Self-rated health among persons with spinal cord injury: What is the role of physical ability?

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Objectives: Self-rated health (SRH) is a powerful concept that has greatly advanced our understanding of health and health outcomes. The SRH measure has become increasingly common in health research. Yet, puzzles remain about what shapes SRH ratings. The absence of knowledge is particularly acute in the context of disability. The aim of this study was to examine the relationship between SRH and self-rated physical ability in a sample of individuals with spinal cord injury (SCI).

Methods: Data from 140 eligible participants drawn from a study of life in the community after SCI were analyzed. The study, cross-sectional in design, was conducted in a large urban city in the mid-western United States. Basic statistics such as ANOVA and chi-square tests were performed as appropriate, and a multiple linear regression analysis modeled the relationship between SRH and physical ability adjusting for potential confounding variables.

Results: Self-rated physical ability was significantly associated with SRH after controlling for relevant covariates ($P < 0.001$). An analysis of the interaction between physical ability and level of injury revealed that the relationship was significant for persons with paraplegia but not for persons with tetraplegia.

Conclusions: This study provides evidence that self-rated physical ability is an important factor associated with SRH for persons with SCI, but that the strength of the relationship depends on level of injury (paraplegia vs. tetraplegia). The challenge for future research is to replicate the study using a more comprehensive measure of physical ability and to ask how beliefs in one's ability to do those activities that are most meaningful and desired shape SRH. Only in this way will our understanding of the physical ability–SRH relationship be clarified.

Keywords: Self-rated health, Spinal cord injury, Physical ability, Disability, Tetraplegia, Paraplegia, Quality of life, Aging with disability

Introduction

Self-rated health (SRH) is one of the most frequently used indicators in research. This relatively simple single-item fixed-response question generally worded as: 'How would you rate your health today? Excellent, very good, good, fair, or poor?' which elicits a subjective, holistic evaluation of one's condition, is documented to accurately predict many important outcomes, including mortality, especially in older adults.^{1–3} Based on decades of persuasive research, data on SRH are now routinely collected in major national surveys that include both able-bodied ('healthy normals') and people with physical disabilities, such as the Health and Retirement Study, Behavioral Risk Factor Surveillance System, and the National Spinal Cord Injury Model Systems Database.^{4–6} Despite the fact that this single-item SRH measure has greatly advanced our knowledge of health and health outcomes, enduring puzzles remain about

what shapes a person's ratings. This is especially true in the area of disability where the conceptual and measurement issues are more complex.

In the context of disability, there has been considerable evolution in the concepts and language used to describe functioning and health. In the International Classification of Functioning, Disability, and Health (ICF) framework, which now guides theory and research in this field, an individual's overall health or 'functioning' is viewed as a complex interaction between one's bodily functions and structures, contextual factors in the environment and various personal factors embodied in the individual him or herself.^{7,8} The interactions between these major factors are dynamic and work in multiple directions to shape the level and kinds of activities (ICF concept) engaged in and one's overall participation (ICF concept) in society. The ICF model is a useful framework to guide investigations of the independent influence of one factor on another, recognizing that one element in the model has the potential to modify others.

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Increasingly, in the broader SRH literature, evidence points to links between SRH and what is called ‘physical functioning’,^{9–12} especially in older adults, suggesting that persons with diminished activity levels tend to rate their health poorly. Using the ICF model we can test this relationship in the disability context, drawing a parallel between the terms ‘physical functioning’ used in the aging literature and the ICF activity concept. Although this relationship has been repeatedly confirmed for older adults, it has been rarely investigated for younger populations living with significant permanent physical disability.

Persons with spinal cord injury (SCI) represent a model group for examining SRH and its relationship to self-rated physical activity since they provide a valuable contrast to the situation of older adults who as a group tend to experience declines in physical ability more slowly as a function of age. Persons who sustain a traumatic SCI tend to be injured early in life and their bodily functions tend to remain relatively unchanged through adulthood although they often decline again in late life. Evidence also indicates that although persons with SCI experience significant restrictions in activity and participation, many perceive their health as excellent or very good;^{13–15} indeed, on the whole persons living with SCI do not rate their health much differently than able-bodied persons.¹⁶

Therefore, we ask whether it is appropriate to assume that the relationship between SRH and physical ability holds for persons with SCI in the same way that it does for older persons. A related reason to examine SRH in the context of permanent physical disability is to force a more critical examination of the types of measures of physical ability used with persons with SCI, to determine their appropriateness for comparison within the broader SRH literature.

