



Contents lists available at ScienceDirect

## Disability and Health Journal

journal homepage: [www.disabilityandhealthjnl.com](http://www.disabilityandhealthjnl.com)

## Vitality and mental health in disability: Associations with social relationships in persons with spinal cord injury and their partners

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### ARTICLE INFO

#### Article history:

Received 3 August 2016

Received in revised form

13 December 2016

Accepted 14 December 2016

#### Keywords:

Social relationships

Loneliness

Mental health

Vitality

Spinal cord injury

### ABSTRACT

**Background:** Various social relationship constructs have been proposed to affect mental health. However, these constructs have rarely been studied in a comprehensive way in persons with chronic disabilities and their partners, inhibiting researchers from evaluating their relative importance.

**Objective:** To investigate 1) the variation in the quantity and quality of social relationships in persons with spinal cord injury (SCI) and their partners; 2) dyadic coherence within social relationship constructs; 3) the interrelationships between social relationship constructs; and 4) the associations of social relationship constructs with vitality and mental health.

**Methods:** Cross-sectional survey data from 133 couples of persons with SCI and their partners was used. Quantitative (social networks) and qualitative aspects (social support, relationship quality, loneliness, and reciprocity in partnerships) of social relationships were assessed. Correlations were performed to analyse dyadic coherence and interrelationships of social relationship constructs and multivariable regressions were applied to examine associations with vitality and mental health.

**Results:** Loneliness, larger social networks and higher relationship quality were more prevalent in SCI. All social relationship constructs, apart from loneliness, were more similar within couples than between couples and the interrelationships between different constructs were small. Qualitative aspects of relationships were more important than the quantitative aspects in their associations to vitality and mental health. These associations were most consistent for loneliness, reciprocity and relationship quality in both groups.

**Conclusions:** In the long-term management of community functioning in persons with SCI and their partners, the fostering of high quality intimate relationships should take priority.

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### Disclosures

The authors have no conflicts of interest to declare. This study has been financially supported by the Swiss National Science Foundation (SNF; Grant Number 100017\_153256/1; to MB and CF) and by the Swiss Paraplegic Foundation, Nottwil, Switzerland.

### 1. Introduction

Health-related sociological research has consistently shown that social relationships can have a substantial impact on health.<sup>1</sup> Social

integration, strong social networks and the associated functional resources have been shown to predict morbidity and mortality.<sup>2</sup> Similarly, social isolation and conflicting social relationships exert significant adverse effects on health and survival.<sup>3</sup> The association to mental health has been the most prominently reported in the literature. To investigate the associations between social relationships and mental functioning, vitality and mental health have been selected as indicators.<sup>4</sup> Vitality assesses an important motivational aspect of self-reported health, namely the level of energy available to engage in agency and in striving for goals.<sup>5</sup> Good mental health is imperative for satisfactory engagement in social roles, and thereby closely related to social relationships.<sup>6</sup>

A seminal review of the different sociological constructs of social relationships provided by Berkman et al. (2000) discriminated between upstream and downstream factors.<sup>1</sup> Upstream factors

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include the broader social structure and quality of opportunities for social integration (e.g., culture, labor market, neighborhood) and its quality (e.g., social capital).<sup>1,6</sup> Upstream factors shape the nature and characteristics of social networks that facilitate opportunities for downstream resources such as social support and quality of close social contacts. These latter two dimensions, social networks and social support or quality of relationships define the core content of empirical research at the individual level. Thus far, few studies have addressed different social relationship constructs in a comprehensive approach towards studying associations with vitality and mental health.<sup>7</sup> The inclusion of a wide range of social relationship constructs may demonstrate their potentially differential associations with health. Definitions of the social relationship constructs included in this study can be found in Table 1.

In this contribution, we aim to address the issue of vitality and mental health in relation to social relationships with a particular focus on persons with a physical disability. The exploration of social relationships and their associations to vitality and mental health in persons with disabilities is particularly important, given that people with functional limitations are generally disadvantaged in their opportunities to fully participate in social life.<sup>8</sup> Due to environmental barriers and the attitudes of significant others, persons with disabilities may experience limitations in their engagement in and maintenance of social relationships and may also experience a changing role within their social networks.<sup>9,10</sup> The partners of persons with disabilities are oftentimes involved in costly, long term social engagement as confidants and caregivers.<sup>11</sup> Even when the provision of caregiving is not necessary, the partners may adapt their social environment in accordance with the perceived limitations of the person with disabilities. Studying social relationships in this context therefore provides the opportunity to understand social relationships and their association with vitality and mental health in a potentially asymmetrical dyad, whereby involvement in social networks and the provision and receipt of social resources may be unequal.

In this study, we use spinal cord injury (SCI) as an informative case in point as this condition has a far-reaching impact on an individual's functioning and often leads to major disability. Affected persons sustain a complete or partial loss of sensory and motor function below the lesion level, which potentially impacts on their interaction with the social environment.<sup>12,13</sup> The goal of this study is therefore to explore social relationships and their associations to vitality and mental health in persons with SCI and their partners. More specifically, the aims are to investigate 1) the variation in the quantity and quality of social relationships in persons with SCI and their partners; 2) dyadic coherence in social relationship constructs; 3) the interrelationships of the social relationship constructs in order to demonstrate that they are distinct constructs; and 4) the associations between the diverse social relationship constructs with vitality and mental health.

