ACRM
AMERICAN CONGRESS OF REHABILITATION MEDICINE

Archives of Physical Medicine and Rehabilitation

journal homepage: www.archives-pmr.org

Archives of Physical Medicine and Rehabilitation 2019;100:448-57

ORIGINAL RESEARCH

Sense of Coherence, Disability, and Health-Related Quality of Life: A Cross-Sectional Study of Rehabilitation Patients in Norway

Vegard P. Moen, MSc,[a,b] Geir E. Eide, PhD,[b,c] Jorunn Drageset, PhD,[b] Sturla Gjesdal, MD, PhD[b]

From the [a]Centre for Habilitation and Rehabilitation, Haukeland University Hospital, Bergen; [b]Department of Global Public Health and Primary Care, University of Bergen, Bergeny; and [c]Centre for Clinical Research, Haukeland University Hospital, Bergen, Norway.

Abstract

Objective: To study relations between sense of coherence (SOC), disability, and mental and physical components of health-related quality of life (HRQOL) among rehabilitation patients.

Design: Survey.

Setting: Rehabilitation centers in secondary care.

Participants: Patients (N=975) from the Western Norway Health Region consented to participate and had valid data of the main outcome measures.

Interventions: Not applicable.

Main Outcome Measures: SOC was measured with the sense of coherence questionnaire (13-item SOC scale [SOC-13]), disability with the World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0), and HRQOL with the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36).

Results: Mean scores ± SD were 62.9±12.3 for SOC-13, 30.8±16.2 for WHODAS 2.0, 32.8±9.6 for SF-36 physical component score, and 43.6±11.8 for SF-36 mental component score. Linear regression analysis showed that increased SOC score was associated with reduced disability scores in the following domains with estimated regression coefficients (95% confidence interval) cognition −0.20 (−0.32 to −0.08), getting along −0.36 (−0.52 to −0.25), and participation −0.23 (−0.36 to −0.11). The fit of 2 structural models with the association from SOC to HRQOL and disability or with disability as a mediator was better for the mental versus the physical component of HRQOL. High SOC increased the mental component of HRQOL, consistent for all diagnostic groups. For both models, good fit was reported for circulatory and less good fit for musculoskeletal diseases.

Conclusions: The results indicate that higher SOC decreases disability in mental domains. The effect of SOC on disability and HRQOL might vary between diagnostic groups. SOC could be a target in rehabilitation, especially among patients with circulatory diseases, but prospective studies are needed.

Archives of Physical Medicine and Rehabilitation 2019;100:448-57

Rehabilitation aims to maintain or increase functional status and health-related quality of life (HRQOL).[1-3] Rehabilitation patients usually have chronic conditions with sensory, cognitive, and mobility impairments, and experience activity limitations as well as participation restrictions. HRQOL is poorer in rehabilitation patients compared with a healthy reference population.[4]

Aron Antonovsky developed a *salutogenic* model to explain why some people remain healthy, or even improve their health, when experiencing life events (stressors) whereas others become ill.[5] A key concept in Antonovsky's model is sense of coherence (SOC), a measure of an individual's capacity to cope. SOC captures an individual's perception of life as being comprehensible, manageable, and meaningful.[5] Strong SOC indicates adaptive strategies when responding to stressors[6] and results in better

Disclosures: none.

https://doi.org/10.1016/j.apmr.2018.06.009

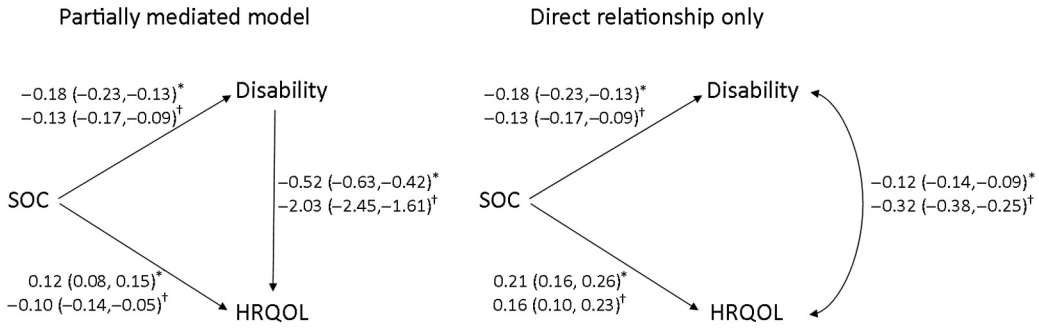

Fig 1 Hypothesized structural models, including the results from SEM among 975 patients accepted for specialized somatic rehabilitation in the Western Norway Health Region during the first half of 2015.*Estimated standard regression coefficients with 95% CIs for model including MCS of HRQOL. †Estimated standard regression coefficients with 95% confidence intervals for model including PCS of HRQOL.

health, reduced risk of mortality, and lower distress in depression, anxiety, and pain.[7-12] Therefore, rehabilitation could include goals that strengthen individuals' SOC.[13] Better knowledge of SOC and how it affects disability and HRQOL may help to identify subgroups when planning rehabilitation and tailoring interventions.[14]

Previous studies have shown that strong SOC is related to less disability.[14-16] One study reported that SOC was a protective factor for disability.[14] However, that study only included older adults and used an overall disability score, which may be less relevant in clinical settings than disability domains. To our knowledge, no previous studies have investigated the effect of SOC on disability (as conceptualized in the International Classification of Functioning, Disability and Health[17]) among rehabilitation patients. Relations between SOC and disability domains such as participation in society have not been assessed.

Measurement of HRQOL provides an evaluation of health encompassing many important aspects,[18] among others disability, and may be considered the ultimate outcome for health care.[19] A comprehensive review has shown that better HRQOL is associated with higher SOC in various patient populations.[20] Moreover, a study among adolescents with congenital heart disease showed a predominant direction of this association from SOC to perceived health,[21] suggesting further investigation of this relation and its direction in other populations.

We have not found any studies investigating the direction of the association from SOC to HRQOL and disability simultaneously, whether SOC has a direct relation to HRQOL and disability, or if the direction of the association from SOC to HRQOL is mediated by disability (fig 1).

Multimorbidity and pain are associated with increased disability and poorer HRQOL[22-25]; moreover, multimorbidity impairs SOC.[8] Studies have also shown associations between sociodemographics, psychological distress, and SOC, disability, and HRQOL.[26-28]

This study aimed to increase the understanding of SOC, disability, and HRQOL in rehabilitation patients. Specific objectives were to (1) describe the simultaneous distribution of SOC, disability, and HRQOL; (2) investigate possible effects of SOC on disability domains; and (3) investigate hypothesized structural models for SOC, disability, and HRQOL. Analyses were also performed specifically for diagnostic groups to enhance clinical significance.

