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ORIGINAL RESEARCH

Trajectories of Self-Efficacy, Depressed Mood, and Anxiety From Admission to Spinal Cord Injury Rehabilitation to 1 Year After Discharge

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Abstract

Objective: Self-efficacy (SE) is an important determinant for the psychological adjustment of people with spinal cord injury (SCI). However, little is known about the course of SE during inpatient rehabilitation up to 1 year after discharge. The aim of this study was to determine latent trajectory classes of SE, depressive mood, and anxiety in people with SCI, as well as the interrelationships between these trajectories.

Design: Longitudinal inception cohort study.

Setting: Eight specialized SCI rehabilitation centers.

Participants: The participants (N=268) were mainly men 183 of 268 (68.3%) with a mean age of 55.6 years. Almost half had a traumatic SCI 135 of 268 (50.4%) and tetraplegia (53.7%), and the minority had a motor complete SCI (32.2%).

Interventions: Not applicable.

Main Outcome Measures: SE was measured using the University of Washington Self-Efficacy Scale. In addition, the Hospital Anxiety and Depression Scale was used to asses distress and perform dual trajectory modeling analyses.

Results: Three trajectories of SE, indicating low, middle, and high SE, could be distinguished. Furthermore, a 2-class trajectory solution for depressive mood and a 4-class solution for anxiety were found to be most suitable. All trajectories were stable over time. Developmental connections between SE and depressive mood and between SE and anxiety were revealed. In particular, participants who adjusted well, reporting low scores on depressive mood and anxiety, could be identified by their high SE scores. However, the group of participants with high depressive mood scores and anxiety scores could not always be identified based on their SE trajectory.

Conclusions: In accordance with our hypotheses, distinct trajectories of SE, depressive mood, and anxiety were identified and high probabilities that SE trajectories were interrelated to the trajectories from depressive mood and anxiety were confirmed. Concurrent screening for SE and distress might best detect people at risk for adjustment problems.

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Many people with spinal cord injury (SCI) experience difficulties in adjusting to their condition,[1] resulting in elevated levels of depressive mood and anxiety.[1-4] It is estimated that the prevalence of major depression in people living with SCI is 22% (range, 7%-48%), which is much higher than the estimated 3% in the general population.[5,6] Similarly, the estimated prevalence of anxiety disorders for people living with SCI, is much higher (27%; range, 15%-32%) compared with the general population (7%).[7,8]

Psychological characteristics, such as self-efficacy (SE), have been implicated in the adjustment process for individuals with SCI.[1-10] SE is defined as the belief that one can successfully execute the behavior required to produce the desired outcomes.[11] SE is a valuable clinical predictor of adjustment and thereby a potential target for interventions during the SCI rehabilitation process.[10,12-14] Most studies investigating SE of people with SCI were performed in community dwelling people.[10] In the chronic phase, one would expect much less change over time compared with the first rehabilitation phase and the first years thereafter, as has been found in people with stroke.[15]

To date only a few longitudinal studies on SE in people with SCI have been published. Using different SE measures, these studies have shown no overall changes in mean SE scores over time.[3,13,16-21] However, some studies have remarked that there were changes of individual scores, suggesting the possibility of diverging SE trajectories. So far, only 1 study has investigated latent trajectory classes of SE in people with SCI.[13] In that study, a relatively small sample of 88 participants was assessed from the start of inpatient rehabilitation up to 6 months after discharge. Four trajectory classes were found, 3 of which were stable and 1 of which, including a small percentage of the sample (12.6%), showed a decreasing trajectory. For these 4 trajectories, no significant changes over time were described.[13]

Trajectories of SE have also been examined in other fields such as cardiac rehabilitation, older people, and people functioning as a mentor for at-risk adolecents.[22-25] In these studies, between 2-4 trajectories were found, of different shape (including a stable, linear pattern of increasing or decreasing self-efficacy, but also an initial increase followed by a decrease in self-efficacy).

In this study, we sought to investigate the course of SE after onset of SCI with larger numbers of participants and measurement points, another SE scale, targeting domain specific SE for people with SCI, and the addition of anxiety compared with the previous study.[13] The first aim of this study was to determine trajectories of SE, depressive mood, and anxiety in people with SCI. The second aim was to determine whether concurrent changes in SE are related to changes in depressive mood and anxiety. It was hypothesized that (1) distinct trajectories of SE, depressive mood, and anxiety would be identified and (2) the probability would be high that SE trajectories are interrelated to trajectories of depressive mood and anxiety.

