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ORIGINAL REPORT

LONG-TERM CHANGE AND PREDICTORS OF CHANGE IN PHYSICAL AND MENTAL FUNCTION AFTER REHABILITATION: A MULTI-CENTRE STUDY

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Objective: **To investigate changes and predictors of change in physical and mental function over a 3-year period after rehabilitation.**
Design: **Prospective cohort.**
Participants: **Patients, across diseases, living in western Norway, accepted for somatic spesialized interprofessional rehabilitation (n = 984).**
Methods: **Physical and mental function were assessed at admittance (baseline), and after 1 and 3 years using the Medical Outcome Study Short Form 36 (SF-36). Associations between changes in SF-36 component summary scores and sense of coherence, pain, disease group (musculoskeletal, neoplasm, cardiovascular, neurological, other), exercise habits and demographic variables were analysed using linear mixed modelling.**
Results: **In the total group, mean (standard deviation) physical component summary scores improved by 2.9 (8.4) and 3.4 (9.3) points at 1 and 3 years, respectively. Mental component summary scores improved by 2.1 (9.7) and 1.6 (10.8) points. Improvement in physical component summary was significantly greater for patients with higher sense of coherence (b = 0.09, $p = 0.001$) and for the neoplasm disease group (b = 2.13, $p = 0.046$). Improvement in mental component summary was significantly greater for patients with low sense of coherence (b = –0.13, $p = < 0.001$) and higher level of education (b = 3.02, $p = 0.0302$). Interaction with age (physical component summary: b = 0.22, $p = 0.039$/ mental component summary b = 0.51, $p = 0.006$) indicated larger effect at 1 year than at 3 years.**
Conclusion: **Physical and mental function improved in the total study group over the 3-year period. Sense of coherence at baseline was associated with improved physical and mental function, suggesting that coping resources are important in rehabilitation.**

Key words: rehabilitation; function; sense of coherence; coping resources.

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LAY ABSTRACT

Rehabilitation aims to improve function among people with disabilities. This study investigated how physical and mental function change in a 3-year period after rehabilitation, and the factors related to these changes. In a cohort of 984 rehabilitation patients, physical and mental function were measured before rehabilitation (baseline) and at 1 and 3 years after rehabilitation. Both physical and mental function improved over a period of 3 years, with the greatest improvement from baseline to 1 year. Improved function at 1 year remained relatively stable over time. Participants with higher coping resources at baseline, measured by sense of coherence, had the greatest improvement in physical function, and less improvement in mental function. Participants' disease group influenced change in physical function. Participants with a higher level of education demonstrated greater improvement in mental function. These results imply that coping resources should be addressed as an important part of rehabilitation.

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Rehabilitation is widely used to improve health and function among people with disabilities, regardless of age and disease (1, 2). It has been estimated that one-third of the global population will need rehabilitation at least once in the course of their disease or injury (3). Among people in need of rehabilitation, the estimated years of life living with disability is 310 million (3). This highlights the importance of rehabilitation where the overall goal is optimizing functioning regardless of diagnoses (4, 5). In the International Classification of Functioning, Disability and Health (ICF) functioning is described as a person's lived experience of health. Functioning relates to body functions, body structures, activities and participation, and its dynamic interaction with a health condition, personal and environmental factors (6).

In non-rehabilitation settings, studies have found that an increased number of diseases, older age, poor mental health, and poor self-perceived health are risk indicators for future limitations in physical functioning (7, 8). A number of studies on functional rehabilitation trajectories have examined changes over time for specific diagnostic groups, including traumatic brain injury (9, 10), sepsis (11) and musculoskeletal conditions (12). Some studies have investigated functional trajectories as part of health-related quality of life (13, 14). Few studies have investigated predictors of change in function over longer periods of time, and across diagnoses after rehabilitation. However, 1 study evaluating activity-based rehabilitation in a large heterogeneous group of patients, found that changes in physical and mental functioning in a 1-year rehabilitation trajectory were positively associated with time, younger age, personal assistance for less than 2 h a week, lower level of pain, high chronic disease-efficacy, and non-neurological diagnoses (15). Another disease overarching 1-year follow-up study, after activity-based rehabilitation, found that patients with lower levels of perceived fatigue and pain at discharge and those who had accepted their disability were more likely to obtain a stable high outcome up to 1 year after rehabilitation (16).