List of abbreviations:

95% CI	**95% confidence interval**
HADS	**Hospital Anxiety and Depression Scale**
HRQOL	**health-related quality of life**
MCS	**mental component score**
PCS	**physical component score**
SEM	**structural equational modeling**
SF-36	**Medical Outcomes Study 36-Item Short-Form Health Survey**
SOC	**sense of coherence**
SOC-13	**13-item SOC**
WHODAS 2.0	**World Health Organization Disability Assessment Schedule 2.0**

Methods

Design, sample, and procedure

The study used a cross-sectional design. All patients in the Western Norway Health Region accepted for inpatient or outpatient rehabilitation at a rehabilitation center in secondary care during the first half of 2015, and who were referred from hospitals or general practitioners, were invited by mail or at admittance. A flow chart showing participant inclusion and exclusion is shown in fig 2. Further details are provided in a previous paper.[29]

Patient-reported data were linked to individual public register data obtained from Statistics Norway, on educational attainment, residence municipality, and marital status.

Ethics

This study was approved by the Regional Committee for Medical Research Ethics in Western Norway, REK-No. 2014-1636. Written informed consent, including linkage to public register data, was obtained from study participants.

Main variables

The 36-item World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0) assesses disability across 6 domains[30]: cognition (6 items), mobility (5 items), self-care (4 items), getting along (5 items), life activities (8 items), and participation (8 items). Four life activities items relate to household and 4 to work or study. Responses are on a 5-point Likert scale with 2 anchor responses ("none" and "extreme or cannot do"). Domain scores and a total disability score are calculated using *complex scoring* according to the manual, ranging from 0 (no disability) to 100 (full disability). An algorithm enabled

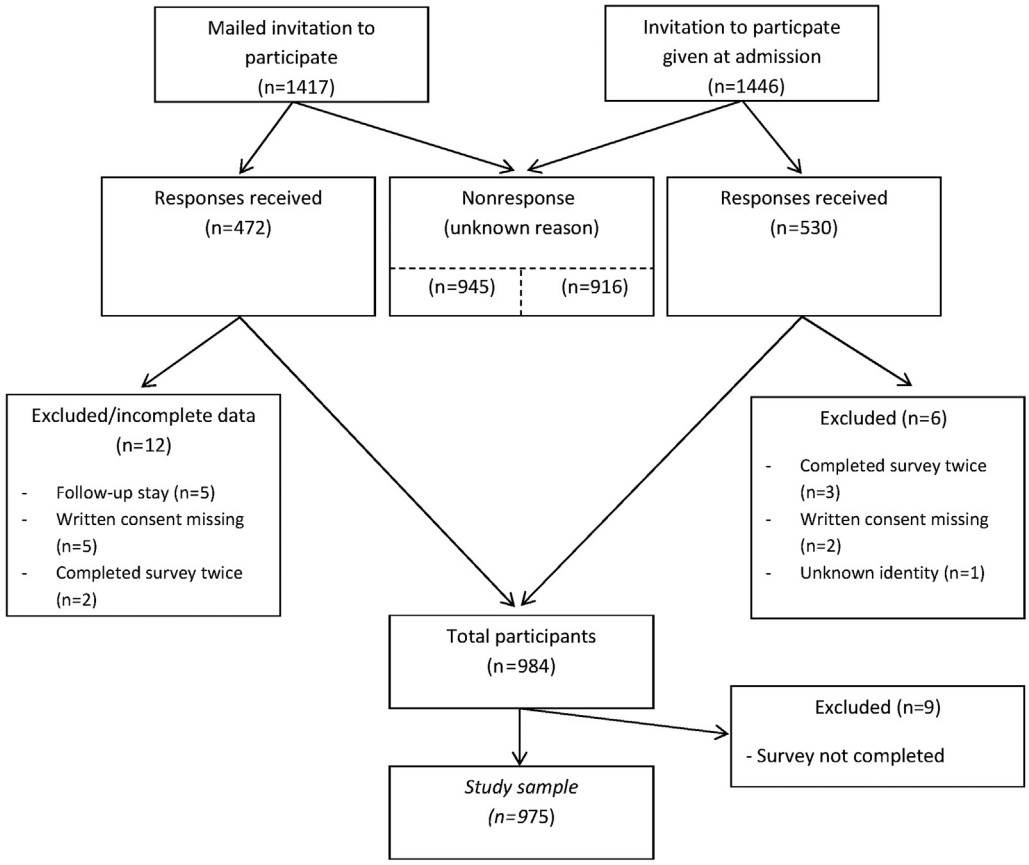

Fig 2 Flowchart of patients accepted for rehabilitation at a rehabilitation center in secondary care in the Western Norway Health Region during the first half of 2015.

calculation of a score for the life activities domain and a total score (regardless of whether the 4 items related to work or study were answered). The instrument has satisfactory reliability and moderate validity for use in rehabilitation services.[31]

The Medical Outcomes Study Short-Form Health Survey (SF-36) version 1 assesses HRQOL.[32] The scale contains 36 items in 8 domains: mental health, vitality, bodily pain, general health, social functioning, physical functioning, role limitation related to physical problems, and role limitation related to emotional problems. In addition, 1 item assesses changes in general health over the past year. The 8 domain scores can be summarized to give a mental component score (MCS) and a physical component score (PCS), which were used in this study. Scores range from 0 to 100, with higher scores indicating better HRQOL. The instrument is a valid measure of health status for a range of patients[33] with adequate and high reliability.[34]

The 13-item SOC (SOC-13)[35] scale comprises items in 3 subscales: comprehensibility, manageability, and meaningfulness. Each item is scored on a 7-point Likert scale with 2 anchor responses ("never" and "very often"). After reversing 5 negatively formulated items, all items are summed to give a total score of 13-91; higher scores indicate stronger SOC. The SOC-13 has generally acceptable reliability and validity.[36-38]

Adjustment variables

Symptoms of depression and anxiety were assessed using the Hospital Anxiety and Depression Scale (HADS)[39] which comprises 14 items on 2 subscales: anxiety and depression. Each subscale has 7 items. Scores range from 0 to 21, higher scores representing higher severity. HADS performs well as a screening instrument in assessing symptom severity in somatic patients[40] and has adequate validity and reliability.[41]

Diagnostic groups were categorized based on referral diagnoses (registered according to the International Classification of Diseases-10 chapter without any further details) into musculoskeletal, circulatory, and neurologic diseases, neoplasms, and other (including various health conditions with <50 patients).