## 2. Methods

### 2.1. Study design

Pro-WELL is a longitudinal community-based survey with three measurement waves spaced over a 12 month period (t0 baseline; t1: month 6; t2: month 12). Data were collected using standardized telephone interviews and questionnaires (paper-pencil or online). This paper uses cross-sectional data from the baseline assessment that was carried out between May 2015 and January 2016. In total, 676 persons with SCI were eligible and 133 couples of persons with SCI and their partners were recruited at baseline (total n = 266). Although the response rate was restrained (19.7%), a comprehensive non-response analysis demonstrated good representation of the source population with insignificant selection bias regarding sociodemographic and lesion characteristics.<sup>25</sup> The study protocol and all measures were approved by the Ethical Committee of Northwest and Central Switzerland (document EKNZ 2014-285). We strictly observed all regulations concerning informed consent and data protection. A more detailed description of the study design is provided in the cohort profile of the pro-WELL study.<sup>25</sup>

### 2.2. Sampling frame and participants

Participants for the pro-WELL study were recruited from a larger study, namely the community survey of the Swiss Spinal Cord Injury Cohort Study (SwiSCI). The SwiSCI survey included persons with traumatic or non-traumatic SCI aged over 16 years living in Switzerland and excluded persons with congenital conditions leading to SCI, new SCI in the context of palliative care, neurodegenerative disorders, and Guillain-Barré syndrome.<sup>26</sup> Details of the study design, recruitment outcomes and participation rates of the SwiSCI survey are reported elsewhere.<sup>27,28</sup> The first wave of the SwiSCI community survey (September 2011–March 2013; n = 1922) served as the sampling frame for the pro-WELL recruitment. All persons aged 30–65 at the time of the pro-WELL recruitment who spoke German or French were contacted for eligibility screening (n = 1108). Eligibility screening assessed if the person was in a stable relationship and if their partners also agreed to participate, as only couples were included in the pro-WELL study. Persons with severe cognitive impairment, as assessed by their understanding during telephone eligibility screening of what their involvement in the study would entail were excluded and partners needed sufficient language skills in German or French for study participation.<sup>25</sup>

### 2.3. Measures

#### 2.3.1. Social relationship constructs

**Social networks.** The availability of social relationships was

**Table 1**  
Definitions of relevant social relationship constructs.

The following definitions illustrate the distinctness of each individual social relationship construct. *Social networks* describe the size, density, frequency and duration of social contacts,<sup>14</sup> whereas *social support* emphasizes the functional significance in terms of providing and receiving instrumental, emotional or informational resources.<sup>15</sup> The distinction between perceived (subjective) and received (objective) social support is also important as in some cases, acts of social support may lead to distress in recipients rather than reassurance (e.g., the case of overprotection).<sup>16,17</sup> Further aspects of the *quality of relationships*, in particular its depth (e.g., meaningfulness, positive role of the partner) or its negative characteristics (conflicts and hostility) need to also be considered in this comprehensive approach. Tense or overly demanding relationships may be a source of stress which cancel out the beneficial effect of other forms of social resources or social contact.<sup>18</sup> In addition to these more conventional measures, the spectrum of social relationships has been enriched by including measures of loneliness and reciprocity, both of which are subjective evaluations of relationship quality. *Loneliness* is experienced as a reaction to an individual's ideal of a relationship, assessing the discrepancy between the relationships they have, and the relationships they would like to have. Feelings of loneliness can occur independently of the availability of social contacts, and it is this appraisal which matters for health.<sup>19</sup> *Reciprocity* is a social norm of equivalence between give and take embedded within social exchange, and when this norm is violated by an unequal provision or receipt of social resources, a feeling of unfair or unjust treatment is experienced.<sup>20</sup> Failed reciprocity in terms of high efforts spent and low reward received, in turn elicits strong negative emotions and associated stress reactions with adverse long term effects on health.<sup>21</sup> Several studies have shown a detrimental effect of failed reciprocity on health, independent of social support, supporting the notion of reciprocity as a distinct concept.<sup>22–24</sup>

measured using five items from the Social Network Index (SNI).<sup>29</sup> The SNI is a composite measure of four types of social connection: marital status (married = 1; not married = 0); church group membership (yes = 1; no = 0); membership in other community organisations (yes = 1; no = 0), and sociability (high = 1; low = 0).<sup>29</sup> The latter concept included two items assessing the number of close friends and relatives. Persons indicating having at least three friends or relatives with which they were closely in touch were coded as 1, whereas persons indicating a lower number were coded as 0. In summary, each of the four types of social connection was scored with either 0 or 1 to signify whether an individual had access to this type of social connection or not. As none of the included persons received a 0 in all four types of social connection, the individual's SNI sum score included 4 categories ranging from 1 to 4.<sup>30</sup> Due to the low frequency of individuals scoring 1, the sum score was grouped into three categories ( $\leq 2$ ; 3; 4) for use in multivariable analysis.