Methods

Participants

The study design has been described in detail elsewhere.[26] In short, 285 people with SCI participated in a longitudinal cohort study (fig 1). All participants were admitted for their initial rehabilitation after they sustained SCI, were >18 years of age, had no severe cognitive impairment or severe mental health disorders, had no limited life expectancy (eg, due to cancer-related SCI), were expected to be admitted for at least 4 weeks, and possessed

List of abbreviations:

GBTM	group-based trajectory modeling
HADS	Hospital Anxiety and Depression Scale
SCI	spinal cord injury
SE	self-efficacy
UW-SES	University of Washington self-efficacy Scale

sufficient knowledge of the Dutch language to complete the questionnaires.

Procedure

The participants were recruited in all 8 rehabilitation centers that specialize in SCI rehabilitation in the Netherlands. The inclusion period was between January 2016 and December 2017, and data collection ended in May 2019. After informed consent was given, the participant filled out a comprehensive questionnaire at admission; at discharge; and at 3, 6, and 12 months after discharge. Injury characteristics were recorded by a trained rehabilitation physician at admission or retrieved from medical records.

The Medical Ethics Committee of the University Medical Centre Utrecht declared that the study did not require formal ethical approval under the Dutch law regulating medical research in human beings (reference no. 15-449/C). The Medical Ethics Committees of all participating centers approved this protocol.

Measures

Sociodemographic variables collected included age, sex, presence of a partner, educational level, and preinjury employment. Injury characteristics for the sample included time since injury, traumatic or nontraumatic etiology, paraplegia or tetraplegia, and motor complete (ie, American Spinal Injury Association Impairment Scale A and B) or motor incomplete lesion according to the International Standards for Neurological Classification of Spinal Cord Injury.[27]

SE was assessed using the short version of the University of Washington Self-efficacy Scale (UW-SES).[28] This 6-item version has a 5-point response scale ranging from 1 (not at all confident) to 5 (totally confident). The total score ranges between 6-30, with higher scores indicating greater self-perceived confidence in managing challenges related to SCI. The summed total score was converted into a T score (mean ± SD, 50±10).[28] The UW-SES has been validated for people with SCI and multiple sclerosis in the chronic phase.[28-30]

Distress was assessed using the Hospital Anxiety and Depression Scale (HADS). The HADS is a commonly used measure of psychological distress in SCI Studies.[31] It contains 14 statements with 2 scales, depressive mood and anxiety, with 7 items each. Respondents were asked to indicate the extent to which they agree with each statement on a 4-point scale. The score on both scales ranges from 0-21, with higher scores indicating more symptoms of depression or anxiety, respectively.[32-34]

Statistical analyses

Missing items were replaced with the mean score of the scale or subscale if the total extent of missing items was <20%, otherwise the scale or subscale was considered missing.[35]