The ability to adapt and cope with disability or illness may be important factors in rehabilitation. The complex interaction between functioning, disability and health, and contextual factors (such as coping) is illustrated in the ICF (6). Antonovsky used sense of coherence (SOC) to explain an individual's capability to mobilize their internal and external resources to cope and promote health (17, 18). SOC implies a global orientation and includes comprehensibility (the sense that you can understand events), manageability (the belief that you have the resources to manage and stay in control), and meaningfulness (the feeling that things are meaningful and worth your time and effort) (17, 18). In earlier research among rehabilitation patients, stronger SOC is associated with better mental health and better health-related quality of life (19).

To our knowledge, no study has included SOC as a predictor of change in physical and mental function over time following rehabilitation. In addition, there is a knowledge gap in how and why patients with different diagnoses show change in outcome beyond 1 year after rehabilitation. This study used a mixture of patient-reported and registry data to build on previous research, and had a 2-fold purpose. Firstly, the study aimed to describe changes in physical and mental function over a 3-year period after rehabilitation. Secondly, the study investigated if and how changes in physical and mental function over time were associated with patients' initial health problems, coping resources and sociodemographic characteristics.

METHODS

Study design

This multi-centre, prospective cohort study of rehabilitation patients was based on patient-reported survey data and demographic data retrieved from Statistics Norway (the producer of official statistics in Norway). Survey data were collected at baseline (before admittance to specialized rehabilitation) in 2015, with follow-ups in 2016 and 2018.

Context and participants

This study was part of the Rehabilitation Cohort West (REKOVE) study (19). Patients living in western Norway aged ≥ 18 years who were eligible for specialized rehabilitation (secondary healthcare) between January and June 2015 were invited to participate in REKOVE. Of the 2,863 eligible participants, 984 responded to the baseline survey, which included several validated instruments. The survey was repeated at 1 and 3 years after baseline, with responses received from 675 and 627 participants, respectively. All patients who completed the Medical Outcome Study Short Form 36, version 1 (SF-36) at baseline and at 1 and/or 3 years ($n = 666$) were included in the current study (Fig. 1). Between baseline and 1 year, all patients received up to 4 weeks of interprofessional rehabilitation as an inpatient or outpatient. According to the agreement between the rehabilitation centres and the regional health authorities rehabilitation across all centres should be evidence-based, goal-orientated and individually adapted. Interventions focused on physical activity, cognitive approaches including coping strategies, and pain management. However, the current study did not collect specific information about the content of care.

Outcome variables

The SF-36 is a self-reported generic measure of health and function. The instrument is widely used to assess health outcomes affected by disease and treatment (20). It offers a valid measure of health and function across a range of diagnoses (21). Normative data for the Norwegian population is available (22). The instrument assesses 8 functional domains, summarized into 2 components: a physical component summary (PCS) that measures general health, bodily pain, physical functioning and role physical; and a mental component summary (MCS) that assesses vitality, social functioning, mental health and role emotional. These component summaries aim to reflect the physical and mental dimensions of health and function in daily activities (23). The PCS and MCS were calculated on a scale from 0 to 100 in accordance with the SF-36 scoring manual, with a higher score representing better health/function (23, 24).