Literature reporting on studies that investigated factors influencing SRH among persons with SCI is very sparse. Indeed, to our knowledge there is only one such previously published study.¹³ Krahn and colleagues, using the SF-36 showed that physical functioning was not related to SRH. However, is physical ability truly unimportant for SRH among individuals with SCI, or is the SF-36 and the particular SF-36 item measuring physical ability inappropriate for this group of disabled individuals with SCI, and therefore unable to capture a relationship that may exist between physical ability and perceived health? Among persons with SCI, physical ability has been shown to importantly predict the level of participation (an important component of the ICF model) a person achieves in the months and years after injury.^{8,13,17,18} Given the power of SRH to

predict other meaningful health outcomes for older adults, it is important to examine these relationships carefully.

The purpose of this study was to examine the association between self-reported physical ability to perform everyday tasks and SRH, adjusting for relevant covariates such as health conditions, demographic factors, injury level, and injury duration. Although SCI is always accompanied by some level of disability, we hypothesized that the degree of reported physical ability ‘to do’ everyday activities would play an important role in the perceptions of health reported by our sample of SCI survivors, just as differences in this ability may signal differences in perceived health for older populations.

Methods

Participants

Participants were drawn from a larger study of 140 men and women residing in the community after SCI (R01#1HD43378, funded by the National Institutes of Health (NIH), PI: Lysack). The recruitment procedure, described in detail elsewhere,¹² is presented here in brief. Recruitment centered on the city of Detroit, MI, and the surrounding area and study volunteers were identified using word-of-mouth from one participant to another (i.e. the snowball sampling technique), advertisements in local disability newsletters, flyers posted in community centers, grocery stores and pharmacies, brochures distributed to SCI support groups, and information sheets in physician waiting rooms. A total of 164 individuals responded to our recruitment efforts and of these 140 were found eligible for the study. All met the following inclusion criteria: (1) living independently in the community, (2) aged 18–70 years, (3) medical diagnosis of traumatic SCI, and (4) current wheelchair use, all self-reported. Approval for the study was obtained from the Institutional Review Board at Wayne State University in advance of data collection. All research participants gave informed consent and signed the required form prior to their participation in the study.

Measures

Self-rated health

SRH is a single-item measure where participants rate their overall health on a five-point scale. All the participants were asked a question: ‘Would you say your health in general is: excellent, very good, good, fair, or poor?’.

Physical ability

Physical ability was assessed by asking a question: ‘How would you currently rate your overall physical ability to

do the things you need to do or want to do every day? (e.g. things like personal hygiene, looking after your house, doing your shopping, seeing friends, work)' with possible answers: excellent, good, fair, poor, or bad. This question measures the individual's perception of the degree to which they have the physical ability to engage in these activities. Few participants indicated that their physical ability was 'poor' or 'bad' and therefore these two categories were merged in the analyses.

Demographic characteristics

Demographic characteristics included current age (years), gender (men, women), and ethnicity (Caucasian, minorities (African American, Hispanic, Native American, Asian/Pacific Islander, and other)).

Injury-related details

Data on two main injury variables were collected: level of injury (paraplegia, tetraplegia) and injury duration (years).

Health conditions

Participants were asked whether they were currently seeing a doctor for pressure sores/skin breakdown, urinary tract infections, obesity (>20 lb overweight), depression, pain, use of respirator/ventilator, heart trouble, breathing problems, diabetes, and hypertension/blood pressure problems. These health conditions are among the most common ones for persons with SCI.^{19–22} A binary variable, reflecting the number of conditions reported (≤ 1 vs. ≥ 2), was computed.

Analysis

All data were analyzed using SPSS version 16. Person-specific descriptive statistics were obtained on all the variables described above. Associations of personal demographic characteristics and relevant covariates with SRH were assessed using ANOVA and chi-square tests, as appropriate. The level of significance was set at $\alpha = 0.05$ throughout. A multiple linear regression model was estimated using SRH (scored 1–5) as the dependent variable. Independent variables in the regression models were those that in our sample were significantly related to SRH (age, number of health conditions, physical ability) as well as demographic characteristics (gender, ethnicity), and injury details (level of injury, injury duration) that were significantly associated with physical ability (and which therefore could potentially modify the relationship between physical ability and SRH) (see Table 3). Many of these variables are known to affect SRH in able-bodied populations.^{23,24} We then developed a stepped sequence of models to address the aim of the study, each with SRH as the

dependent variable. The first model (Model 1) was constructed by including all of the covariates listed above as independent variables. The second model (Model 2) was built on Model 1 by adding physical ability as an independent variable. Models 3a and 3b examined the relationship between physical ability and SRH separately for persons with paraplegia and persons with tetraplegia.