To identify developmental trajectories for SE, depressive mood, and anxiety, group-based trajectory modeling (GBTM)[36] was used to identify groups of people who respond in similar ways and therefore are considered to be members of the same trajectory class.[37-39] For GBTM, we included all participants with at least 1 measurement within the 5 time points. Missing data were handled by the model using a maximum likelihood estimation which generates asymptotically unbiased parameter estimates through the assumption that the data are missing at random.[37] The
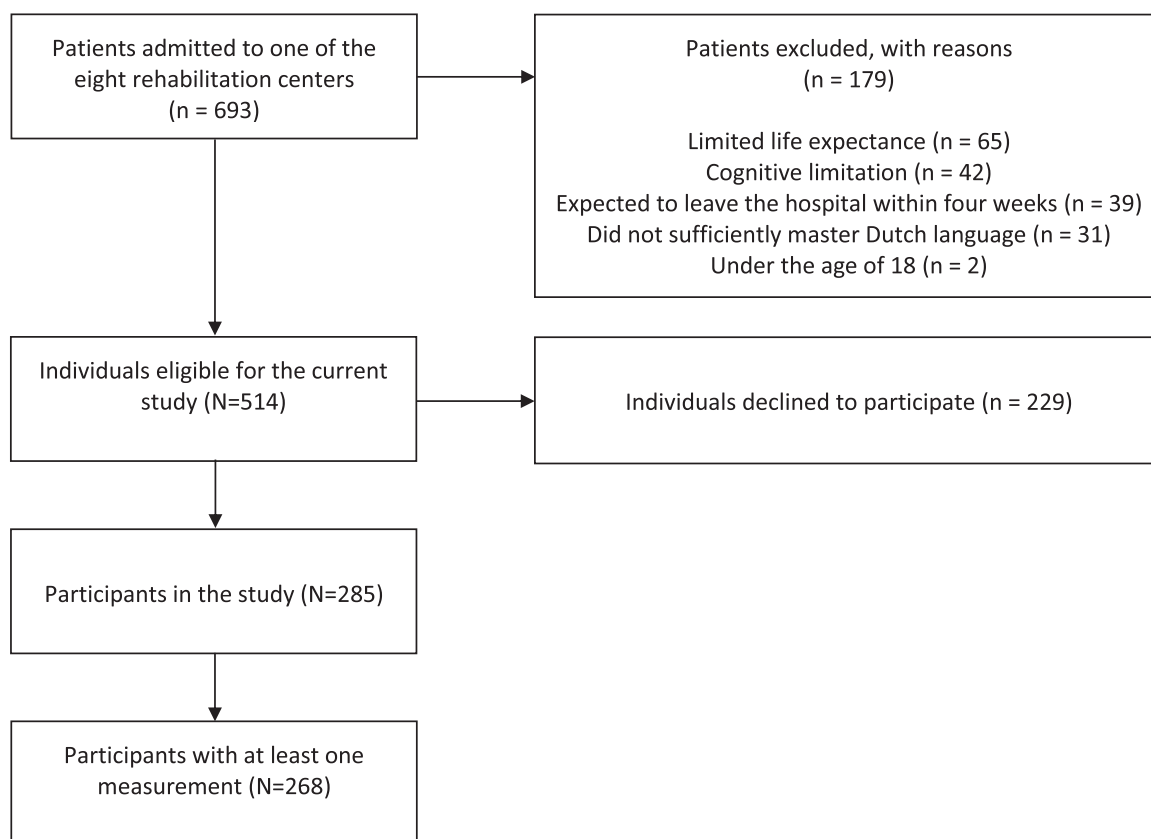
Fig 1 Flow diagram of the participants.

output was the probability, for each participant, of membership in the trajectories. A stepwise approach was used, starting with the statistical model with the lowest possible number of trajectories (ie, 1), and adding 1 more trajectory class at each step.

The optimal number of classes was determined from 4 indices. The first was the Akaike information criterion, Bayesian information criterion, and the sample size-adjusted Bayesian information. These criteria estimate the relative amount of information lost by a given model, a smaller number indicates a better model fit. The second, entropy value, qualified the amount of uncertainty in the model, with higher scores indicating a higher accuracy of the classification. The third was the Vuong-Lo-Mendell-Rubin likelihood ratio test and bootstrap Lo-Mendell-Rubin likelihood ratio test statistic. Both of these methods approximate the P value of the generalized likelihood ratio test, with significant P values ($<.05$) indicating that the model is preferred over a model with 1 less trajectory. The fourth was interpretability of the model.[40-42] In addition, dual trajectory modeling analyses[36,43] were conducted to estimate concurrent changes in SE, depressive mood, and anxiety (ie, whether changes in SE are co-occurring in depressive mood or anxiety scores as they evolve contemporaneously over time).[36] The output from the dual trajectory analyses was the probability of membership in each of the trajectory groups for both measurement series (ie, the probability that the SE and depressive mood or anxiety trajectories were related). The independent sample t test was used to test for differences between the SE trajectories groups for their baseline characteristics. Data were analyzed using SPSS, version 25,[a] and GBTM analyses were conducted using Mplus version 7.3.[b]

Results

The characteristics of the participants of this study are described in table 1. Most participants were men, had a mean age of 55.6 years, and had a partner. Almost half of the participants had a traumatic SCI and tetraplegia, and the minority had a motor complete SCI. Time from onset of injury to admission was, on average, 5 weeks, and the mean duration of inpatient rehabilitation was 13.6 weeks.