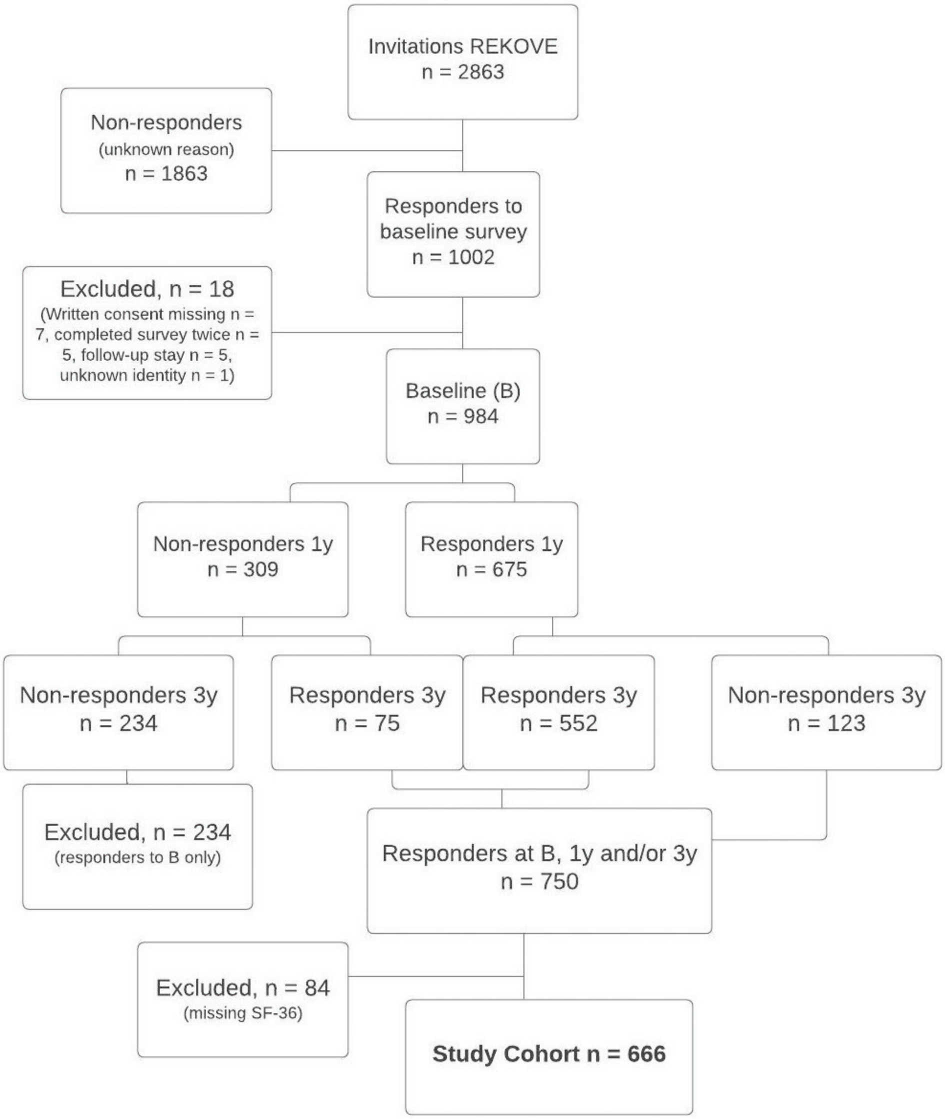

Fig. 1. Flowchart of the inclusion process of the Rehabilitation Cohort West study (REKOVE) recruited at rehabilitation centres in western Norway, January–June 2015, aged 18 years or above. B: baseline; 1 y: 1 year; 3 y: 3 years.

Explanatory variables

Coping resources were measured at baseline using the 13-item Sense of Coherence questionnaire (SOC-13). SOC is widely used (25) and a relevant tool in rehabilitation (19). Responses are given on a 7-point Likert-type scale from "never" (1) to "very often" (7). Five negatively formulated items were recoded. Scores are summarized to a global score of 13–91, where 91 is the best score (17).

Pain intensity at baseline was measured using a numerical rating scale, a recommended measure of pain (26). Participants rated their level of pain by circling an integer between 0 and 10, where 0 represented no pain and 10 the worst pain possible. Data on weekly exercise was also collected at baseline, and defined as going for a walk, skiing, swimming, training or playing sports, using a 5-point scale (never = 0 to almost every day = 5) (27). Place of residence was categorized as rural (0) or urban (1), with urban defined as ≥20.000 inhabitants in the municipality and rural as <20,000 inhabitants (28). The highest level of education completed was categorized as elementary school (at most 10 years), high school (11–13 years) or university (≥14 years). Referral diagnoses (International Classification on Diseases-10 (29)) related to rehabilitation were used to categorize patients into disease groups: musculoskeletal diseases, neoplasms, diseases of the circulatory system (cardiovascular, including stroke), neurological diseases, and other. Sex was categorized as female (0) or male (1). Age (obtained at baseline) was used as a continuous variable divided by 10 (age per 10 years).