Although linear regression is regarded as more appropriate for a continuous outcome variable, it is recognized as a robust method for even dichotomous variables²⁵ and has been used elsewhere with SRH as the dependent variable.^{26–28} As a verification of our results we repeated all of our analyses using binary logistic regression (dichotomizing SRH into 'positive' (excellent, very good, good) vs. negative ('fair', 'poor')). The results obtained in this way did not materially differ from the linear regression analyses. We elected to present our results in linear regression form because the available data are used more completely and the regression coefficients are more easily interpretable.

To calculate the power we have in our sample to detect effects in our linear regression models, we refer to Cohen³⁷. Assuming a 'medium' effect size ($f^2 = 0.15$) and sample sizes of 138 or 137 and 6 or 7 independent variables (Models 1 and 2), we obtain power >95%. For Models 3a and 3b, where we have sample sizes of 78 and 59 and 6 independent variables, we obtain power >79%.

Results

Sample characteristics

The sample is described in Table 1. Participants were aged 18–68 years; mean of 40 years ($SD = 12$). In accordance with other studies in SCI, participants were mostly men (68%). As expected, the level of education was relatively high (69% completed high school or more), but most of the participants were unemployed (76%). Insufficient income was reported by 30% of participants. Uniquely, a significant number in this sample were African Americans (40%).

Mean SCI duration was 10.5 years ($SD = 11$) and the sample included almost equal numbers of individuals with tetraplegia and paraplegia (44 and 56%, respectively). Ratings of perceived health were in general very positive: 18% excellent, 29% very good, 38% good, 12% fair, and 3% poor. There was no difference between persons with paraplegia and persons with tetraplegia on the SRH variable. Also the sample was quite healthy – 64% reported only one health condition or fewer (for more details about health conditions see Table 2). There was no significant association between

Table 1 Characteristics of persons with SCI for the total sample and by SRH status

	Total sample <i>n</i> = 140	Excellent SRH <i>n</i> = 26 (18.6%)	Very good SRH <i>n</i> = 40 (28.6%)	Good SRH <i>n</i> = 53 (37.9%)	Fair SRH <i>n</i> = 17 (12.1%)	Poor/bad SRH <i>n</i> = 4 (2.9%)	ANOVA/ chi-square
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	<i>P</i> value
Age (years)	39.8 ± 12.2	33.4 ± 10.5	39.7 ± 12.5	41.9 ± 12.4	42.8 ± 11.6	42.0 ± 6.2	0.037
Injury duration (years)	10.5 ± 11.1	7.7 ± 7.2	11.0 ± 11.6	12.6 ± 12.5	7.3 ± 9.3	9.0 ± 10.1	0.278
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
Gender							0.534
Males	95 (67.9%)	19 (73.1%)	28 (70%)	33 (62.3%)	11 (64.7%)	4 (100%)	
Females	45 (32.1%)	7 (26.9%)	12 (30%)	20 (37.7%)	6 (35.3%)		
Race							0.896
Whites	78 (55.7%)	13 (50.0%)	23 (57.5%)	29 (54.7%)	10 (58.8%)	3 (75.0%)	
Minorities (40% Afro-Americans)	62 (44.7%)	13 (50.0%)	17 (42.5%)	24 (45.3%)	7 (41.2%)	1 (25.0%)	
Level of injury							0.533
Tetraplegia	61 (43.6%)	13 (50.0%)	20 (50%)	22 (41.5%)	5 (29.4%)	1 (25.0%)	
Paraplegia	79 (56.4%)	13 (50.0%)	20 (50%)	31 (58.5%)	12 (70.6%)	3 (75.0%)	
Health conditions							0.006
≤1	90 (64.3%)	20 (76.9%)	31 (77.5%)	32 (60.4%)	5 (29.4%)	2 (50.0%)	
≥2	48 (34.3%)	6 (23.1%)	9 (22.5%)	19 (35.8%)	12 (70.6%)	2 (50.0%)	
Education							0.919
Less than high school	14 (10.0%)	2 (7.7%)	4 (10%)	6 (11.3%)	2 (11.8%)		
High school graduate, GED	30 (21.4%)	4 (15.4%)	9 (22.5%)	11 (20.8%)	4 (23.5%)	2 (50%)	
Greater than high school, vocational	96 (68.6%)	20 (76.9%)	27 (67.5%)	36 (67.9%)	11 (64.7%)	2 (50%)	
Employment							0.563
Yes	33 (23.6%)	7 (26.9%)	12 (30%)	11 (20.8%)	3 (17.6%)		
No	106 (75.7%)	18 (69.2%)	28 (70%)	42 (79.2%)	14 (82.4%)	4 (100%)	
Income sufficiency							0.316
Less than enough	42 (30.0%)	12 (46.2%)	9 (22.5%)	15 (28.3%)	4 (23.5%)	2 (50%)	
Just enough	72 (51.4%)	9 (34.6%)	22 (55%)	27 (50.9%)	12 (70.6%)	2 (50%)	
Greater than enough	24 (17.1%)	4 (15.4%)	9 (22.5%)	10 (18.9%)	1 (5.9%)		
Physical ability							0.006
Excellent	34 (24.3%)	13 (50%)	12 (30%)	9 (17%)			
Good	47 (33.6%)	6 (23.1%)	14 (35%)	22 (41.5%)	5 (29.4%)		
Fair	40 (28.6%)	3 (11.5%)	10 (25%)	15 (28.3%)	9 (52.9%)	3 (75%)	
Poor/bad	17 (12.1%)	3 (11.5%)	4 (10.0%)	6 (11.3%)	3 (17.6%)	1 (25%)	