The distributions of scores on the UW-SES, HADS depression, and HADS anxiety at all measurement time points are depicted in table 2. The mean UW-SES scores were well below the mean of 50. The mean scores for depressive mood and anxiety were low. Nevertheless, 95 of 268 (35.5%) and 78 of 268 (26.4%) of the participants had a score of 8 or higher for depressive mood and anxiety, respectively, indicating a possible disorder.[34] No significant change over time was found for all 3 scales.

The fit indices of the 5 GBTM classes for the T score of the UW-SES are shown in table 3. Although the information criteria decreased from the 3-class model to the 4-class model, they seemed to reach a plateau at the same time the entropy decreased. Based on this information, a 3-class trajectory solution was considered to show the best fit. As a result of this 3-class trajectory solution, 17 of 268 (6.3%) of the participants belonged to a low SE group, 180 of 268 (67.2%) belonged to a middle SE group, and 71 of 268 (26.5%) belonged to a high SE group (named after their relative position). Figure 2 shows the 3 UW-SES trajectories, with 3 more or less horizontal lines. Only in the high SE group, scores increased from 50 to 56; although not statistically significant, this seemed to be clinically relevant. The high SE group was

Table 1   Characteristics of the participants who completed at least 1 of the measurements by whole group and SE trajectory classes

Characteristics	All Participants (N=268)		Participants Divided Into SE Trajectory Classes		
			Low (n=17)	Middle (n=180)	High (n=71)
	n	n (%) or Mean ± SD, Range	n (%) or Mean ± SD, Range	n (%) or Mean ± SD, Range	n (%) or Mean ± SD, Range
Female sex	268	85 (31.7)	7 (41.2)	55 (30.6)	23 (32.4)
Age, y	268	55.6±15.3, 18-84	57.9±11.6, 34-78	57.5±14.5, 18-84	50.1±16.8, 18-78 ‡
Have a partner	265	190 (71.7)	12 (70.6)	132 (74.6)*	46 (64.8)*
Education (≥Bachelor)	262	76 (29.0)	3 (20.0)	43 (24.4)	30 (42.3)†
Have paid job before SCI	266	172 (64.7)	10 (58.8)	106 (59.2)	56 (80.0)†
Premorbid psychological help	251	62 (24.7)	8 (50.0)†	41 (24.6)	13 (19.1)
Nontraumatic cause of SCI	268	133 (49.6)	6 (35.3)	97 (53.9)	30 (42.3)
Tetraplegia	268	144 (53.7)	12 (70.6)†	94 (52.2)	38 (53.5)
Motor complete	266	59 (22.2)	2 (11.8)	46 (25.7)†	11 (15.7)
Traumatic brain injury	259	36 (13.9)	3 (17.6)	21 (12.1)†	12 (17.4)
Weeks since injury at admission	268	5.0±4.0, 0-30	6.4±4.8, 2-21	5.2±4.3, 0-30	4.2±2.8, 1-15
Weeks of inpatient rehabilitation	261	13.6±10.1, 2-62	14.9±8.5, 3-29	14.1±9.9, 2-62	11.9±10.9, 2-62

* Significant difference with 1 other group (*P*<.05).
† Significant difference with both other groups (*P*<.05).

significantly younger, higher educated, and more participants had a paid job before the onset of SCI compared with the other 2 groups (see table 1). The middle SE group had significantly more participants with complete SCI and fewer participants with traumatic brain injury than both other groups. Furthermore, the middle SE group had significantly more participants with a partner than the high SE group. The low SE group had significantly more participants who had psychological help before the onset of their SCI and more participants with tetraplegia than both other groups.