Statistical methods

Descriptive statistics were used to report participants' characteristics (e.g. mean and standard deviation (SD)) at baseline and changes in MCS and PCS scores. Change scores were calculated for the PCS and MCS by subtracting the score at baseline from the score at

1 year and 3 years. Pearson's correlation coefficient (r) was used to examine the associations between MCS/PCS scores, age, SOC and pain at baseline, and changes in MCS/PCS scores from baseline to 1 and 3 years. The strength of correlation was defined as weak (|r|=0.10 to 0.29), moderate (|r|=0.30 to 0.49) or strong (|r|=0.50 to 1.0) (30).

Linear mixed models (LMMs) were used to examine whether changes in physical and mental function (SF-36, PCS/MCS) could be predicted by time, and sex, place of residence, level of education, exercise habits, SOC, pain, age and disease group, using data from baseline. As recommended by Lydersen (31), this study analysed change scores rather than using analysis of covariance of follow-up measures adjusted for baseline values. Thus, change scores of PCS and MCS from baseline were used as outcome variables in the LMMs and time as an explanatory variable with 2 categories (t_1=1 year; t_2=3 years). First, LMMs were estimated with time and 1 other explanatory variable at a time, and interaction with time was tested. Secondly, a fully adjusted model was estimated and interactions with time added in a forward stepwise manner at inclusion level 0.05. Results are reported with estimated regression coefficient (b) and *p*-value with a significance level of 0.05.

Data were analysed using IBM SPSS statistical software (Windows version 26), provided by IBM, Chigago, Illinois, USA.

Missing data

Missing values for the SF-36 items were treated according to the SF-36 manual (24). To obtain a MCS and PCS score, the participant had to answer at least 50% of the items (24). For the SOC-13, participants with more than 3 missing values per subscale were excluded. For included participants, missing scores were imputed based on the mean across each participant's available responses for each subscale.

Ethics approval

This study was performed in accordance with the principles of the Declaration of Helsinki. The Regional Committee for Medical Research Ethics in Western Norway approved this study (REK-number 2014-1636). All participants gave written informed consent.

RESULTS

Participants' characteristics

Of the 984 patients participating in REKOVE, 750 participated in 1 or both of the follow-up surveys. Of these, 666 patients answered the SF-36 questionnaire at baseline and at 1 year and/or 3 years and were included in this study cohort (Fig. 1). Their mean (SD) age was 58 (13) years and 61% were female. The 4 most common disease groups were musculoskeletal (47%), diseases of the circulatory system (20%),

Table I. Characteristics and explanatory variables of 984 participants, aged 18 years or above, included in the Rehabilitation Cohort West Study (REKOVE) recruited at rehabilitation centres in western Norway, January–June 2015, aged 18 years or above

Variable	Baseline cohort (*n*=984)		Study cohort (*n*=666)		Not included in study cohort (*n*=318)	
Category	*n*	%	*n*	%	*n*	%
Age, years, mean (SD)	984	57.8 (14.1)	666	58.3 (13.1)	318	56.7 (15.9)
Median [IQR]		58 [18, 92]		59 [20, 92]		57 [18, 91]
Sex						
Male	360	36.6	261	39.2	99	31.1
Female	624	63.4	405	60.8	219	68.9
Referral disease group						
Neoplasms	54	5.5	40	6.0	14	4.4
Neurology	87	8.8	54	8.1	33	10.4
Musculoskeletal	457	46.4	314	47.1	143	45.0
Circulatory system	187	19.0	134	20.1	53	16.7
Other	199	20.2	124	18.6	75	23.6
Level of education						
Elementary school	204	20.7	109	16.4	95	29.9
High school	490	49.8	343	51.5	147	46.2
University/college	278	28.3	209	31.4	69	21.7
Place of residence						
Rural	465	47.3	332	49.8	133	41.8
Urban	519	52.7	334	50.2	185	58.2
Exercise habits at baseline						
Never	59	6.0	29	4.4	30	9.4
Less than once a week	145	14.7	90	13.5	55	17.3
Once a week	188	19.1	130	19.5	58	18.2
2–3 times a week	376	38.2	265	39.8	111	34.9
Almost every day	199	20.2	148	22.2	51	16.0
SOC-13 baseline, mean (SD)	933	62.9 (12.3)	651	63.7 (12.1)	282	61.3 (12.5)
Pain baseline (NRS), mean (SD)	905	4.7 (2.8)	624	4.6 (2.8)	281	4.9 (2.8)