**Social support.** Emotional and tangible aspects of perceived social support were measured with items from the Swiss Health Survey (SHS) 2012. Emotional support was assessed using the question "Among the people you are close to, do you have somebody who you can always talk to about personal problems?", response options included: none; one person; several persons.<sup>31</sup> Tangible support was assessed in the following areas: housework, health issues, financial issues, activities of daily living (in persons with SCI only), and caregiving (in partners only). Response options for each area were: none; one person; several persons. This resulted in a sum score ranging from 0 to 8. Due to the linear relationship between tangible support and both outcomes a continuous variable was used in multivariable analysis.

**Relationship quality.** Quality of partner relationship was assessed using items from the social support and depth subscales of the Quality of Relationship Inventory (QRI), eight items were rated on a 4-point Likert scale, resulting in a sum score ranging from 0–24.<sup>32</sup> Thus the meaningfulness and the positive role of the partnership, along with the extent to which one could turn to one's partner for support, and the responsibility or need one felt for their partner were assessed. The Cronbach's alpha across all 8 items was 0.82, demonstrating satisfactory internal consistency in our sample. To capture the non-linear relationship between the quality of relationship sum score and both of the study outcomes, three categories were created to represent individuals with low (0–13), middle (14–18), and high quality relationships (19–24). Cut offs were defined based on graphical inspection. To investigate correlations between different social relationship constructs (Tables 4 and 5), the sum score ranging from 0 to 24 was used. For multivariable analysis testing the association of relationship quality with mental health and vitality, the categorical variable was introduced (low, middle, high quality).

**Loneliness.** Three items from the Revised UCLA loneliness scale<sup>33</sup> were used to capture subjective feelings of loneliness, with a score ranging from 0 to 6. This scale has recently been validated in an SCI population.<sup>34</sup> Due to the skewed distribution of responses, we dichotomised the score in order to discriminate persons who sometimes or often felt lonely from persons who never felt lonely.

**Reciprocity.** Reciprocity in partner relationship was examined with an item used effectively in established cohort studies (i.e. GAZEL<sup>24</sup> and Whitehall II<sup>23</sup>). This item asks "Have you always been satisfied with the balance between what you have given your partner and what you have received in return?", and is rated on a 4-point Likert scale. Reciprocity was dichotomized to represent persons with little or no reciprocity in partner relationships as compared to persons with high reciprocity.

## 2.4. Vitality and mental health

Two subscales of the 36-Item Short Form Health Survey (SF-36, version 1.0) were used to assess vitality and mental health. For both subscales, a sum score ranging from 0 to 100 was computed according to recognised scoring algorithms.<sup>35</sup> Higher scores indicate better mental health and higher vitality.

## 2.5. Confounders

To identify potential confounding variables, a preliminary analysis was undertaken which assessed associations between sociodemographic, socio-economic, social relationship and health variables (results displayed in the supplementary material). Variables significantly related to both, the independent (in this case social relationship constructs) and the dependent variable (vitality and mental health), were included as confounders in both multivariable models. These included paid employment and financial hardship. Paid employment is a dichotomous variable indicating whether a person is in paid employment (yes or no), and financial hardship is a single item assessing participants ability to manage with their available financial resources. Response options included 'very scarce; scarce; just lasts; lasts good; lasts very good'. Age, gender, hours of caregiving (for partners) and lesion severity (for persons with SCI) were also included in multivariable models due to evidence suggesting their confounding effects.<sup>36</sup>

## 2.6. Statistical analysis

Analyses were conducted using STATA version 14.0 for Windows (College Station, TX, USA). Firstly, we described the distribution of social relationship constructs, vitality and mental health in persons with SCI and their partners, using t tests for continuous variables and Wilcoxon matched pairs sign rank tests for ordinal variables in comparative analysis. Intra-class correlations were computed to assess dyadic coherence in social relationship constructs, vitality and mental health. If the within dyad variation is smaller than the between dyad variation, it can be inferred that couples are more similar than non-couples.

Within and between population correlations were computed to gain an in-depth understanding of the associations between all distinct social relationship constructs in persons with SCI and their partners. Following Cohen,<sup>37</sup> absolute correlation coefficients with successive lower limits of 0.10, 0.30, 0.50 were considered as small, medium and large respectively.

Regression analyses were performed separately for persons with SCI and their partners. Tobit regression was utilized to investigate the association of social relationships with vitality and mental health, as to account for ceiling effects in both dependent variables.<sup>38</sup> The coefficients of such models may be interpreted in a similar manner to ordinary least squares regression coefficients, acknowledging that the linear effect is on the uncensored latent variable rather than the observed dependent variable. Two sets of regression models were computed: Model 1 was univariable (unadjusted), Model 2 was adjusted for age, gender, employment status, financial hardship, lesion severity (SCI only) and hours of caregiving (partner only). Coefficients with 95% confidence intervals, and *p* values are presented.