Multimorbidity was defined as the coexistence of more than 1 self-reported chronic conditions in the same individual[42] based on the referral diagnosis and a predefined list of self-reported chronic conditions. The list is reported elsewhere.[29]

Pain or discomfort was measured using the EuroQol 5 dimensions 5 levels.[43] This instrument comprises 5 questions and a health rating scale. The questions assess physical activity, psychological distress, and pain or discomfort. Pain or discomfort has 5 possible responses, from no pain or discomfort to extreme pain or discomfort. Measurement properties of the instrument have been tested extensively.[44]

Age was categorized by decades. Marital status was dichotomized as married or unmarried. The highest completed education level was categorized as primary school, high school, or college or university. Smoking status was dichotomized as current smoking or not. Residence was dichotomized as rural or urban, with the cutoff being 20,000 inhabitants in the municipality. Rehabilitation was dichotomized as initial (referred by a general practitioner) or ongoing management (referred by a hospital).

Table 1 Distribution of WHODAS score, SF-36 component scores, and SOC score among 975 patients accepted for specialized somatic rehabilitation in the Western Norway Health Region during the first half of 2015

Variables			WHODAS Score* (n=967)		SF-36† PCS† (n=885)		SF-36‡ MCS‡ (n=885)		SOC§ (n=933)	
Categories	n	Women (%)	Mean ± SD	*P*	Mean ± SD	*P*	Mean ± SD	*P*	Mean ± SD	*P*
All	984‖	63.4	30.8±16.2	NA	32.8±9.6	NA	43.6±11.8	NA	62.9±12.3	NA
Sex	NA	NA	NA	**	NA	**	NA	††	NA	**
Men	360	0	27.8±16.6	NA	35.1±10.3	NA	45.1±11.5	NA	65.2±12.0	NA
Women	624	100	32.6±15.6	NA	31.4±8.9	NA	42.7±11.9	NA	61.6±12.3	NA
Age¶ (y)	NA	NA	NA	**	NA	**	NA	**	NA	**
18-29	28	75.0	33.5±18.6	NA	37.0±11.6	NA	39.8±11.9	NA	53.3±12.5	NA
30-39	79	86.1	34.0±16.1	NA	33.0±9.0	NA	40.7±10.1	NA	57.7±13.7	NA
40-49	180	69.4	36.1±16.5	NA	32.9±9.1	NA	39.9±12.3	NA	58.6±12.1	NA
50-59	252	60.0	29.6±14.4	NA	33.9±9.7	NA	43.5±12.2	NA	63.1±12.2	NA
60-69	241	58.8	27.6±15.7	NA	33.6±9.9	NA	45.3±11.1	NA	65.4±11.2	NA
70-79	156	57.9	29.3±17.0	NA	30.2±9.3	NA	47.1±11.3	NA	66.9±10.4	NA
≥80	48	58.7	31.3±16.2	NA	27.1±7.3	NA	47.9±9.9	NA	67.9±11.5	NA
Health condition, ICD-10	NA	NA	NA	**	NA	**	NA	**	NA	††
Musculoskeletal diseases	457	75.9	34.4±15.0	NA	29.6±7.3	NA	42.5±12.1	NA	61.7±12.6	NA
Circulatory diseases	187	33.7	23.2±15.6	NA	38.9±10.1	NA	45.8±11.1	NA	66.1±10.9	NA
Neurologic diseases	87	55.2	35.0±16.3	NA	30.3±8.7	NA	46.5±10.6	NA	64.0±11.7	NA
Neoplasms	54	81.5	33.3±16.8	NA	35.1±9.0	NA	38.9±11.6	NA	61.6±13.2	NA
Other#	199	61.3	27.4±16.0	NA	34.8±11.0	NA	44.1±11.7	NA	62.8±12.3	NA
Multimorbidity	NA	NA	NA	**	NA	**	NA	††	NA	**
Yes	635	65.7	32.9±16.7	NA	31.7±9.1	NA	42.7±12.3	NA	61.8±12.8	NA
No	349	59.3	27.1±14.5	NA	34.9±10.2	NA	45.3±10.8	NA	65.2±11.0	NA
Rehabilitation urgency	NA	NA	NA	‡‡	NA	††	NA	NA	NA	††
Elective	653	68.0	31.9±15.9	NA	32.3±9.3	NA	42.8±12.1	NA	61.6±12.6	NA
Acute	274	53.6	27.6±16.3	NA	34.6±10.2	NA	45.8±11.1	NA	66.5±10.7	NA
Unknown	57	57.9	34.9±15.6	NA	29.9±9.8	NA	43.2±10.9	NA	61.1±12.2	NA
Marital status	NA	NA	NA	‡‡	NA	NA	NA	**	NA	**
Unmarried	455	69.9	32.3±16.4	NA	32.6±9.7	NA	41.4±12.3	NA	60.9±12.9	NA
Married	525	57.9	29.6±15.8	NA	33.0±9.6	NA	45.5±11.1	NA	64.7±11.5	NA
Unknown	4	NA	23.7±16.9	NA	31.2±10.3	NA	47.6±6.0	NA	65.5±11.2	NA
Educational level	NA	NA	NA	‡‡	NA	††	NA	NA	NA	††
Primary school	205	68.8	33.6±17.1	NA	30.6±9.6	NA	43.6±11.8	NA	60.5±12.8	NA
Secondary school	490	60.2	30.7±16.1	NA	32.9±9.9	NA	43.5±12.5	NA	63.0±12.2	NA
College/university	278	66.2	29.0±15.5	NA	34.3±10.8	NA	43.8±10.8	NA	64.5±11.9	NA
Unknown	11	66.2	32.9±14.3	NA	30.7±9.1	NA	43.8±7.9	NA	64.4±12.4	NA
Smoking	NA	NA	NA	††	NA	NA	NA	**	NA	**
Yes	184	70.7	34.1±14.6	NA	31.9±8.6	NA	39.2±12.3	NA	58.1±12.6	NA
No	788	61.4	30.7±16.4	NA	33.0±9.9	NA	44.7±11.5	NA	64.1±12.0	NA
Unknown	12	61.4	29.6±16.0	NA	36.1±4.9	NA	41.9±9.5	NA	62.3±8.7	NA

(*continued on next page*)

Table 1 (*continued*)

