of depressed and nondepressed people with SCI, rather than correlating a continuum of depression intensity against the

Table 1 Summary of literature search

Lead authors	*Year*	*Title*	*Journal*	*Conclusions*
Forchheimer *et al.*[36]	2012	Comorbidities and secondary health conditions and their relationship to levels of depression among depressed persons with SCI	*Topics in Spinal Cord Injury Rehabilitation* (Oral Presentation)	'Very few comorbidities were observed in this sample of depressed persons with SCI...Neither comorbidities nor secondary health conditions were associates with levels of depressive symptomatology'.
Bombardier *et al.*[47]	2012	An exploration of modifiable risk factors for depression after spinal cord injury: which factors should we target?	*Archives of Physical Medicine and Rehabilitation*	'Our findings suggest that having fewer rewarding activities, and to a lesser extent, having less confidence in one's ability to manage the effects of SCI are independent predictors of greater depression severity after SCI'.
Hoffman *et al.*[33]	2011	A longitudinal study of depression from 1 to 5 years after spinal cord injury	*Archives of Physical Medicine and Rehabilitation*	'Results…suggest that increasing pain, declining health status, and decrease in unsafe alcohol use were risk factors for the development of depression'.
Liu *et al.*[39]	2010	Prediction of severe neurogenic bowel dysfunction in persons with spinal cord injury	*Spinal Cord*	'…compared with those with no sign of depression, the patients presenting with moderate and severe depression had a significantly increased NBD score, which means they have worse bowel function and suffer from a higher risk of acquiring more severe NBD'.
Gélis *et al.*[38]	2009	Pressure ulcer risk factors in persons with spinal cord injury. Part 2: the chronic stage	*Spinal Cord*	'Daily skin monitoring was found to be a potential protective/risk factor for pressure ulcer development; Limited evidence was found indicating that depression is a potential protective/risk factor for pressure ulcer development'.
Krause *et al.*[14]	2008	A prospective study of health and risk of mortality after spinal cord injury	*Archives of Physical Medicine and Rehabilitation*	'In addition to secondary conditions that have been the traditional focus of prevention efforts (e.g., pressure ulcers, urinary tract infections), amputations, fractures and depressive symptoms were associated with higher risk for mortality…'.
Oh *et al.*[45]	2006	Depressive symptoms of patients using clean intermittent catheterization for neurogenic bladder secondary to spinal cord injury	*Spinal Cord*	'The results demonstrate that the patients with neurogenic bladder secondary to SCI have higher degrees of depression than normal population. In addition, our findings also suggest that depression is closely related to gender and patient's ability to perform self catheterization'.
Dorsett and Geraghty.[8]	2004	Depression and adjustment after spinal cord injury: a three-year longitudinal study	*Topics in Spinal Cord Injury Rehabilitation*	'Repeated measures logistical regression analysis of determinants of depression revealed that two variables, overall self-rated adjustment ($P = .002$) and the presence of pressure sores ($P = .002$), were statistically significant determinants of depressive symptomatology in this group of people with spinal cord injury'.
Krause *et al.*[44]	2001	An exploratory study of pressure ulcers after spinal cord injury: relationship to protective behaviors and risk factors	*Archives of Physical Medicine and Rehabilitation*	'…having attempted suicide… [was] associated with having been hospitalized for a PU since injury'.
Herrick *et al.*[37]	1994	Social support and the prediction of health complications among persons with spinal cord injuries	*Rehabilitation Psychology*	'Discriminant function analysis found level of injury, lesion, age, depression, and elements of social support to be significantly predictive of [decubitus ulcers and urinary tract infections] over the year'.

constructed index of complications. To our knowledge, the former, more basic type of analysis in reference to a complications index has not been pursued.

Earlier research has suggested an association between depression in SCI and specific physical complications, such as PUs and urinary tract infections.[8,37] However, causation remains unresolved: does the depression exacerbate the complication or does experiencing the complication makes the individual depressed?