Table 3 shows also the fit indices for the 5 GBTM classes for the HADS depressive mood scale. Although the information indices indicated a plateau at 4 classes, a 2-class trajectory solution was considered to show the best fit based on its entropy value and on the significance of the Vuong-Lo-Mendell-Rubin likelihood ratio test and the bootstrap Lo-Mendell-Rubin likelihood ratio test. A total of 181 of 268 (65.5%) of the participants belonged to a trajectory of stable low depressive mood, and 87 of 268 (34.5%) to belonged to a trajectory of stable high depressive mood (fig 3). Furthermore, in table 3, the fit indices for the 5 GBTM classes for the HADS anxiety scale are depicted. Based on the information criteria, entropy, and *P* values, a 4-class trajectory solution was considered the best fit for anxiety. A total of 109 of 268 (40.7%) of the participants belonged to a trajectory of stable low anxiety, 102 of 268 (38.1%) belonged to a stable moderate anxiety trajectory, 48 of 268 (17.9%) belonged to a stable high anxiety trajectory, and 9 of 268 (3.4%) belonged to a trajectory of very high and

further increasing anxiety (fig 4). No significant change over time was found for all 3 scales as slope measures were not significant (*P*>.05) in the GBTM.

Table 4 shows the temporal associations between SE and depressive mood and between SE and anxiety. The conditional probabilities to belong to the low depression or the low anxiety trajectory class if one had high stable SE was 1.0 or a 100% chance of having stable low scores on depressive mood and anxiety if one contemporaneously had high SE. In contrast, there was a high probability of having high scores on depressive mood if one belonged to the stable low SE trajectory of .899 or 90% chance. For anxiety there was more ambiguity in the low SE group, with an almost 50% chance one belonged to a high or very high anxiety trajectory. In the middle SE group, most participants had conditional high probability of belonging to the group with low depressive mood scores or moderate anxiety scores (0.788 and 0.545, respectively).

Discussion

This study provides additional information on the course of SE during the initial rehabilitation of people with SCI up to 1 year after discharge. Three distinct trajectories of SE could be identified, with the largest group 180 of 268 (67.2%) belonging to the stable middle trajectory. The second largest group 71 of 268 (26.5%) followed a stable high SE trajectory, with above-average

Table 2   Scores on the UW-SES, HADS depressive mood, and HADS anxiety at all measurement timepoints

Timepoint	UW-SES 6 *t* Score, Mean ± SD	n	Cronbach α	Depressive Mood, Mean ± SD	N	Cronbach α	Anxiety, Mean ± SD	N	Cronbach α
Admission	43.3±8.3	262	.87	6.6±4.2	267	.81	5.7±4.2	267	.83
Discharge	45.5±9.5	227	.91	5.3±3.9	225	.83	4.9±3.9	225	.85
3 months postdischarge	42.7±8.4	211	.90	6.3±4.0	212	.84	5.1±3.8	213	.84
6 months postdischarge	43.7±9.3	199	.91	5.7±3.8	200	.83	4.8±4.0	200	.86
1 year postdischarge	45.7±9.7	195	.92	6.1±3.9	197	.82	5.3±4.1	197	.88

Table 3 Fit indices for the 5 class growth mixture models for UW-SES self-efficacy *t* score, HADS depressive mood, and HADS anxiety

Fit Index	1 Class	2 Class	3 Class	4 Class	5 Class
UW-SES *t* score					
AIC	7925.3	7673.9	7608.8	7565.1	7560.8
BIC	7950.5	7709.8	7655.5	7622.6	7629.0
SSBIC	7928.3	7678.1	7614.3	7571.8	7568.8
Entropy		0.744	0.788	0.72	0.66
VLRT (*P* value)		<.001	.32	.04	.70
BLRT (*P* value)		<.001	<.001	<.001	.05
HADS depressive mood					
AIC	6217.5	5794.9	5663.1	5623.4	5629.4
BIC	6242.6	5830.8	5709.8	5680.8	5697.6
SSBIC	6220.4	5799.1	5668.6	5630.1	5637.1
Entropy		0.817	0.780	0.757	0.747
VLRT (*P* value)		.001	.265	.288	.481
BLRT (*P* value)		<.001	<.001	<.001	N/A
HAND anxiety					
AIC	6193.2	5728.4	5570.1	5492.2	5475.2
BIC	6218.3	5764.3	5616.8	5549.7	5543.4
SSBIC	6196.1	5732.6	5575.6	5499.0	5483.2
Entropy		0.869	0.796	0.813	0.784
VLRT (*P* value)		<.001	.200	.015	.316
BLRT (*P* value)		<.001	<.001	<.001	<.001

Abbreviations: AIC, Akaike information criterion; BIC, Bayesian information criterion; BLRT, bootstrap Lo-Mendell-Rubin likelihood ratio test statistic; SSBIC, sample size-adjusted Bayesian information criterion; VLRT, Vuong-Lo-Mendell-Rubin likelihood ratio test.

scores. The smallest group 17 of 268 (6.3%) followed a stable low trajectory with very low average scores (≈2 SD below avarage). Next, developmental connections between SE and depressive mood and anxiety were revealed by dual trajectory modeling. The hypothesis that SE trajectories are interrelated to depressive mood and anxiety could be confirmed.