Variables			WHODAS Score* (n=967)		SF-36† PCS† (n=885)		SF-36‡ MCS‡ (n=885)		SOC§ (n=933)	
Categories	n	Women (%)	Mean ± SD	*P*	Mean ± SD	*P*	Mean ± SD	*P*	Mean ± SD	*P*
Living area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Urban	519	65.1	31.3±16.1	NA	33.0±10.0	NA	42.9±11.7	NA	62.9±12.3	NA
Rural	465	61.5	30.3±16.2	NA	32.7±9.3	NA	44.4±11.9	NA	63.0±12.3	NA

Abbreviations: ICD-10, International Classification of Diseases-10; NA, not applicable.
* 0=lowest score of disability, 100=highest score of disability.
† 0=lowest score of HRQOL, physical component, 100=highest score HRQOL, physical component.
‡ 0=lowest score of HRQOL, mental component, 100=highest score HRQOL, mental component.
§ 13=lowest score, 91=highest score (best).
‖ Total included in the study.
¶ Mean ± SD: 57.6±14.0 years.
\# Diseases included the following: endocrine, nutritional, and metabolic diseases (n=36), respiratory diseases (n=37), injuries and external causes (n=27), skin diseases (n=24), factors influencing health status and contact with health services (n=23), mental and behavioral disorders (n=12), symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified (n=9); codes for special purposes (n=7); diseases of the digestive system (n=6); diseases of the blood and blood-forming organs, and certain disorders involving the immune mechanism (n=5); diseases of the ear and the mastoid process (n=3); diseases of the genitourinary system (n=3); congenital malformations, deformations, and chromosomal abnormalities (n=5); and certain infectious and parasitic diseases (n=2).
** *P*<.05 (F test).
†† *P*<.01 (F test).
‡‡ *P*<.001 (F test).

Statistical analysis

For descriptive statistics, mean and SD are reported. To compare the female proportion and age distribution between participants and nonparticipants, exact chi-square and Mann-Whitney *U* tests were used.

Multiple linear regression analysis was used to study the effect of SOC on domain-specific disability. Results are reported as estimated regression coefficients with 95% confidence intervals (95% CI) and *P* values from the F test. The distribution of residuals was checked for adherence to assumptions of linearity, normality, and variance homogeneity. Analysis of variance was performed using the F test to investigate differences in SOC scores for variables with more than 2 categories. Tukey post hoc test was used for subgroup comparisons.

Path analysis using structural equational modeling (SEM) was performed for 2 hypothesized models (see fig 1). Satisfactory model fit was defined as a comparative fit index close to 0.95 or higher, Tucker-Lewis index close to 0.95 or higher, a root mean square error of approximation close to <0.06 or lower and cutoff close to 0.08 or lower, and standardized root mean square residual close to 0.08 or lower.[45] Regression coefficients were examined for statistical significance. Estimated model parameters are given with 95% CI.

All analyses were performed for the full sample and separately for diagnostic groups. However, the structural models were estimable only in 3 diagnostic groups because the other groups were too small for valid analysis.

Multiple imputations for missing items were applied according to the WHODAS 2.0 manual,[30] with the number of imputation sets=5. If the rate of missing WHODAS 2.0 items was >50%, the data were excluded. Missing items in the SF-36 were managed according to the SF-36 manual.[32] For the HADS and SOC-13, scores for patients with fewer than 3 missing questions per subscale were included. For missing data, scores were imputed based on the mean across each person's available responses for each subscale. For SEM analysis, listwise deletion was used, and no further imputation or adjustments were applied. The criterion for statistical significance was set at 5%. SPSS version 23[a] was used for all statistical analyses except SEM where RStudio version 1.0.143[b] with the lavaan package 0.5-23.1097 was used.

Results

In total, 984 of eligible patients provided responses and data of 975 patients were included in the analyses (response rate, 34.6%). The mean age ± SD was 57.6±14.0 years and 63.2% of participants were women. Among nonparticipants the mean age ± SD was 55.6±16.7 years (*P*<.001) and 67.2% were women (*P*<.05).

Main outcome measures could not be calculated for 9 patients. After imputation for missing items, a WHODAS 2.0 overall disability score could be calculated for 967 patients, SF-36 PCS and MCS scores for 885 patients, and SOC scores for 933 patients. For all scales (and variables), missing values for items ranged from 0.4% to 4.2%, except for 1 WHODAS 2.0 item concerning sexual activities (12.8%).

WHODAS 2.0, SF-36 (PCS and MCS), and SOC-13 scores are shown in table 1. Men had significantly higher SOC scores than women (*P*<.001), and participants aged ≥50 years had significantly higher SOC scores than those aged <50 years (*P*≤.01).

Table 2 Results of a fully adjusted linear regression analysis for predicting WHODAS 2.0 domain scores among 975 patients accepted for specialized somatic rehabilitation in the Western Norway Health Region during the first half of 2015