SD: standard deviation; IQR: interquartile range; SOC: Sense of Coherence (scale 13–91); NRS: numerical rating scale (0–10).

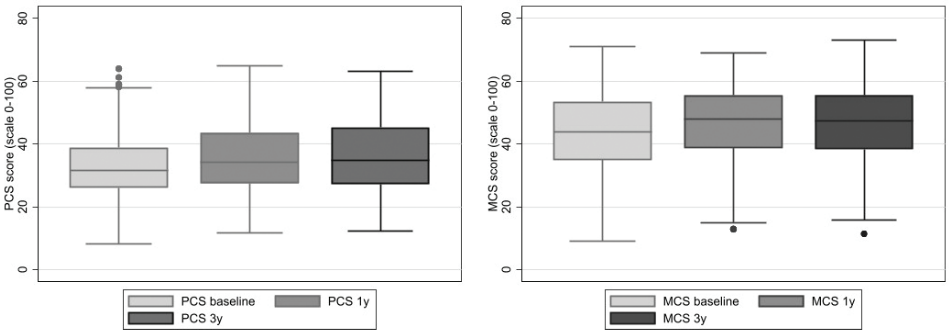

Fig. 2. Physical (PCS) and mental (MCS) function of the Medical Outcome Study Short Form 36 (SF-36) as reported by participants, aged 18 years or above, included in the Rehabilitation Cohort West Study (REKOVE) in western Norway, January–June 2015. Scores at baseline, 1 year (1 y) and 3 years (3 y) for PCS (*left*) and MCS (*right*).

neurological diseases (8%) and neoplasms (6%) (Table I). The mean age of participants who responded to either 1 or both follow-up surveys (study cohort) was 1.6 years higher and they had a higher mean SOC score (by 2.4 points) at baseline compared with participants who were not included in the study cohort. In addition, the study cohort had a higher percentage of participants with a higher level of education than those that were not included (Table I).

Changes in the physical component summary

The mean (SD) PCS score improved by 2.9 (8.4) points from baseline to 1 year and by 3.4 (9.3) points from baseline to 3 years (Fig. 2, Table SI). The highest change scores were found in those with higher level of education, patients in the neoplasms group and in those who exercised less than once a week at baseline (Table SI).

Age had a weak negative correlation (r = −0.138) and pain had a strong negative correlation (r = −0.553) with PCS score at baseline, but neither age nor pain at baseline correlated with change in PCS at either follow-up (Table II). SOC-13 scores were not correlated with PCS scores at baseline, but demonstrated a weak positive correlation with PCS change scores from baseline to 3 years (r = 0.139) (Table II).

Changes in the mental component summary

The mean (SD) MCS score improved by 2.1 (9.7) points from baseline to 1 year and by 1.6 (10.8) points from baseline to 3 years (Fig. 2, Table SI). The highest change scores were found in those with higher level of education, patients in the neoplasms group, and at 1year in those who exercised almost every day at baseline (Table SII).

Age had a weak positive correlation with the MCS score at baseline (r = 0.197), and a weak negative correlation with change in MCS scores from baseline to 3 years (r = −0.107) (Table II). SOC-13 scores demonstrated a strong positive correlation with MCS scores at baseline (r = 0.596), and a weak negative correlation with change scores at 1 and 3 years (r = −0.118 and r = −0.143, respectively) (Table II). Baseline pain scores showed a weak negative correlation with baseline MCS scores (r = −0.237), but no correlation between baseline pain scores and MCS change scores at 1 and 3 years (Table II).