Table 2 Prevalence of health conditions in the study sample ($n = 138$)

Health condition	Number (%)
Pressure sore	25 (17.9%)
Urinary tract infections	28 (20%)
Obesity	9 (6.4%)
Depression	24 (17.1%)
Pain	51 (36.4%)
Use of respirator/ventilator	2 (1.4%)
Heart trouble	7 (5%)
Breathing problems	11 (7.9%)
Diabetes	10 (7.1%)
Hypertension/high blood pressure	23 (16.4%)

Note: Participants could select more than one condition.

the number of health conditions and injury level (paraplegia, tetraplegia). However, a significant proportion of participants reported insufficient (fair, poor, or bad) physical ability (41%). Not unsurprisingly, there was a significant association between injury level and physical ability (Table 3). There were small amounts of missing data: physical ability (two), health conditions (two), employment (one), and income sufficiency (two). Therefore, the valid sample sizes for regression analysis were $n = 138$ for Model 1 and $n = 137$ for Models 2 and 3.

Relationship of physical ability and selected demographic, injury-related, and health variables to SRH

Unadjusted analysis showed that age, number of health conditions, and perceived physical ability were all significantly associated with SRH in the expected directions (see Table 3). Thus, SRH scores were higher when individuals reported fewer health conditions and when they perceived their physical ability to do things was relatively 'good'. Notably the level of injury (tetraplegia, paraplegia) and injury duration were not related to SRH. We conducted further analysis of the relationship between SRH and perceived physical ability through a series of linear regression models adjusting for demographics, injury details, and health conditions.

Linear regression models

Model 1 (see Table 4) confirms that participants with fewer health conditions were more likely to rate their health positively ($P < 0.01$), consonant with the available literature on SRH.

Also, age was significantly associated with SRH in unadjusted analysis ($r = 0.266$, $P < 0.01$), and the relationship was confirmed when controlling for other variables ($P = 0.030$). Interestingly, both injury duration

Table 3 Spearman correlations among all relevant variables and SRH in persons with SCI

	1.	2.	3.	4.	5.	6.	7.	8.
1. SRH	1.000							
2. Age	0.266**	1.000						
3. Gender	0.043	0.006	1.000					
4. Ethnicity	-0.052	-0.157	0.064	1.000				
5. Level of injury	-0.138	0.015	0.012	0.058	1.000			
6. Injury duration	-0.024	0.446**	0.037	-0.119	0.129	1.000		
7. Health conditions	0.278**	0.212*	0.174*	-0.027	0.065	-0.018	1.000	
8. Physical ability	0.340**	0.083	0.024	-0.012	0.237**	-0.293**	0.319**	1.000

* $P < 0.05$.