Predictor Variable Categories	Cognition		Mobility		Self-Care		Getting Along		Life Activities		Participation	
	B	(SE)	B	(SE)	B	(SE)	B	(SE)	B	(SE)	B	(SE)
Intercept	8.32	(5.67)	−5.53	(8.03)	−8.63	(5.96)	32.87	(6.45)	9.02	(8.83)	23.53	(5.91)
Women (ref: men)	0.66	(1.22)	1.69	(1.72)	−0.99	(1.27)	−3.25	(1.38)¶	7.07	(1.89)#	0.87	(1.26)
Age (y)		**		#				¶				¶
18-29	8.96	(3.40)	−3.69	(4.82)	1.93	(3.58)	−0.65	(3.87)	−5.15	(5.31)	−0.76	(3.56)
30-39	3.17	(2.24)	−9.39	(3.17)	−0.33	(2.36)	−2.11	(2.55)	2.10	(3.50)	2.76	(2.34)
40-49	5.35	(1.69)	−4.84	(2.39)	−0.72	(1.78)	4.96	(1.93)	4.97	(2.63)	3.24	(1.76)
50-59	1.41	(1.52)	−4.85	(2.15)	−2.11	(1.59)	−0.18	(1.72)	0.99	(2.37)	0.53	(1.58)
60−69	0.00	(ref)	0.00	(ref)	0.00	(ref)	0.00	(ref)	0.00	(ref)	0.00	(ref)
70-79	−0.86	(1.80)	6.63	(2.53)	2.34	(1.87)	−0.93	(2.06)	−0.31	(2.80)	−3.16	(1.88)
≥80	0.83	(3.00)	15.00	(4.18)	2.55	(3.11)	0.92	(3.40)	−3.29	(4.60)	4.30	(3.21)
Health condition		**		#		¶		¶		#		¶
Musculoskeletal diseases	−0.52	(1.75)	10.23	(2.45)	0.87	(1.81)	0.31	(1.96)	5.85	(2.70)	2.67	(1.82)
Circulatory diseases	0.00	(ref)	0.00	(ref)	0.00	(ref)	0.00	(ref)	0.00	(ref)	0.00	(ref)
Neurologic diseases	0.26	(2.28)	17.32	(3.22)	4.41	(2.38)	2.41	(2.59)	10.80	(3.58)	6.78	(2.38)
Neoplasms	7.85	(2.73)	3.52	(3.86)	-1.59	(2.87)	7.74	(3.10)	12.46	(4.26)	4.55	(2.80)
Other*	−2.13	(1.79)	4.75	(2.52)	−2.56	(1.86)	−0.73	(2.02)	−0.85	(2.77)	−0.82	(1.86)
Multimorbidity (ref: no)	2.81	(1.16)**	2.55	(1.64)	3.64	(1.22)**	1.62	(1.32)	4.66	(1.81)**	2.91	(1.21)¶
Rehabilitation urgency (ref: elective)	1.58	(1.27)	5.32	(1.80)**	5.80	(1.33)#	0.16	(1.47)	4.50	(1.98)¶	2.52	(1.33)
Unmarried (ref: married)	−1.23	(1.12)	0.58	(1.59)	0.24	(1.18)	−1.19	(1.29)	1.25	(1.75)	−1.50	(1.18)
Education		**		#								
Primary school	4.84	(1.56)	8.70	(2.20)	3.41	(1.63)	−2.10	(1.76)	2.54	(2.43)	3.07	(1.63)
Secondary school	2.05	(1.24)	3.16	(1.75)	1.10	(1.30)	−0.93	(1.42)	3.28	(2.24)	1.51	(1.29)
College/university	0.00	(ref)	0.00	(ref)	0.00	(ref)	0.00	(ref)	0.00	(ref)	0.00	(ref)
Current smoking (ref: yes)	2.61	(1.45)	0.63	(2.03)	1.01	(1.51)	0.97	(1.63)	3.81	(2.24)	2.08	(1.49)¶
Rural municipality (ref: urban)	0.55	(1.09)	−2.15	(1.54)	−0.59	(1.14)	−0.01	(1.24)	−1.65	(1.70)	−0.90	(1.14)
EQ-5D (pain/discomfort)†	0.50	(0.63)	8.47	(0.89)#	3.36	(0.66)**	1.42	(0.71)¶	5.72	(0.98)#	4.12	(0.66)#
HADS-D score‡	1.69	(0.20)#	1.38	(0.28)#	0.84	(0.21)#	1.77	(0.22)#	2.48	(0.31)#	1.85	(0.21)#
HADS-A score§	0.52	(0.19)**	−0.67	(0.27)¶	−0.01	(0.20)	0.24	(0.22)	−1.01	(0.30)#	0.31	(0.20)
SOC score‖	−0.20	(0.06)**	−0.04	(0.09)	0.01	(0.07)	−0.36	(0.07)#	−0.11	(0.10)	−0.23	(0.07)#

Abbreviations: B, unstandardized estimated regression coefficient; EQ-5D, EuroQol EQ-5D; HADS-A, Hospital Anxiety and Depression scale, anxiety subscale; HADS-D, Hospital Anxiety and Depression scale, depression subscale; ref, reference.

* Diseases included the following: endocrine, nutritional, and metabolic diseases (n=37), respiratory diseases (n=36), injuries and external causes (n=26), factors influencing health status and contact with health services (n=23), mental and behavioral disorders (n=13), symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified (n=9); codes for special purposes (n=7); diseases of the digestive system (n=6); diseases of the blood and blood-forming organs, and certain disorders involving the immune mechanism (n=5); diseases of the ear and the mastoid process (n=3); diseases of the genitourinary system (n=3); congenital malformations, deformations, and chromosomal abnormalities (n=3); and certain infectious and parasitic diseases (n=2).

† From no pain or discomfort to extreme pain or discomfort, 5 categories.

‡ 0=lowest score of depressive symptoms, 21=highest score of depressive symptoms.

§ 0=lowest score of anxiety symptoms, 21=highest score of anxiety symptoms.

‖ 13=lowest score, 91=highest score (best).

¶ $P \leq .05$ (F test).

\# $P \leq .001$ (F test).

** $P \leq .01$ (F test).

Participants with circulatory diseases scored significantly higher than those with musculoskeletal diseases ($P = .001$).

Disability domains with mental components were associated with SOC, with lower disability scores for higher SOC scores (table 2). The estimated regression coefficients (95% CI) of SOC on cognition, getting along, and participation were −0.20 (−0.32 to −0.08), −0.38 (−0.52 to −0.25) and −0.23 (−0.36 to −0.11), respectively. No significant interactions were found, and the reported results were based on analyses with no interaction terms included.

The disability domain getting along was associated with SOC for most diagnostic groups, with lower disability score for higher SOC score, and associations with SOC were present in some other domains for some diagnostic groups (table 3).

The results from the SEM are shown in fig 1 and table 4. SOC had a positive association with both HRQOL measures, mostly mediated by disability because better SOC led to reduced disability which led to better HRQOL. The model fit was best for the subpopulation with circulatory diseases. All models were significantly better than the independent model.

Table 3 Results of a fully adjusted linear regression analysis for predicting WHODAS 2.0 domain scores in main groups of diseases among 975 patients accepted for specialized somatic rehabilitation in the Western Norway Health Region during the first half of 2015*

Predictor Variable	Cognition		Mobility		Self-Care		Getting Along		Life Activities		Participation	
Diagnostic Groups	B	(SE)	B	(SE)	B	(SE)	B	(SE)	B	(SE)	B	(SE)
SOC†												
Musculoskeletal diseases	−0.23	(0.10)‡	0.02	(0.12)	0.20	(0.10)‡	−0.30	(0.11)§	0.07	(0.13)	−0.18	(0.09)‡
Circulatory diseases	−0.32	(0.14)‡	−0.22	(0.19)	−0.32	(0.15)‡	−0.03	(0.14)	−0.18	(0.25)	−0.28	(0.15)
Neurologic diseases	−0.04	(0.24)	−0.22	(0.37)	−0.06	(0.26)	−0.69	(0.24)§	−0.40	(0.42)	−0.48	(0.21)‡
Neoplasms	0.18	(0.27)	0.38	(0.32)	0.07	(0.25)	−0.94	(0.37)‡	0.34	(0.43)	0.41	(0.32)
Other*	−0.21	(0.15)	−0.23	(0.24)	−0.20	(0.16)	−0.54	(0.17)§	−0.40	(0.23)	−0.27	(0.17)

Abbreviation: B, unstandardized estimated regression coefficient.