In this study, we found a 3-class model most suitable to describe trajectories of the UW-SES score. In the only other study known to investigate trajectories of SE in people with SCI, a 4-class trajectory was found most suitable. Three stable trajectories were found (19% belonged to a high, 54% to a moderate, and 14% to a low SE trajectory), similar to this study, and 1 trajectory of decreasing SE (13%).[13] From a theoretical point of view and the sources of SE (performance accomplishments, vicarious experience, verbal persuasion, emotional arousal), it is not clear why SE would decrease during initial rehabilitation and the 6 months thereafter.[44] During rehabilitation, all sources but especially performance accomplishments are applied in abundance, which would be expected to result in an increase of SE. The differences in both studies could be attributed to the difference in the used scales, the Moorong Self-Efficacy Scale vs the UW-SES in this study. A comparison between these 2 scales, however, revealed that these 2 instruments measure the same underlying construct.[45] In this study, we used a larger sample size and had a greater number of timepoints, thus ending up with a statistically more robust result. The results in this study correspond with research in other (diagnostic) groups, although not in all.[22-24]

Participants in the low SE group had not only a high risk for contemporaneous depressed mood but also required psychological help significantly more often before the onset of SCI. These findings suggests that the interrelationship between SE and depressed mood was already present before onset of SCI. Furthermore, these findings are in accordance with previous research.[2] Members in the low SE group more often had a tetraplegia when compared with both other groups, suggesting that a more severe SCI could have a greater effect on SE compared with a less severe injury. On the other hand, this finding could be based on chance, although the low SE group was small (n=17) and no differences were found with respect to motor completeness. Most previous studies did not find any correlation between SE and level of injury,[14,29,46-49] with just 1 exception.[50] In the only other SE trajectory study,[13] no significant differences were found with respect to level of injury between the 4 SE groups. Furthermore, in this study, participants in the high SE group were younger, were higher educated, and significantly more often had a paid job when compared with both other groups. These factors appear to have a protective aspect, as was found in some of the previous studies,[46,50] although most did not find these associations.[13,14,29,47-49]

For depressive mood, a 2-class trajectory was found most suitable in this study. This result deviates from a hypothesized
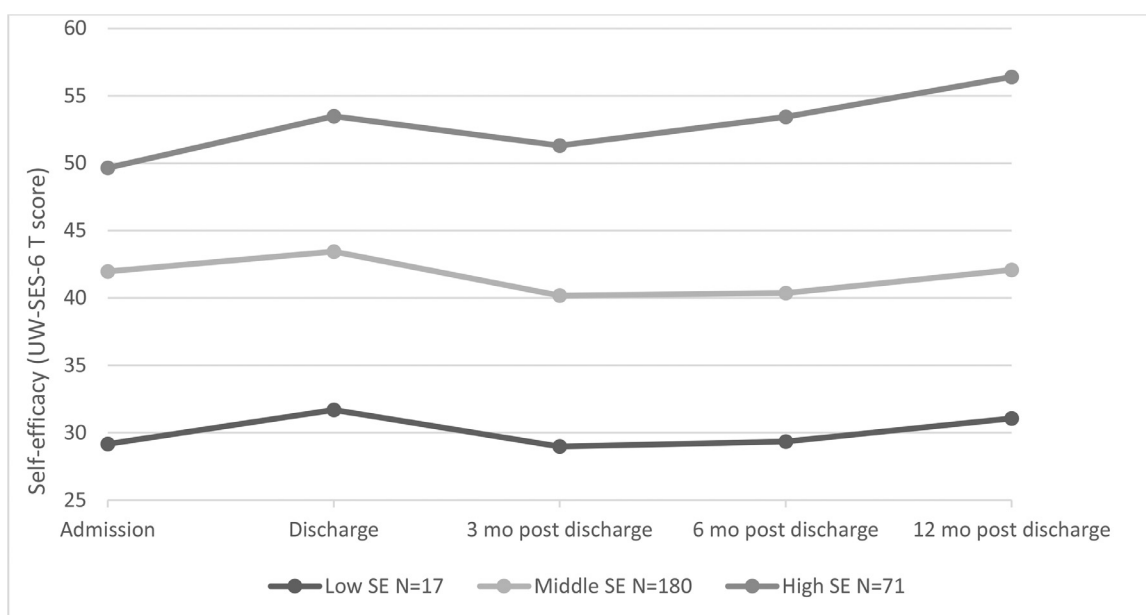