** $P < 0.01$.

Table 4 Factors associated with SRH among persons with SCI: multiple linear regression analysis

Variables	Model 1 ($R^2 = 0.136$; $n = 138$)			Model 2 ($R^2 = 0.235$; $n = 137$)		
	<i>b</i>	SE	95% CI	<i>b</i>	SE	95% CI
Age (years)	0.018*	0.008	0.002–0.034	0.010	0.008	-0.006–0.026
Gender	-0.014	0.181	-0.373–0.344	-0.009	0.171	-0.348–0.329
Ethnicity	-0.057	0.172	-0.397–0.283	-0.009	0.162	-0.330–0.312
Level of injury	-0.317	0.169	-0.651–0.017	-0.493**	0.166	-0.823–(-0.164)
Injury duration (years)	-0.006	0.009	-0.024–0.012	0.007	0.009	-0.011–0.025
Health conditions	0.506**	0.184	0.141–0.871	0.409*	0.178	0.057–0.760
Physical ability				0.373***	0.091	0.192–0.553

* $P < 0.05$.

** $P < 0.01$.

*** $P < 0.001$.

Table 5 Factors associated with SRH among persons with SCI by level of injury: paraplegics vs. tetraplegics

Variables	Model 3a			Model 3b		
	Paraplegics ($R^2 = 0.274$; $n = 78$)			Tetraplegics ($R^2 = 0.263$; $n = 59$)		
	<i>b</i>	SE	95% CI	<i>b</i>	SE	95% CI
Age (years)	0.013	0.012	−0.011–0.036	0.013	0.011	−0.009–0.035
Gender	0.016	0.234	−0.450–0.483	0.061	0.265	−0.470–0.592
Ethnicity	0.260	0.227	−0.192–0.712	−0.353	0.234	−0.822–0.117
Injury duration (years)	0.011	0.013	−0.014–0.036	−0.004	0.013	−0.030–0.022
Health conditions	0.171	0.250	−0.327–0.669	0.619*	0.254	0.109–1.129
Physical ability	0.553***	0.131	0.293–0.814	0.183	0.126	−0.070–0.436

* $P < 0.05$.** $P < 0.01$.*** $P < 0.001$.

and level of injury were not related to SRH ($P = 0.541$; $P = 0.063$).

Model 2 was constructed to determine the relationship between SRH and physical ability, after controlling for the covariates in Model 1. Results indicate that physical ability was significantly associated with SRH even after controlling for potential confounders ($P < 0.001$). As well, level of injury was an independent predictor of SRH in Model 2 (non-significant in Model 1) suggesting a possible interaction between physical ability and level of injury.

To disentangle the relative influences on SRH, all possible two-way interactions among the variables in Model 2 were investigated. Only the interaction between physical ability and level of injury ($P = 0.028$) was found to be significant. To aid in interpreting this finding, the sample was divided by level of injury and regression Model 3 was estimated by repeating Model 2 for each of the two subsamples. Table 5 shows that physical ability was highly related to SRH for persons with paraplegia (Model 3a) but not for persons with tetraplegia (Model 3b). The number of health conditions was significantly related to SRH for persons with tetraplegia, as it was for the whole sample, but was not a factor for participants with paraplegia. No specific health condition was associated with SRH for either paraplegics or tetraplegics.

Discussion

The purpose of this study was to explore the relationship between SRH (ICF ‘health’) and physical ability (ICF ‘activity’) in SCI survivors. Despite the developed literature on SRH, there is a notable lack of studies focused on SRH among populations living with severe disabilities like SCI. Participants in our sample reported levels of SRH that are somewhat higher than studies of persons with SCI documented elsewhere¹³ (mean 3.5 vs. 3.1). Furthermore, the sample’s SRH was not

very different from that reported by the general population.^{4,5} This finding supports the notion that disability and health are separate constructs, and is consistent with the literature on disability and quality of life which documents high subjective quality-of-life ratings even for individuals who are severely disabled.^{18,29–32}

Consistent with other literature on SRH, we found that individuals reporting more health conditions also rated their health as less robust. Health conditions have been recognized as a strong predictor of SRH among the general population^{23,24} as well as disabled populations.³³ This makes intuitive sense since individuals who have more health conditions should rate their health less positively.