* Adjusted for sex, age groups, multimorbidity, rehabilitation urgency, marital status, education, smoking, urbanity, pain/discomfort, depressive symptoms, and anxiety symptoms.

† 13=lowest score, 91=highest score (best). Diseases included the following: endocrine, nutritional, and metabolic diseases (n=37); respiratory diseases (n=36); injuries and external causes (n=26); factors influencing health status and contact with health services (n=23); mental and behavioral disorders (n=13); symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified (n=9); codes for special purposes (n=7); diseases of the digestive system (n=6); diseases of the blood and blood-forming organs, and certain disorders involving the immune mechanism (n=5); diseases of the ear and the mastoid process (n=3); diseases of the genitourinary system (n=3); congenital malformations, deformations, and chromosomal abnormalities (n=3); and certain infectious and parasitic diseases (n=2).

‡ $P \leq .05$ (F test).

§ $P \leq .01$ (F test).

Discussion

To our knowledge this is the first study to assess the relations between SOC, domain-specific disability, and HRQOL in a large sample of rehabilitation patients with diagnoses that are common in rehabilitation centers in secondary care. SEM was performed, in which 2 structural models were investigated. The largest diagnostic groups were analyzed separately to enhance the clinical relevance.

In comparisons with previous Norwegian studies, the mean SOC-13 score found in this study was slightly lower than in a population of women after myocardial infarction[46] and higher than in a sample of patients with musculoskeletal pain,[47] consistent with the lower SOC-13 scores for patients with

Table 4 Results from SEM for prior hypothesized structural models of SOC, disability, and HRQOL among 975 patients accepted for specialized somatic rehabilitation in the Western Norway Health Region during the first half of 2015

	Both Models				Model 1* Only				Model 2† Only
	Fit Indices‡				Regression Coefficients				Covariance
Variables Diagnostic Groups	CFI	TLI	RMSEA(95% CI)	SRMR	SOC→ Disability	SOC→ HRQOL	Disability→ HRQOL	SOC→ HRQOL	Disability↔ HRQOL
SOC, disability, MCS									
All diseases	0.902	0.898	0.081 (0.080-0.083)§	0.090	−0.178§	0.115§	−0.524§	0.209§	−0.115§
Musculoskeletal diseases	0.878	0.873	0.084 (0.082-0.086)§	0.098	−0.211§	0.135§	−0.461§	0.233§	−0.116§
Circulatory diseases	0.980	0.979	0.038 (0.032-0.043)§	0.093	−0.385‖	0.153‖	−0.409§	0.311‖	−0.032§
Other	0.937	0.935	0.064 (0.06-0.068)§	0.102	−0.408¶	0.161¶	−0.252§	0.264‖	−0.058§
SOC, disability, PCS									
All diseases	0.852	0.847	0.093 (0.092-0.094)§	0.103	−0.127§	−0.096§	−2.030§	0.162§	−0.318§
Musculoskeletal diseases	0.749	0.741	0.101 (0.099-0.103)§	0.114	−0.161§	−0.096§	−0.967§	0.059¶	−0.211§
Circulatory diseases	0.955	0.954	0.055 (0.051-0.059)§	0.101	−0.294‖	−0.026	−1.366§	0.375‖	−0.096§
Other	0.894	0.890	0.081 (0.078-0.084)§	0.115	−0.235¶	−0.210¶	−1.772§	0.205	−0.219§

Abbreviations: CFI, comparative fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; TLI, Tucker-Lewis index.

* Partially mediated.

† Direct relation only.

‡ Satisfactory fit of a model was defined by a CFI and TLI close to 0.95 or higher, an RMSEA close to 0.06 or lower, and a standardized root mean square residual close to 0.08 or lower.[42]

§ $P \leq .001$ (F test).

‖ $P \leq .01$ (F test).

¶ $P \leq .05$ (F test).

musculoskeletal diseases compared to patients with circulatory diseases in the present study. The mean SF-36 domain scores in the present study (data not shown) were lower compared with a Dutch study of patients in a rehabilitation center.[47] However, the Dutch study was postrehabilitation, 6-12 months after discharge. In our study population, overall disability scores were higher than in similar populations of other studies.[48,49]

Importance of SOC among rehabilitation patients

From a theoretical perspective, Antonovsky argued for an association between SOC and both mental and physical components of health, with better health according to stronger SOC. However, the lack of association between SOC and the physical domains of disability (mobility, self-care, life activities) found in the present study is consistent with a previous systematic review.[9] An association between mental disability domains and SOC was found in all diagnostic groups and implies that rehabilitation patients with better capacity to cope report less disability in mental domains, also consistent with the same review.[9] Some items in the participation domain assess attitudes, reactions, and actions from significant persons, which may represent aspects of social support that is positively related to SOC.[50]

The results from the SEM in the full sample showed better fit of both hypothesized models, including the mental components of HRQOL, than the physical components, also in line with previous studies.[9] This suggests that rehabilitation patients who are able to mobilize available resources to manage challenges of everyday life, and who find this meaningful, may have improved mental health. This was also found in a study where higher levels of SOC predicted better mental health in men 3-6 months after a myocardial infarction.[51]

The fit indices for the hypothesized models found in patients with circulatory diseases support a direction of association from SOC to disability and mental components of HRQOL, consistent with a previous study among adolescents with congenital heart disease.[21] However, this comparison requires caution, considering the development of SOC in younger ages, as theorized by Antonovsky.[35] The fit indices were also adequate considering the physical component of HRQOL. To our knowledge, this has not been reported previously and further investigation using longitudinal studies is needed to confirm that SOC actually improves the physical component of HRQOL among patients with circulatory diseases.

Among patients with musculoskeletal diseases, the results from the path analysis did not support the hypothesized models. We have not found any studies explaining this directly, and future studies should investigate if SOC-related constructs such as pain, depression, and anxiety can explain why these relations vary among different diseases. However, a study among patients with long-term musculoskeletal pain showed no association between SOC and work reentry.[47] Thus, the relation between SOC, disability, HRQOL, and other important rehabilitation outcomes should be further investigated especially in this diagnostic group.