Item nonresponse was addressed using multiple imputation (MI). MI by chained equations (MICE) was applied to impute all independent variables but no dependent variables.<sup>39</sup> For each model, imputations were carried out for 20 datasets. Given that pro-WELL well represented the source population, we refrained from adjusting for unit non-response.<sup>25</sup>

### 3. Results

A total of 133 persons with SCI and 133 partners were included in this study. The majority of persons with SCI were male (73.7%), with a mean age of 51.5 years. The majority of persons with SCI were paraplegic and the mean time since injury was 21.1 years. The majority, 57%, of persons with SCI had paid employment and 33.1% experienced financial hardship. The mean age of the partners was 49.7 years, 66.9% had paid employment and 33.8% experienced financial hardship. Average daily load of caregiving was 1.8 h (see Table 2).

#### 3.1. Study aim 1: Variation of social relationships in persons with SCI and partners

Descriptive statistics of the study variables can be found in Table 3. Persons with SCI showed significantly larger social networks, better relationship quality and a higher level of loneliness than partners. Persons with SCI reported having access to emotional support from more than one persons ( $p = 0.069$ ), however, differences were small and inconclusive. Partners indicated better vitality and mental health than persons with SCI, although differences were indecisive.

#### 3.2. Study aim 2: Dyadic coherence in social relationship constructs

Intra-class correlations of social relationship constructs indicated that most aspects of social relationships were more similar within couples than between couples as within dyad variation was smaller than between dyad variation in all of the social relationship constructs (Table 3). The only construct to not show this decisively was loneliness, meaning that the variation in loneliness within partnerships was comparable to the average variation in loneliness in the population ( $p = 0.086$ ).

#### 3.3. Study aim 3: Interrelationships of the social relationship constructs

Distinct constructs of social relationships showed interrelationships, including relationship quality with reciprocity and loneliness, and emotional support with tangible support, both in persons with SCI and in partners (Table 4). The social network, relationship quality and perceived reciprocity of the person with SCI was positively correlated to that of their partner (Table 5). Reciprocity reported by either the person with SCI or partner was positively correlated with relationship quality in the partner or person with SCI.

#### 3.4. Study aim 4: Social relationships, mental health and vitality

Associations of social relationship constructs with vitality and mental health are displayed in Table 6. Loneliness was consistently negatively associated with vitality and mental health in both, partners and persons with SCI, in the unadjusted as well as the adjusted models. Persons with SCI who reported feeling lonely sometimes or often scored on average 15.0% lower in vitality and 14.2% lower in mental health than those who reported never feeling lonely. Similar associations were observed for partners, as partners who reported feelings of loneliness scored on average 10.7% and 10.0% lower on the vitality and mental health scales, respectively. An association to vitality and mental health was also found for reciprocity. Individuals with higher levels of reciprocity had an on average > 11.0% higher score in vitality (SCI and partner) and increased mental health, the effect of which was more apparent in partners (10.8% increase) than in persons with SCI (8.4% increase). Relationship quality was positively related to vitality in both groups, a 20.0% increase in those with middle quality relationships and 27.7% increase in those with high quality relationships compared to low quality relationships was observed in persons with SCI and a 17.8% increase in those with middle quality

**Table 2**  
Basic sociodemographic and lesion characteristics of the baseline sample of the pro-WELL study.

	Persons with SCI	Partners
Total [Missing values: SCI; partner]	133 (100)	133 (100)
<b>Categorical variables</b>	<b>N (% , 95% CI)</b>	<b>N (% , 95% CI)</b>
<i>Sociodemographic characteristics</i>		
Gender [0; 0]		
Male	98 (73.7, 65.5 to 80.5)	35 (26.3, 19.5 to 34.5)
Female	35 (26.3, 19.5 to 34.5)	98 (73.7, 65.5 to 80.5)
Paid employment [0; 0]	76 (57.1, 48.5 to 63.3)	89 (66.9, 58.4 to 74.4)
In a partnership before SCI [7; 7]	56 (44.4, 38.3 to 50.6)	56 (44.4, 38.3 to 50.6)
Financial hardship [4; 5]		
No	85 (63.9)	83 (62.4)
Yes	44 (33.1)	45 (33.8)
<i>Lesion characteristics</i>		
Lesion severity [2]		
Complete paraplegia	49 (37.4, 29.5 to 46.1)	--
Incomplete paraplegia	45 (34.4, 26.6 to 43.0)	--
Complete tetraplegia	13 (9.9, 5.8 to 16.4)	--
Incomplete tetraplegia	24 (18.3, 12.5 to 26.0)	--
Aetiology [3]		
Non-traumatic	21 (16.2, 10.7 to 23.6)	--
Traumatic	109 (83.8, 76.4 to 89.3)	--
<b>Continuous variables</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>
Age in years [1; 6]	51.5 (9.4)	49.7 (10.5)
Years of education [2; 7]	13.9 (3.2)	14.0 (3.1)
Household income [19; 17]	4585.0 (1493.2)	4376.3 (1567.9)
Years since injury [5]	21.1 (11.5)	--
Hours of caregiving [12]	--	1.8 (3.3)

Abbreviations: CI: Confidence interval; SCI: Spinal cord injury; SD: Standard deviation.