The most investigated physical complication with a possible link to depression appears to be PUs. The research in this area, however, still involves only a few cross-sectional studies. A 2009 systematic review that examined the research specific to depression could only conclude that depression is a 'potential' risk factor for the development of PUs.[38] It is encouraging, however, that this association appears to be one of the instances where depressive symptomatology is a risk factor for the complication, whereas taking depression medication is not. This result points to both the probable role of 'active' depression as a causal factor and the potential for enhanced benefits when depression is controlled.

It should be noted that the systematic review cited here focused on the chronic or community-living stage of SCI. In a different paper from 2009, the same review team examined the literature pertinent to acute and rehabilitation stages; that search generated no additional information about the effect of depression on PU development.[38]

Only one other strand of evidence was located. Neurogenic bowel dysfunction, which can result in fecal impaction (one of the main triggers of autonomic dysreflexia), has also been linked to depression in SCI.[39] Causality with respect to depression and neurogenic bowel dysfunction outcomes has yet to be elucidated.

The specific mechanism of self-care from the diabetes literature provided a helpful starting point in tracing potential mechanisms from the time of injury up to and including life in the community; commitment to optimizing functional rehabilitation therapy represents another important factor. These two dimensions reflect the logic that there is a voluntary and involuntary side to avoiding complications, namely, personal commitments to care *and* the physical capability to follow through on those commitments. A related agenda includes finding support for connections between these mechanisms and other patient risk factors that ultimately increase the occurrence of one or another physical complication in SCI.

The incorporation of self-management attitudes, knowledge and skills, as well as functional capabilities, in the conceptual model is supported by past and present SCI literature. Poor outcomes because of inattention to skin and bladder care, for example, have been described for over 40 years. On the other hand, the reluctance of people with SCI to participate in rehabilitation was noted as early as in 1950.[40] A reviewer examining research available 25 years ago coined the term 'self-neglect' to describe the patient factors contributing to these types of mechanisms.[41] More recent studies have also highlighted the importance of consistent self-management in avoiding SCI complications.[42] For instance, the review of risk factors for PUs cited earlier pointed to the utility of skin-specific behaviors, specifically finding that daily skin monitoring was a significant protective factor for PU development.[38]

An important principle in validating self-management approaches to preventing complications is whether such strategies are acceptable to individuals with SCI. A recent survey of ~1000 Dutch individuals with SCI noted that a high percentage believed that certain physical complications were 'totally' preventable; this included 27% regarding bladder-related complications, 24% regarding bowel-related complications and 53% regarding PUs.[43] Moreover, the most important preventive mechanisms identified in this SCI population were linked to the following: adherence to key self-management behaviors, ensuring that high quality of care was being accessed, and taking advantage of good information related to SCI complications.

The face validity of self-management in avoiding physical complications is easy to accept. A more critical issue for the conceptual model is whether there is evidence that SCI-related depression negatively affects an individual's commitment to self-management training and/or functional recovery, thereby reducing the uptake of protective behaviors. In this vein, some SCI researchers have concluded that depression can 'lead to apathy in terms of self-care'.[44] Similarly, there are indications in the literature that depression in SCI can lengthen rehabilitation lengths of stay (and costs) while yielding poor results in terms of both self-care skills and functional capability.[6,45,46]

Finally, studies also support the idea of 'feedback loops', where certain patient factors and increased complications following depression may in turn accentuate the initial depression. For instance, a study of risk factors for depression in SCI showed that having 'less confidence in one's abilities to manage the effects of SCI' is an independent predictor of greater depression severity.[47]

Although the research outlined above is modest, on balance the evidence provides guidance for the proposed conceptual model that may be further tested, refined and ultimately applied.

DISCUSSION

Although depression in SCI has been widely studied,[46] this paper underlines the possibility of unique impacts and mechanisms related to the condition, and the idea that these phenomena may be worthy of further investigation. Beginning with a parallel story in the world of diabetes and then following the limited studies in the SCI sphere, the existing evidence can inform a conceptual model explaining how depression could exacerbate the occurrence of short-term physical complications. The match-up between the posited mechanisms and various ICF categories required a degree of creative adaptation, but the result is a comprehensive picture promising substantial explanatory power, as well as practical lines of research to refine the model and ultimately improve care.