Fig 2 Plots of GBTM using the short version of the UW-SES over time from admission in the rehabilitation center to 1 year after discharge.
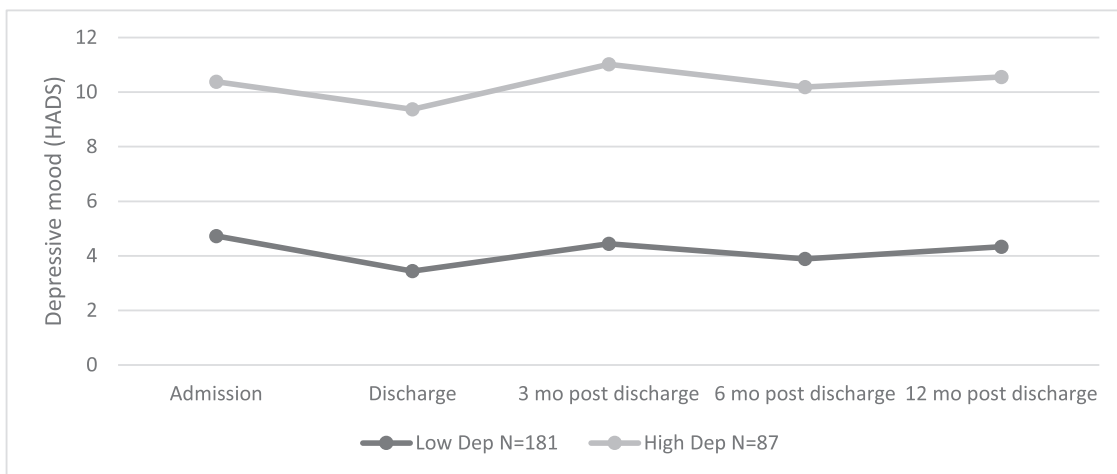
Fig 3   Plots of GBTM using the mean depressive mood scores of the HADS over time from admission in the rehabilitation center to 1 year after discharge.
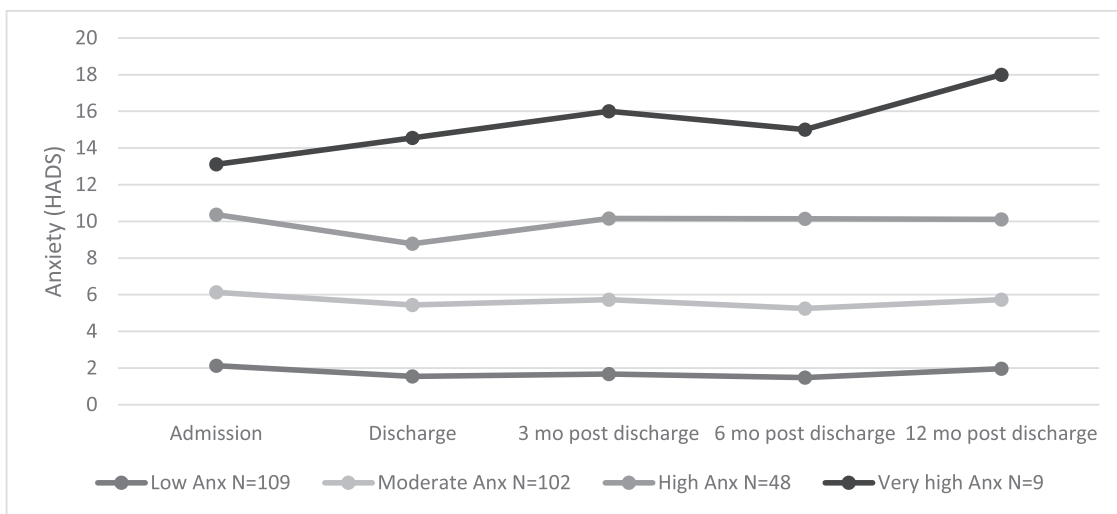

Fig 4   Plots of GBTM using the mean anxiety scores of the HADS over time from admission in the rehabilitation center to 1 year after discharge.