**Table 3**

Summary statistics for social relationship constructs, vitality and mental health in the baseline sample of the pro-WELL study.

	Persons with SCI	Partners	Difference (SCI-partner), <i>p</i> value†	ICC: Within dyad variation, between dyad variation, <i>p</i> value
Total [Missing values SCI; partner]	133 (100)	133 (100)		
<b>Social relationship constructs</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>Mean difference</b>	
Tangible support (0–8) [5; 10]	4.4 (1.6)	4.5 (1.8)	–0.1, 0.36	0.16, 0.28, 0.030
	<b>N (%), 95% CI)</b>	<b>N (%), 95% CI)</b>	<b>% difference</b>	
Social network index [3; 3]			<0.001	0.36, 0.53, <0.0001
I (socially isolated)	2 (1.5, 0.4 to 6.0)	23 (17.7, 12.0 to 25.3)	–16.2	
II	41 (31.3, 23.9 to 39.8)	49 (37.7, 29.7 to 46.4)	–6.4	
III	56 (42.8, 34.5 to 51.4)	36 (27.7, 20.6 to 36.1)	15.1	
IV (socially integrated)	32 (24.4, 17.8 to 32.6)	22 (16.9, 11.4 to 24.4)	7.5	
Emotional support [2; 3]			0.069	0.16, 0.28, 0.032
None	6 (4.6, 2.1 to 9.9)	6 (4.6, 2.1 to 10.0)	0	
One person	62 (47.3, 38.9 to 55.9)	75 (57.7, 49.0 to 65.9)	–10.4	
More persons	63 (48.1, 39.6 to 56.7)	49 (37.7, 29.7 to 46.4)	10.4	
Loneliness [3; 4]			0.037	0.12, 0.22, 0.086
Never (0)	68 (52.3, 43.7 to 60.8)	82 (63.6, 54.9 to 71.5)	–11.3	
Sometimes or often (≥1)	62 (47.7, 39.2 to 56.3)	47 (36.4, 28.5, 45.1)	11.3	
Relationship quality [2; 3]			0.042	0.39, 0.56, <0.0001
Low quality (≤13)	5 (3.8, 1.5 to 8.9)	6 (4.6, 2.1 to 9.6)	–0.8	
Middle quality (14–18)	18 (13.7, 8.7 to 20.8)	26 (17.7, 12.0 to 25.3)	–4.0	
High quality (≥19)	108 (82.4, 74.9 to 88.1)	101 (77.7, 69.7 to 84.0)	4.7	
Reciprocity [3; 3]			0.56	0.28, 0.44, <0.001
Not at all	5 (3.9, 1.6 to 9.0)	6 (4.6, 2.1 to 10.0)	–0.7	
A little	20 (15.4, 10.1 to 22.7)	16 (14.6, 9.5 to 21.9)	0.8	
Quite a lot	50 (38.5, 30.4 to 47.7)	55 (42.3, 34.0, 51.0)	–3.8	
High	55 (42.3, 34.0 to 51.0)	50 (38.5, 30.4, 47.2)	3.8	
<b>Vitality and mental health</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>Mean difference</b>	
Vitality (0–100) [3; 5]	55.5 (19.9)	60.0 (18.2)	–4.5, 0.057	0.28, 0.43, 0.001
Mental health (0–100) [3; 5]	70.9 (17.3)	74.2 (15.7)	–3.3, 0.056	0.35, 0.52, <0.0001

Abbreviations: ICC: Intra-class correlation; SCI: Spinal cord injury; SD: Standard deviation, CI: Confidence interval.

† *p* values from *t*-test for continuous variables and Wilcoxon matched pairs sign rank test for ordinal variables.**Table 4**

Individual perspective: Correlations (with 95% confidence intervals) between different social relationship constructs in persons with spinal cord injury (SCI) and partners.

	Social network	Emotional support	Tangible support	Loneliness	Relationship quality
<b>Persons with SCI</b>					
Social network	1.00				
Emotional support	–0.04 (–0.21, 0.13)	1.00			
Tangible support	–0.17 (–0.34, 0.00)*	0.22 (0.05, 0.38)**	1.00		
Loneliness	–0.17 (–0.33, 0.01)	0.05 (–0.13, 0.22)	0.03 (–0.15, 0.20)	1.00	
Relationship quality	0.15 (–0.03, 0.31)	0.00 (–0.17, 0.17)	–0.11 (–0.28, 0.07)	–0.32 (–0.47, –0.16)***	1.00
Reciprocity	0.11 (–0.06, 0.28)	–0.10 (–0.27, 0.07)	–0.06 (–0.23, 0.12)	–0.21 (–0.37, –0.04)*	0.52 (0.38, 0.64)***
<b>Partners</b>					
Social network	1.00				
Emotional support	–0.04 (–0.22, 0.13)	1.00			
Tangible support	–0.03 (–0.20, 0.15)	0.36 (0.19, 0.50)***	1.00		
Loneliness	–0.06 (–0.23, 0.11)	–0.03 (–0.20, 0.14)	–0.07 (–0.24, 0.10)	1.00	
Relationship quality	0.07 (–0.11, 0.24)	0.23 (0.06, 0.39)*	0.05 (–0.13, 0.22)	–0.28 (–0.43, –0.11)**	1.00
Reciprocity	0.03 (–0.14, 0.20)	0.17 (0.00, 0.34)	0.07 (–0.10, 0.24)	–0.17 (–0.33, 0.00)	0.63 (0.51, 0.72)***