SRH has been long studied among older adults and one of the main contributions of this literature has been to establish a strong link between physical disability (often measured as a number of limitations in basic or instrumental activities of daily living (ADL or IADL)) and SRH.^{9,11,12,34} Thus, from the aging and SRH literature we might expect that persons with significant disability like SCI would rate their health more negatively than their able-bodied counterparts. Yet, it is already known that many persons living with SCI rate their health very positively,¹⁶ which is also the case in our sample as we noted above. Based on the results of this study, we suggest that the factors that influence SRH among individuals with disability who are younger and otherwise healthy (aging with disability) may be different from those that are salient for older adults (aging into disability). Indeed, we found that in our sample (Table 4, Model 1) level of injury was not related to SRH, after adjusting for relevant covariates. Instead, it is the number of health conditions that was significantly related to SRH, suggesting that the relationship between physical disability and SRH does not hold for persons with SCI in the same way that it does for older adults.

Nonetheless, our finding that the level of injury is not linked to SRH does not mean that physical ability is unimportant for persons with SCI. Subjective ratings of physical ability were significantly associated with SRH – study participants who rated their physical ability higher also reported better SRH (Table 4, Model 2). Closer examination revealed an interaction between injury level and self-rated physical ability. Analysis of this interaction showed that ratings of physical ability were importantly related to SRH for individuals who were less severely impaired (paraplegia), whereas they were not important for more individuals with more severe impairment (Table 5, Models 3a and 3b).

Our tentative interpretation of this finding, at least in part, is that physical ability in and of itself may not be a determinant of SRH, but rather *the degree to which one's self-assessed physical ability is consonant with one's perception of what this physical ability should be*. Thus, ratings of physical ability are more strongly related to SRH for individuals with paraplegia because they expect to be able to do more, and negatively affect SRH if they perceive they are able to do less than what they feel they should be able to do. However, we do not have a good explanation of why a perception of lower than expected physical ability results in diminished SRH. We note that although the number of health conditions was not different for persons with paraplegia and tetraplegia in our sample, the number of health conditions was negatively correlated with physical ability for paraplegics but not for tetraplegics. Thus, it is possible, we speculate, that persons with paraplegia feel the burden of comorbidities more acutely whereby more health conditions lower perceptions of physical ability resulting in an increase in the disconnect between one's ratings of physical ability and one's expectations of what this ability should be.

More research is needed to determine whether individuals with different injury levels judge their physical ability to do things differently, and in turn, how these judgments may shape more global judgments like SRH.

With our findings, and our suggested explanations for them, we concur with Krahn *et al.*¹³ when they say 'In predicting SRH ... what appears relevant is the ability to carry out one's roles, regardless of how that is accomplished'. If future research is truly to probe the activity–health relationship as theorized by the ICF, it would also be appropriate to measure much more thoroughly under what conditions persons with SCI choose to engage in an activity for which they have the physical capacity, and when they do not. Previous research in SCI has demonstrated this 'can do/does do' distinction and

described an array of reasons why persons with SCI who have the capacity to perform certain activities do not do them routinely.³⁵ Therefore, the salient metric for SRH may be whether an individual with SCI believes that they have the capacity to do the activity if they desired and not whether they perform it independently in practice. Finally, while the measurement of actual and not perceived physical ability is important, tapping into the subset of meaningful activities that an individual truly desires to engage in may be the most critical factor that shapes the overall ratings of health.

The study findings are tempered by a number of limitations. First, the study was cross sectional in design; this allows findings to be interpreted only as associations and not as predictive. Future research should include longitudinal designs to examine whether changes in physical ability to do activities predict changes in SRH as well. Second, the sample was limited to volunteers in metropolitan Detroit and was relatively small. Third, all the covariates included in our models were based on self-reports, including reports of health conditions and level of injury. Fourth, the measure of physical ability was based on responses to a single question developed for the purposes of this study. For future research, studies using larger samples, and a more comprehensive assessment of activity or even a performance-based tool should be considered. We could then determine whether a performance-based measure of physical ability or a subjective measure of physical ability is more salient for SRH. Finally, the use of parametric methods (linear regression) on ordinal data in our analysis is a limitation, but, as reported earlier, the same approach has been used elsewhere.^{26–28} As a check on our results, the linear model was replicated using binary logistic regression with the dependent variable dichotomized into positive vs. negative SRH. Both linear and logistic regression models provided results not materially different from each other.