Research agendas

Although existing studies have focused on specific aspects of depression in SCI, there has not yet been an attempt to thoroughly study the complex relationships and mechanisms suggested in this paper. This paper is meant to spur efforts to address that gap, including the application of advanced analytic techniques to the large data sets in SCI registries.

The proposed conceptual model underlines two strategies to follow in looking for further scientific confirmation. First, the model may be supported in a *global* way, that is, by demonstrating evidence of depression causing an increase in physical complications in SCI. On the other hand, the *component* mechanisms in the model may be progressively validated, although more global evidence is being developed by researchers.

New 'global evidence' would entail demonstrating a correlation that shows depression to be a risk factor for one or more physical complications in SCI. This requires research of a prospective or longitudinal nature (rather than a cross-sectional design) so that the causal direction of interest can be demonstrated. Although there is evidence that experiencing a physical complication in SCI can increase depression, in the opinion of the authors, it is likely that depression

also increases other complications, which needs further study to be conclusively demonstrated.

Alternately, the more indirect pursuit of 'component evidence' to reinforce the conceptual model would comprise a demonstration of the effect of depression on self-management or functional recovery, combined with an indication that these two mechanisms ultimately influenced the risk of physical complications.

Recent research has shown that the use of antidepressant medications during in-patient rehabilitation has a complex relationship with the length of stay and functional outcomes.[48] More studies are needed to disentangle the effects of medication timing, patient personality traits and rehabilitation goals and efficiency, as well as the role of screening in different stages of care following SCI. A compelling test of this paper's hypothesis would be to see whether recommended application of antidepressant medications and/or nonpharmaceutical interventions along the SCI-care continuum leads to a lower risk of physical complications and lower health-care utilization. Better quantification of these effects could ultimately inform cost-effectiveness modeling that would be of further use to health-care planners.

This sort of applied research would be informed by longitudinal studies designed to resolve the contradictory evidence about the incidence of depression at different time periods post SCI. In the same way, it would be helpful to better distinguish depression from 'natural' short-term grief related to the losses inherent in SCI, from posttraumatic stress reactions, and from the cognitive effects of comorbidity (such as brain injury) that sometimes accompany the trauma causing SCI. In these ways, the specific psychological resources required at different stages of care could be effectively marshaled.

Finally, in light of other factors with a psychological element, such as pain interference, personality types, appraisals, world views, spirituality, coping and adjustment, it is quite evident that the conceptual model could be extended in a number of directions—as long as the increased complexity holds out the promise of improving health care in SCI.

Prevention, treatment and potential cost avoidance

There is much at stake in acting on what is already suggested by the existing evidence and the related conceptual model. Other complications of SCI seem to garner more attention from care providers; the preceding discussion underlines the vital importance of also preventing and/or treating depression following SCI.

The priority and urgency of interventions becomes clearer in light of the short time frame of depression-related effects. Thus, impaired self-care can have quick consequences in terms of PU development or fecal impaction triggering autonomic dysreflexia; in the same way, paying attention to these mechanisms can generate relatively quick wins, with the promised improvements being realized over a time horizon measured in weeks or months rather than years or decades.

It is important to ensure that depression is addressed early and effectively in order to optimize reduction of physical complications. This strategy requires reversal of the current pattern of under-treatment in the SCI population, and careful attention to guideline-based recommendations and emerging best practices for depression care. According to the conceptual model, there is also potential to offset the effects of persistent depression by directly reinforcing the self-management knowledge and skills associated with avoiding physical complications.[49]

Similarly, informed by the conceptual model, there is an opportunity to reinforce self-management tools (even in the face of ongoing depression or other psychological obstacles) at different time points following SCI, drawing on the lessons from the broader universe of chronic disease care.[50]

In sum, benefits could be substantial if the different means described in this paper were to be consistently applied, thereby mitigating the affect of depression in SCI, alleviating patient burden and reducing health-care costs.

CONFLICT OF INTEREST

H Krueger, L Trenaman and D Williams have received funding from the Rick Hansen Institute and the Rick Hansen Foundation. V Noonan and C Rivers are employees of the Rick Hansen Institute.

ACKNOWLEDGEMENTS

This study was funded by the Rick Hansen Institute and Health Canada.

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