\**p* ≤ 0.05; \*\**p* ≤ 0.01; \*\*\**p* ≤ 0.001.

relationships and 21.4% increase in those with high quality relationships compared to low quality relationships was observed in partners. The association of relationship quality to mental health showed larger coefficients. Received emotional support showed positive associations with vitality and mental health in both groups, however there was weak support for this relationship in persons with SCI. Received tangible support was negatively associated with vitality in partners but not in persons with SCI (1.8% decrease in partners). In both populations, received tangible support demonstrated an inverse association with both health indicators, whereby

higher levels of tangible support were associated with lower levels of both vitality and mental health. The size and frequency of contact in social networks showed no significant association with either health indicator although mental health and vitality were tentatively enhanced for those with larger social networks.

#### 4. Discussion

This study examined associations of six different social relationship constructs among persons with a severe disability, SCI, and

**Table 5**  
Dyadic perspective: Correlations (with 95% confidence intervals) between different social relationship constructs in persons with spinal cord injury (SCI) and partners.

		Partners					
		Social network	Emotional support	Tangible support	Loneliness	Relationship quality	Reciprocity
Persons with SCI	Social network	0.49 (0.35, 0.62)***	-0.05 (-0.23, 0.13)	-0.12 (-0.29, 0.06)	-0.05 (-0.22, 0.13)	0.22 (0.05, 0.38)**	0.11 (-0.07, 0.28)
	Emotional support	-0.01 (-0.19, 0.16)	0.17 (-0.00, 0.34)	-0.01 (-0.19, 0.17)	0.07 (-0.11, 0.24)	0.04 (-0.14, 0.21)	0.02 (-0.16, 0.20)
	Tangible support	-0.01 (-0.19, 0.16)	0.35 (0.18, 0.49)**	0.18 (0.00, 0.34)	0.07 (-0.10, 0.25)	-0.02 (-0.19, 0.16)	-0.02 (-0.20, 0.16)
	Loneliness	-0.24 (-0.40, -0.07)*	0.00 (-0.18, 0.17)	0.09 (-0.09, 0.26)	0.13 (-0.05, 0.30)	-0.17 (-0.34, 0.00)*	-0.20 (-0.36, -0.02)*
	Relationship quality	0.09 (-0.09, 0.26)	0.07 (-0.11, 0.24)	-0.13 (-0.30, 0.05)	-0.15 (-0.32, 0.03)	0.36 (0.20, 0.51)***	0.19 (0.02, 0.36)**
	Reciprocity	0.11 (-0.07, 0.28)	0.10 (-0.08, 0.27)	-0.103 (-0.27, 0.07)	-0.16 (-0.33, -0.1)	0.27 (0.10, 0.43)**	0.27 (0.10, 0.43)**

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

their partners with two aspects of mental functioning, namely vitality and mental health. Interrelationships between the different social relationship constructs were weak apart from the correlation between the qualitative aspects of loneliness, relationship quality and reciprocity. Furthermore, this study demonstrated variability in the consistency and strength of associations with vitality and mental health across the different social relationships constructs. The most consistent and strongest associations were apparent in case of loneliness, reciprocity, and relationship quality, whereas no substantive associations were observed with our measure of social network. Receiving tangible support was found to be related to poorer health. This latter finding may indicate a disadvantaged situation requiring instrumental resources or an individual's negative reaction to help. This may be especially true in the case of potentially unequal relationships, whereby one individual may not have the opportunity to adequately reciprocate support received.<sup>40</sup>

The findings of this study suggest that social relationship constructs are generally distinct with only minor interrelationships. The distinctness of social relationship concepts has been established by other studies.<sup>41</sup> Our findings are nonetheless somewhat unexpected, in light of the theoretical framework of Berkman et al., who proposed that upstream factors such as network size provide social resources such as social support, which in turn provide opportunities for enriched relationship quality and diminished perception of loneliness.<sup>19</sup> Conversely, our study demonstrates minimal correlation between social network size and qualitative measures of relationships. In the case of disability and caregiving this may be due to the inability of the network to provide the required kind of support, or to the individual's unwillingness to accept the support offered by the network in a bid to retain autonomy.<sup>42</sup> Other explanations may include the potential for a network to be a source of conflict and hostility,<sup>43</sup> or the potential threshold effects of social networks.<sup>44</sup> These assumptions need further investigation in populations with disabilities.