Although the WHODAS 2.0 measures the restriction on daily life activities and social participation and the SF-36 addresses patient's physical and mental health, these constructs overlap. Nevertheless, the results from the present SEM, which were numerically similar, imply a different causal role of SOC.

Contrary to our hypothesized structural model, with the direction of association from SOC to disability, the authors of a study investigating the association between SOC and disability among elderly adults suggested an opposite direction.[14] For people experiencing disability, a strong preexisting SOC may be weakened[14]; the authors do not further specify the type of this disability. Although Antonovsky postulated SOC to be relatively stable, he considered that SOC could change under certain conditions.[35] Rehabilitation patients with activity limitations and participation restrictions caused by their health condition may have their SOC weakened, consistent with findings from a 5-year prospective population-based study showing that people with certain disease were among those with the largest decrease in SOC score over time.[52] Longitudinal studies are needed to assess whether SOC might be decreased before rehabilitation, and if rehabilitation efforts can restore the previous SOC.

Study limitations

The main limitation of this study is the cross-sectional design. We used our hypothesized models to investigate whether data were consistent with causal links between the main outcome measures, disability, HRQOL, and SOC as the main predictors. However, the limitations of a cross-sectional design are well known, and the present findings can only contribute to other evidence. Further investigations in this research area are needed to clarify the importance of SOC in rehabilitation.

One-third of invited patients consented to participate and a large number of survey instruments were completed, indicating an acceptable response rate compared with other large-scale surveys among rehabilitation patients[4] and in the general population.[53] The large number of instruments used may explain some of the attrition. Nevertheless, the lack of data from 65% of eligible participants limits the validity. The age of participants was slightly higher than among nonrespondents, which may lead to an overestimation of SOC scores because these scores were highest among older adults. However, a lack of information on nonparticipants makes it difficult to determine whether participants were actually healthier or had stronger SOC. Further research should include larger samples with younger patients and with other diseases. Most importantly, only a prospective design can give valid proof of causal mechanisms.

Conclusion

The present study indicates that SOC is related to mental domains of disability as measured by WHODAS 2.0. However, the role of SOC in relation to disability and HRQOL seemed to vary between the diagnostic groups. We believe that targeting SOC in the rehabilitation setting, especially in patients with circulatory diseases, could improve the mental components of disability and HRQOL. Strengthening SOC involves enhancing patients' understanding and reflection on stressful situations and the available resources and might help the patient to engage in the rehabilitation process and take control of their own life. Future prospective studies might clarify the role of SOC in achieving important outcomes in rehabilitation.

Suppliers

a. SPSS, version 23; IBM Corporation.
b. RStudio, version 1.0.143; RStudio.

Keywords

Health-related quality of life; Health status; Rehabilitation; Sense of coherence

Corresponding author

Vegard P. Moen, MSc, Centre for Habilitation and Rehabilitation, Haukeland University Hospital, Østre Nesttunveg 2, Nesttun N-5221, Bergen, Norway. *E-mail address:* vegard.pihl.moen@helse-bergen.no.

Acknowledgments

We thank the World Health Organization for technical support in obtaining the WHODAS 2.0. Furthermore, we thank all rehabilitation institutions (Åstveit Health Center, Red Cross Haugland Rehabilitation Centre, Ravneberghaugen Rehabilitation Centre, LHL Clinics Bergen, LHL Clinics Nærland, Rehabilitering Vest Rehabilitation Centre) and participating staff for recruiting patients for this study. We thank Analisa Avila, ELS, from Edanz Group (www.edanzediting.com/ac) for editing a draft of this manuscript.