Conclusion

This study is one of the first to further the understanding of SRH and its structure among SCI survivors, an important disability group. Our findings suggest that the factors that influence SRH among this group of individuals with physical disabilities are not only similar (number of health conditions and physical ability) to what is reported in the literature for older individuals, but also different in that level of injury is not a significant factor for SRH among persons with SCI in the absence of queries about an individual's perceived physical ability. This difference is likely due to the fact that the persons with SCI are often young when injured,

are disabled due to a traumatic event, and therefore are *aging with* a physical disability, rather than *aging into* a physical disability due to deteriorating health conditions. As research is expanded to investigate how individuals with disabilities other than SCI rate their health, we also need to consider other factors such as age of disability onset³⁶ as well as cause of injury, severity of impairments, and its duration, because all of them will likely play important roles in yet unknown ways. Our study also points to the importance of properly measuring physical ability and activity among persons with physical disability. The challenge for future research would be to replicate the study using additional and more detailed measures that would accurately distinguish the physical capacities of persons with SCI and other disabilities and to explore the role of expectations of physical ability vs. objective performance that may importantly affect the relationship between activity and SRH.

References

- 1 Idler EL, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. *J Health Soc Behav* 1997;38(1): 21–37.
- 2 Jylha M. What is self-rated health and why does it predict mortality? Towards a unified conceptual model. *Soc Sci Med* 2009; 69(3):307–16.
- 3 Mossey JM, Shapiro E. Self-rated health: a predictor of mortality among the elderly. *Am J Public Health* 1982;72(8):800–8.
- 4 Health and Retirement Study. Documentation. Content. Core content 2008 [accessed 2010 Feb 15]. Available from: <http://hrs online.isr.umich.edu/index.php?p=showcontent#LC>.
- 5 Behavioral Risk Factor Surveillance System. Prevalence and trends data. Health status 2008 [accessed 2010 Feb 15]. Available from: <http://apps.nccd.cdc.gov/BRFSS/list.asp?cat=HS&yr=2008&q key=1100&state=All>.
- 6 National Spinal Cord Injury Center. Annual statistical report 2009 [accessed 2010 Feb 15]. Available from: https://www.nscisc.uab.edu/public_content/annual_stat_report.aspx.
- 7 Stucki G. International classification of functioning, disability, and health (ICF): a promising framework and classification for rehabilitation medicine. *Am J Phys Med Rehabil* 2005;84(10):733–40.
- 8 W.H.O. I. Classification of functioning, disability and health. Geneva, Switzerland: World Health Organization; 2001.
- 9 Gama EV, Damian JE, Perez de Molino J, Lopez MR, Lopez Perez M, Gavira Iglesias FJ. Association of individual activities of daily living with self-rated health in older people. *Age Ageing* 2000;29(3):267–70.
- 10 Guralnik JM, Seeman TE, Tinetti ME, Nevitt MC, Berkman LF. Validation and use of performance measures of functioning in a non-disabled older population: MacArthur studies of successful aging. *Aging (Milano)* 1994;6(6):410–9.
- 11 Hoeymans N, Feskens EJ, Kromhout D, van den Bos GA. Ageing and the relationship between functional status and self-rated health in elderly men. *Soc Sci Med* 1997;45(10):1527–36.
- 12 Jylha M, Guralnik JM, Balfour J, Fried LP. Walking difficulty, walking speed, and age as predictors of self-rated health: the women's health and aging study. *J Gerontol A Biol Sci Med Sci* 2001;56(10):M609–17.
- 13 Krahn GL, Suzuki R, Horner-Johnson W. Self-rated health in persons with spinal cord injury: relationship of secondary conditions, function and health status. *Qual Life Res* 2009;18(5):575–84.