Our study highlights the importance of several qualitative aspects of social relationships in relation to poor self-rated health, in particular loneliness. Our results are in line with previous studies, which demonstrated that loneliness is a unique predictor, exerting stronger effects on self-reported health than social support and social networks.<sup>7,45</sup> The strength of association of loneliness with vitality and mental health is considered clinically relevant as a 3 to 5 point change in SF-36 subscale scores has been described as the minimal clinically important difference (MCID).<sup>46,47</sup> Clinically important differences were also found in the associations of reciprocity, relationship quality and received emotional support with vitality and mental health. The bulk of research concerning loneliness has been carried out in ageing populations. In comparison, our study highlights the association of loneliness with vitality and mental health in mid-life, when individuals are traditionally engaged in a number of key social roles, such as paid work and

community organizations. The barriers to these roles in the case of disability may not be age, but rather functional capacity and the caregiving burden. Besides loneliness, other qualitative aspects of social relationships have provided evidence for their association with health. Reciprocity, relationship quality and to some extent emotional support also showed consistent associations with vitality and mental health. These associations were consistently stronger in partners than in persons with SCI, suggesting that social relationships may play a more crucial role in vitality and mental health in this population. Of these aspects, reciprocity was the one which demonstrated the strongest and most consistent associations in both populations. Reciprocity is a relatively new construct to be explored in social relationship research, its roots coming from effort reward imbalance theory and evolutionary psychology.<sup>22,48</sup> Research in the general population has shown a consistent association between reciprocity, health and wellbeing,<sup>23</sup> and our findings support this notion in a disability-caregiving dyad.

Social networks showed weak and inconsistent associations with mental health and vitality. It has previously been suggested that this might be explained by the fact that social networks exert an indirect rather than direct effect on health by providing resources and qualitative aspects.<sup>1,19</sup> As discussed above, our study contests this as no substantial correlation was found between the size of social networks and the social resources they potentially provide. This finding yet again points to the importance of intimate proximal ties and the quality of these relationships for health in persons with disabilities and their partners.

Interventions that enhance existing networks, by developing skills for effective mobilization, provision and receipt of social support may improve the quality of relationships and the associated feelings of reciprocity in both persons with SCI and their partners.<sup>49</sup> The profound effect which loneliness has on vitality and mental health is worrisome given that almost half of all persons with SCI and over a third of partners experienced feelings of loneliness. The encouragement of social connections through peer-to-peer contact, which is based on mutual empathy and understanding has been suggested to inhibit or reduce the perception of social isolation.<sup>50</sup> Future research may look at the effectiveness of such interventions in improving social relationships and thereby enhancing mental functioning.

#### 4.1. Limitations and strengths

This study is inherently subject to several limitations. Firstly, due to its cross-sectional nature, no causal inference can be attained and reverse causality cannot be excluded. Following, individuals with lower vitality and poorer mental health may be less likely to maintain social ties and as a result have poorer quality relationships. Secondly, although a wide array of social relationship constructs were included, other dimensions of social relationships

**Table 6**

Tobit regression of vitality and mental health on different social relationship constructs, coefficients and 95% confidence intervals (CI). Coefficients indicate absolute differences on respective scale ranges.