References

1. Aprile I, Di Stasio E, Romitelli F, et al. Effects of rehabilitation on quality of life in patients with chronic stroke. Brain Inj 2008;22:451-6.
2. Lang E, Liebig K, Kastner S, et al. Multidisciplinary rehabilitation versus usual care for chronic low back pain in the community: effects on quality of life. Spine J 2003;3:270-6.
3. Shepherd CW, While AE. Cardiac rehabilitation and quality of life: a systematic review. Int J Nurs Stud 2012;49:755-71.
4. Krops LA, Jaarsma EA, Dijkstra PU, et al. Health-related quality of life in a Dutch rehabilitation population: reference values and the effect of physical activity. PLoS One 2017;12:e0169169.
5. Antonovsky A. Health, stress, and coping. San Fransisco: Jossey-Bass; 1979.
6. Pallant JF, Lae L. Sense of coherence, well-being, coping and personality factors: further evaluation of the sense of coherence scale. Pers Individ Dif 2002;33:39-48.
7. Benz T, Angst F, Lehmann S, et al. Association of the sense of coherence with physical and psychosocial health in the rehabilitation of osteoarthritis of the hip and knee: a prospective cohort study. BMC Musculoskelet Disord 2013;14:159.
8. Chumbler NR, Kroenke K, Outcalt S, et al. Association between sense of coherence and health-related quality of life among primary care patients with chronic musculoskeletal pain. Health Qual Life Outcomes 2013;11:216.
9. Eriksson M, Lindstrom B. Antonovsky's sense of coherence scale and the relation with health: a systematic review. J Epidemiol Community Health 2006;60:376-81.
10. Marks DF, Murray M, Evans B, et al. Health psychology: theory, research and practice. London: SAGE Publications Ltd; 2015.
11. Super S, Verschuren WMM, Zantinge EM, et al. A weak sense of coherence is associated with a higher mortality risk. J Epidemiol Community Health 2014;68:411-7.
12. Surtees P, Wainwright N, Luben R, et al. Sense of coherence and mortality in men and women in the EPIC-Norfolk United Kingdom Prospective Cohort Study. Am J Epidemiol 2003;158:1202-9.
13. Griffiths CA. Sense of coherence and mental health rehabilitation. Clin Rehabil 2009;23:72-8.
14. Virues-Ortega J, Vega S, Seijo-Martinez M, et al. A protective personal factor against disability and dependence in the elderly: an ordinal regression analysis with nine geographically-defined samples from Spain. BMC Geriatr 2017;17:42.
15. Boeckxstaens P, Vaes B, De Sutter A, et al. A high sense of coherence as protection against adverse health outcomes in patients aged 80 years and older. Ann Fam Med 2016;14:337-43.
16. Schnyder U, Buchi S, Morgeli H, et al. Sense of coherence—a mediator between disability and handicap? Psychother Psychosom 1999;68:102-10.
17. World Health Organization. International Classification of Functioning, Disability and Health (ICF). Geneva, Switzerland: World Health Organization; 2001.
18. Karimi M, Brazier J. Health, health-related quality of life, and quality of life: what is the difference? Pharmacoeconomics 2016;34:645-9.
19. Tengland PA. The goals of health work: quality of life, health and welfare. Med Health Care Philos 2006;9:155-67.
20. Eriksson M, Lindstrom B. Antonovsky's sense of coherence scale and its relation with quality of life: a systematic review. J Epidemiol Community Health 2007;61:938-44.
21. Apers S, Luyckx K, Rassart J, et al. Sense of coherence is a predictor of perceived health in adolescents with congenital heart disease: a cross-lagged prospective study. Int J Nurs Stud 2013;50:776-85.
22. Baruth M, Wilcox S, Schoffman DE, et al. Factors associated with disability in a sample of adults with arthritis. Disabil Health J 2013;6:377-84.
23. Garin N, Olaya B, Moneta MV, et al. Impact of multimorbidity on disability and quality of life in the Spanish older population. PLoS One 2014;9:e111498.
24. Lacey RJ, Belcher J, Rathod T, et al. Pain at multiple body sites and health-related quality of life in older adults: results from the North Staffordshire Osteoarthritis Project. Rheumatology (Oxford) 2014;53:2071-9.
25. Paananen M, Taimela S, Auvinen J, et al. Impact of self-reported musculoskeletal pain on health-related quality of life among young adults. Pain Med 2011;12:9-17.
26. Apers S, Luyckx K, Goossens E, et al. Socio-demographic and clinical determinants of sense of coherence in adolescents with congenital heart disease. Eur Heart J 2013;34:958.
27. Brenes GA, Penninx BW, Judd PH, et al. Anxiety, depression and disability across the lifespan. Aging Ment Health 2008;12:158-63.
28. Kirchberger I, Heier M, Amann U, Kuch B, Thilo C, Meisinger C. Variables associated with disability in male and female long-term survivors from acute myocardial infarction. Results from the MONICA/KORA Myocardial Infarction Registry. Prev Med 2016;88:13-9.
29. Moen VP, Drageset J, Eide GE, Gjesdal S. Dimensions and predictors of disability—a baseline study of patients entering somatic rehabilitation in secondary care. PLoS One 2018;13:e0193761.
30. Üstün TBK, Chatterji S, Rehm J. Measuring health and disability: manual for WHO Disability Assessment Schedule (WHODAS 2.0). Geneva, Switzerland: World Health Organization; 2010.
31. Moen VP, Drageset J, Eide GE, et al. Validation of World Health Organization Assessment Schedule 2.0 in specialized somatic rehabilitation services in Norway. Qual Life Res 2017;26:505-14.
32. Ware JE, Kosinski M, Dewey JE, et al. SF-36 health survey: manual and interpretation guide. Lincoln, RI: Quality Metric Inc; 2000.
33. Garratt AM, Ruta DA, Abdalla MI, et al. The SF36 health survey questionnaire: an outcome measure suitable for routine use within the NHS? BMJ 1993;306:1440-4.
34. Ruta DA, Abdalla MI, Garratt AM, et al. SF 36 health survey questionnaire: I. Reliability in two patient based studies. Qual Health Care 1994;3:180-5.
35. Antonovsky A. Unraveling the mystery of health: how people manage stress and stay well. San Francisco: Jossey-Bass; 1987.

36. Eriksson M, Lindstrom B. Validity of Antonovsky's sense of coherence scale: a systematic review. J Epidemiol Community Health 2005;59:460-6.
37. Feldt T, Lintula H, Suominen S, et al. Structural validity and temporal stability of the 13-item sense of coherence scale: prospective evidence from the population-based HeSSup study. Qual Life Res 2007;16:483-93.
38. Hansen AO, Kristensen HK, Cederlund R, et al. Test-retest reliability of Antonovsky's 13-item sense of coherence scale in patients with hand-related disorders. Disabil Rehabil 2016;39:2105-11.
39. Zigmond AS, Snaith RP. The Hospital Anxiety and Depression scale. Acta Psychiatr Scand 1983;67:361-70.
40. Bjelland I, Dahl AA, Haug TT, et al. The validity of the Hospital Anxiety and Depression scale. An updated literature review. J Psychosom Res 2002;52:69-77.
41. Mykletun A, Stordal E, Dahl AA. Hospital Anxiety and Depression (HAD) scale: factor structure, item analyses and internal consistency in a large population. Br J Psychiatry 2001;179:540-4.
42. Mercer SW, Smith SM, Wyke S, et al. Multimorbidity in primary care: developing the research agenda. Fam Pract 2009;26:79-80.
43. Williams A. Euroqol—a new facility for the measurement of health-related quality-of-life. Health Policy 1990;16:199-208.
44. Janssen MF, Pickard AS, Golicki D, et al. Measurement properties of the EQ-5D-5L compared to the EQ-5D-3L across eight patient groups: a multi-country study. Qual Life Res 2013;22:1717-27.
45. Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. Struct Equ Modeling 1999;6:1-55.
46. Lovlien M, Mundal L, Hall-Lord ML. Health-related quality of life, sense of coherence and leisure-time physical activity in women after an acute myocardial infarction. J Clin Nurs 2017;26:975-82.
47. Lillefjell M, Jakobsen K. Sense of coherence as a predictor of work reentry following multidisciplinary rehabilitation for individuals with chronic musculoskeletal pain. J Occup Health Psychol 2007;12:222-31.
48. Garin O, Ayuso-Mateos JL, Almansa J, et al. Validation of the "World Health Organization Disability Assessment Schedule, WHODAS-2" in patients with chronic diseases. Health Qual Life Outcomes 2010;8:51.
49. Posl M, Cieza A, Stucki G. Psychometric properties of the WHO-DASII in rehabilitation patients. Qual Life Res 2007;16:1521-31.
50. Wolff AC, Ratner PA. Stress, social support, and sense of coherence. West J Nurs Res 1999;21:182-97.
51. Drory Y, Kravetz S, Hirschberger G, et al. Long-term mental health of men after a first acute myocardial infarction. Arch Phys Med Rehabil 2002;83:352-9.
52. Nilsson B, Holmgren L, Stegmayr B, et al. Sense of coherence—stability over time and relation to health, disease, and psychosocial changes in a general population: a longitudinal study. Scand J Public Health 2003;31:297-304.
53. Picavet HS, Schouten JS. Musculoskeletal pain in the Netherlands: prevalences, consequences and risk groups, the DMC3-study. Pain 2003;102:167-78.