4-classes, namely stable high, stable low, increase, and decrease.[51] Three previous studies on trajectories of depressed mood after onset of SCI identified 3 or 4 classes.[13,51,52] However, a reappraisal of the results of 2 studies with the criteria for model fit used in this study would also have led to the conclusion that 2-trajectory models showed the best fit instead of 4 classes.[13,51] The third study found 3 parallel trajectories.[52] From these results, one could question the common assumption that depressive mood is a state variable that might fluctuate over time. This study shows that measures at start of rehabilitation are predictive for 1 year after discharge. One of

the aforementioned studies also investigated trajectories of anxiety. A model with 3 trajectories was found optimal, 1 low stable (57%), 1 decreasing (30%), and 1 increasing (13%).[51]

Clinical implications

This study showed that trajectories of SE, depressive mood, and anxiety were stable over time. The score at baseline was highly predictive for SE and distress 1 year after discharge. Early screening for SE and distress may reveal people at risk for future adjustment problems. This group might benefit from

Table 4   Conditional probabilities for depressive mood and anxiety status given membership in the 3 SE trajectories

Trajectory	Depressive Mood		Anxiety			
	Low	High	Low	Moderate	High	Very High
t score UW-SES (low)	0.101	0.899	0.163	0.339	0.423	0.075
t score UW-SES (middle)	0.788	0.212	0.345	0.545	0.089	0.021
t score UW-SES (high)	1.00	0	1.00	0	0	0

(psychological) interventions during rehabilitation and should be closely monitored after discharge. Furthermore, this study showed strong interrelationships between the trajectories of SE with depressive mood and anxiety. Based on this interrelationship, the group that adjust well (low depressive mood and anxiety) could be identified well by high SE trajectory, although the people with high depressive mood and anxiety scores could not always be identified based on their SE scores. Screening people with SCI for SE as well as for depressive mood and anxiety early in rehabilitation might give us the best information about those people at risk for long term adjustment problems. Identified individuals with low SE might be a possible target for intervention by the whole rehabilitation team.[53] This early intervention might influence the adjustment outcomes, such as depressive mood and anxiety, in a positive way. Furthermore, people with a history of psychological and psychiatric help before onset of SCI should get special attention because they are especially at risk for adjustment problems.[2]

Study limitations

Although we included a large number of participants in the GBTM and the dual trajectory modeling in this study, there is always missing data as a result of loss to follow-up. Although GBTM makes best use of the available data, it does not necessarily mean that there is no bias. Furthermore, we did not include time-stable covariates, like completeness of SCI, in the models that may have an influence on the trajectories. The GBTM models assume that there are measurement invariances. We are not aware of any studies that have examined measurement invariance for HADS or UW-SES-6. This may be a limitation, because we did not test for measurement invariance for these latent constructs and only used the observed variables in this study. Another potential limitation might be the sensitivity to change of the used scales.[45,54] It is unclear how sensitive both used scales are to change over time and, therefore, in this study we could have missed changes that could be flagged by more sensitive scales. The absence of change over time might also be caused by the relative short period after discharge, a longer follow-up might reveal more changes.

Conclusions

In accordance with our hypotheses and former research, different trajectories of SE could be tracked. In this large study, 3 stable trajectories (low, middle, and high SE) could be distinguished. Furthermore a 2-class solution for depressive mood and a 4-class solution for anxiety was found to be most suitable. Developmental connections between SE and depressive mood and anxiety were revealed by dual trajectory modeling. The hypothesis that there was a high probability that SE trajectories were interrelated to depressive mood and anxiety was confirmed. Concurrent screening for SE and distress might best detect people at risk for adjustment problems in the future.

Suppliers

a. SPSS, version 25; IBM Corp.
b. Mplus, version 7.3; Muthén & Muthén.

Keywords

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