Effect size	Persons with SCI		Partners	
	Vitality	Mental health	Vitality	Mental health
Range	0–100		0–100	
	Coefficients (95% CI)	Coefficients (95% CI)	Coefficients (95% CI)	Coefficients (95% CI)
<b>Social Network Index</b>				
Model 1				
I (Socially Isolated)	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)
II	4.00 (–3.93, 11.93)	4.64 (–2.43, 11.70)	1.85 (–5.35, 9.05)	2.94 (–3.35, 9.24)
III (Socially Integrated)	7.13 (–1.97, 16.22)	7.33 (–0.77, 15.43)	9.96 (1.27, 18.64)	8.20 (0.75, 15.64)
<i>p</i> value	0.293	0.180	0.081	0.092
Model 2				
I (Socially Isolated)	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)
II	0.61 (–6.75, 7.98)	3.38 (–3.66, 10.40)	1.03 (–6.12, 8.17)	1.48 (–4.57, 7.52)
III (Socially Integrated)	3.90 (–4.58, 12.39)	6.78 (–1.33, 14.89)	8.40 (0.01, 16.80)	6.47 (–0.54, 13.48)
<i>p</i> value	0.625	0.256	0.139	0.186
<b>Emotional support</b>				
Model 1				
None	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)
One person	14.45 (–2.17, 31.07)	14.68 (0.01, 29.35)	20.29 (5.69, 34.88)	23.62 (11.04, 36.19)
More persons	11.19 (–5.41, 27.79)	8.85 (–5.79, 23.50)	13.16 (–1.73, 28.04)	21.47 (8.67, 34.28)
<i>p</i> value	0.197	0.051	0.006**	<0.001***
Model 2				
None	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)
One person	15.40 (0.19, 30.61)	17.13 (2.68, 31.57)	19.16 (4.96, 33.35)	20.91 (9.03, 32.80)
More persons	12.22 (–2.83, 27.28)	11.16 (–3.13, 25.45)	11.70 (–2.70, 26.09)	18.99 (6.93, 31.05)
<i>p</i> value	0.123	0.027*	0.005**	0.003**
<b>Tangible support</b>				
Model 1				
	–1.52 (–3.73, 0.70)	–1.35 (–3.35, 0.64)	–1.70 (–3.40, –0.01)	–0.35 (–1.85, 1.15)
<i>p</i> value	0.177	0.181	0.049*	0.644
Model 2				
	–1.58 (–3.55, 0.39)	–1.42 (–3.35, 0.50)	–1.83 (–3.46, –0.20)	–0.46 (–1.86, 0.94)
<i>p</i> value	0.119	0.147	0.028*	0.514
<b>Loneliness</b>				
Model 1				
Never	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)
Sometimes or often	–16.90 (–23.21, –10.60)	–15.13 (–20.82, –9.43)	–12.60 (–19.01, –6.18)	–11.70 (–17.30, –6.11)
<i>p</i> value	<0.001***	<0.001***	<0.001***	<0.001***
Model 2				
Never	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)
Sometimes or often	–15.00 (–20.75, –9.26)	–14.22 (–19.75, –8.63)	–10.74 (–17.07, –4.42)	–9.99 (–15.42, –4.56)
<i>p</i> value	<0.001***	<0.001***	<0.001***	<0.001***
<b>Relationship quality</b>				
Model 1				
Low quality	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)
Middle quality	20.00 (0.96, 39.04)	22.44 (5.75, 39.14)	17.77 (1.89, 33.64)	19.47 (5.96, 32.97)
High quality	27.66 (10.43, 44.89)	29.24 (14.12, 44.35)	21.37 (6.80, 35.93)	24.80 (12.39, 37.21)
<i>p</i> value	0.003**	<0.001***	0.014*	<0.001***
Model 2				
Low quality	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)
Middle quality	18.26 (0.59, 35.92)	21.17 (4.39, 37.96)	15.88 (0.49, 31.27)	18.01 (5.26, 30.76)
High quality	27.12 (11.41, 42.84)	29.14 (14.21, 44.08)	19.64 (5.37, 33.92)	22.72 (10.88, 34.57)
<i>p</i> value	<0.001***	<0.001***	0.022*	<0.001***
<b>Reciprocity</b>				
Model 1				
Low reciprocity	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)
High reciprocity	13.92 (5.44, 22.20)	8.81 (1.14, 16.48)	13.48 (5.75, 21.21)	12.96 (6.40, 19.52)
<i>p</i> value	0.002**	0.025*	<0.001***	<0.001***
Model 2				
Low reciprocity	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)	0.00 (Reference)
High reciprocity	11.79 (4.04, 19.54)	8.35 (0.79, 15.92)	11.90 (4.21, 19.59)	10.87 (4.56, 17.17)
<i>p</i> value	0.003**	0.031*	0.003**	<0.001***

Model 1: unadjusted.

Model 2: adjusted for age, gender, lesion severity (SCI only), hours of caregiving (partner only), paid employment, financial hardship.

\* $p \leq 0.05$ ; \*\* $p \leq 0.01$ ; \*\*\* $p \leq 0.001$ ; *p* values from Equal-Fraction-Missing information (FMI) test. Missing values were imputed by multiple imputation.

may have been neglected, most importantly, the provision of social support and certain aspects of negative social relationships such as conflict and hostility.<sup>18</sup> Thirdly, due to limited variation in certain social relationship constructs, as well as ceiling effects, persons with poorer quality social relationships may have been missed in our population. This sampling bias cannot be evaluated as variables

relating to social relationships were not available for non-response analysis.<sup>25</sup> Finally, there were potential limitations due to the measures used. For example, two of the social relationship constructs (i.e., emotional support, reciprocity) were measured by single items and some scales were further reduced by categorization (i.e., relationship quality) or dichotomization of scales (i.e.,

reciprocity). Non-linear relationships could therefore not be assessed. Dichotomization of some scales was reasonable given the low number of cases in some cells as for example in the case of reciprocity, where only  $n = 5$  persons with SCI and  $n = 6$  partners indicated the lowest possible grade of reciprocity. However, the collapsing of information did not distort main findings and conclusions of this study.

These limitations are balanced by several strengths. Firstly, the wide range of included constructs has enabled a comparative analysis in relation to vitality and mental health. In particular, the constructs of reciprocity, quality of relationship and loneliness were added to the more conventional constructs such as social network and social support. Secondly, the inclusion of couples facilitated the analysis of social relationships from two distinct perspectives and enabled comparisons to be drawn between a disabled and a caregiver population. Thirdly, vitality, a measure that has rarely been included in this type of research, emerged as the construct most consistently related to quality aspects of social relationships. Finally, all associations of social relationship constructs with health were adjusted for relevant confounders, thus minimizing the risk of reporting spurious relationships.

## 5. Conclusion

This study highlights the importance of several qualitative aspects of social relationships, namely loneliness, relationship quality and reciprocity, for vitality and mental health in persons with a physical disability and their partners. This result points to the need of strengthening the quality aspects of social relationships in the long-term management of community functioning in persons with SCI and their partners. In this context, the fostering of high quality intimate relationships should take priority.

## Acknowledgements

We are grateful to all the participants of the pro-WELL study for their time and effort spent in responding to our questions and to the research assistants for their great work in recruitment and data collection. We also acknowledge the support from the Steering Committee of the SwiSCI cohort study.

## Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.dhjo.2016.12.008>.

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