- 14 Lysack C, Komanecky M, Kabel A, Cross K, Neufeld S. Environmental factors and their role in community integration after spinal cord injury. *Can J Occup Ther* 2007;74(Spec No.): 243–54.
- 15 Noreau L, Proulx P, Gagnon L, Drolet M, Laramée MT. Secondary impairments after spinal cord injury: a population-based study. *Am J Phys Med Rehabil* 2000;79(6):526–35.
- 16 Lysack C, Neufeld S, Machacova K. Self-rated health among spinal cord injury survivors: speculations for the future. *Int J Therapy Rehabil* 2010;17(12):648–53.
- 17 Dijkers M. 'What's in a name?' The indiscriminate use of the 'Quality of life' label, and the need to bring about clarity in conceptualizations. *Int J Nurs Stud* 2007;44(1):153–5.
- 18 Dijkers MP. Quality of life of individuals with spinal cord injury: a review of conceptualization, measurement, and research findings. *J Rehabil Res Dev* 2005;42(3 Suppl 1):87–110.
- 19 Charlifue SW, Weitzenkamp DA, Whiteneck GG. Longitudinal outcomes in spinal cord injury: aging, secondary conditions, and well-being. *Arch Phys Med Rehabil* 1999;80(11):1429–34.
- 20 Kalpakjian CZ, Scelza WM, Forchheimer MB, Toussaint LL. Preliminary reliability and validity of a spinal cord injury secondary conditions scale. *J Spinal Cord Med* 2007;30(2):131–9.
- 21 Krause JS, Kemp B, Coker J. Depression after spinal cord injury: relation to gender, ethnicity, aging, and socioeconomic indicators. *Arch Phys Med Rehabil* 2000;81(8):1099–109.
- 22 McKinley WO, Gittler MS, Kirshblum SC, Stiens SA, Groah SL. Spinal cord injury medicine. 2. Medical complications after spinal cord injury: identification and management. *Arch Phys Med Rehabil* 2002;83(3 Suppl 1):S58–64, S90–8.
- 23 Hoeymans N, Feskens EJ, Kromhout D, van den Bos GA. The contribution of chronic conditions and disabilities to poor self-rated health in elderly men. *J Gerontol A Biol Sci Med Sci* 1999; 54(10):M501–6.
- 24 Molarius A, Janson S. Self-rated health, chronic diseases, and symptoms among middle-aged and elderly men and women. *J Clin Epidemiol* 2002;55(4):364–70.
- 25 Hellevik O. Linear versus logistic regression when the independent variable is a dichotomy. *Qual Quant* 2009;43:59–74.
- 26 Lee Y, Shinkai S. A comparison of correlates of self-rated health and functional disability of older persons in the Far East: Japan and Korea. *Arch Gerontol Geriatr* 2003;37(1):63–76.
- 27 Hertzman C, Power C, Matthews S, Manor O. Using an interactive framework of society and life course to explain self-rated health in early adulthood. *Soc Sci Med* 2001;53(12):1575–85.
- 28 Parkkari T, Deeg DJ, Bosscher RJ, Launer LL. Physical activity and self-rated health among 55- to 89-year-old Dutch people. *J Aging Health* 1998;10(3):311–26.
- 29 Albrecht GL, Devlieger PJ. The disability paradox: high quality of life against all odds. *Soc Sci Med* 1999;48(8):977–88.
- 30 Abrantes-Pais Fde N, Friedman JK, Lovullo WR, Ross ED. Psychological or physiological: why are tetraplegic patients content? *Neurology* 2007;69(3):261–7.
- 31 Dijkers MP. Quality of life after spinal cord injury: a meta analysis of the effects of disablement components. *Spinal Cord* 1997;35(12): 829–40.
- 32 Dijkers MP. Individualization in quality of life measurement: instruments and approaches. *Arch Phys Med Rehabil* 2003;84(4 Suppl 2):S3–14.
- 33 Mitchell JM, Adkins RH. Differences in predictors of self-rated health among people with and without a disability. *J Rehabil* 2009;75(2):35–42.
- 34 Guralnik JM, Simonsick EM, Ferrucci L, Glynn RJ, Berkman LF, Blazer DG, et al. A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. *J Gerontol* 1994;49(2):M85–94.
- 35 Lysack CL, Zafonte CA, Neufeld SW, Dijkers MP. Self-care independence after spinal cord injury: patient and therapist expectations and real life performance. *J Spinal Cord Med* 2001;24(4): 257–65.
- 36 Jamoom EW, Horner-Johnson W, Suzuki R, Andresen EM, Campbell VA. Age at disability onset and self-reported health status. *BMC Public Health* 2008;8:10.
- 37 Cohen J. Statistical power analysis for the behavioral sciences (second edition). Lawrence Erlbaum Associates: New Jersey; 1988.