Predictors of change over time

The results of the LMM analyses are shown in Table III (PCS) and Table IV (MCS). Fig. 3 (PCS) and Fig. 4 (MCS) illustrate significant results

Table II. Correlations (Pearson's r) between baseline scores of age, Sense of Coherence (SOC) and pain, and the Medical Outcome Study Short Form 36 (SF-36) mental and physical component scores at baseline and change in scores from baseline to 1 and 3 years after baseline among patients included in the study cohort (*n* = 666)

	PCS			MCS		
Baseline variable	Baseline score	Change b to 1 year	Change b to 3 years	Baseline score	Change b to 1 year	Change b to 3 years
Age, years	*−0.138*	0.057	−0.055	*0.197*	0.004	*−0.107*
	(p < 0.001)	(p = 0.168)	(p = 0.198)	*(p < 0.001)*	(p = 0.925)	*(p = 0.013)*
SOC-13	0.024	*0.091*	*0.139*	*0.596*	*−0.118*	*−0.143*
	(p = 0.495)	*(p = 0.028)*	*(p = 0.001)*	*(p < 0.001)*	*(p = 0.004)*	*(p = 0.001)*
Pain (NRS)	*−0.553*	0.013	0.024	*−0.237*	0.007	0.032
	(p < 0.001)	(p = 0.758)	(p = 0.588)	*(p < 0.001)*	(p = 0.862)	(p = 0.474)

PCS: Physical Component Summary (scale 0–100); MCS: Mental Component Summary (0–100); SOC-13: Sense of Coherence (13–91); NRS: numerical rating scale (0–10); b: baseline; Italic letters: statistically significant results.

Table III. Association between changes in scores of the Medical Outcome Study Short Form 36 (SF-36) physical component summary from baseline to follow-up at 1 and 3 years and characteristics of the rehabilitation patients included in the study cohort ($n=666$)

Variable	SF-36, Physical Component Summary (PCS)						
	Unadjusted models[a]				Final adjusted model ($n=605$)		
Category	*n*	b	95% CI	*p*-value	b	95% CI	*p*-value
Intercept	666				−1.41	(−7.18, 4.35)	0.175
Time	666			0.399			*0.035*
1 year	587	−0.30	(−1.01, 0.40)		*−4.80*	*(−8.33, −1.27)*	
3 years	543	0.00	(reference)		*0.00*	*(reference)*	
Sex	666			0.017			0.920
Female	405	−1.74	(−3.17, 0.31)		−0.07	(−1.51, 1.36)	
Male	261	0.00	(reference)		0.00	(reference)	
Place of residence	666			0.136			0.063
Rural	332	0.93	(−0.29, 2.15)		1.22	(−0.07, 2.50)	
Urban	334	0.00	(reference)		0.00	(reference)	
Level of education	661			0.045			0.277
University	209	0.26	(−1.76, 2.28)		1.40	(−0.60, 3.40)	
High school	343	−0.13	(−2.02, 1.76)		0.41	(−1.49, 2.28)	
Elementary school	109	0.00	(reference)		0.00	(reference)	
Exercise habits baseline	662			0.997			0.995
Never	29	0.16	(−3.05, 3.36)		−0.00	(−3.30, 3.30)	
Less than once a week	90	0.22	(−1.89, 2.32)		0.40	(−1.78, 2.58)	
Once a week	130	−0.06	(−1.96, 1.83)		0.34	(−1.63, 2.30)	
2–3 times a week	265	0.21	(−1.40, 1.83)		0.29	(−1.38, 1.97)	
Almost every day	148	0.00	(reference)		0.00	(reference)	
SOC Baseline	651	0.08	(0.03, 0.13)	0.002	*0.09*	*(0.04, 0.15)*	*0.001*
Pain Baseline (NRS)	624	0.05	(−0.18, 0.28)	0.657	0.15	(−0.13, 0.43)	0.297
Age per 10 years	666	0.09	(−0.38, 0.55)	0. 718			
Time × Variable[b]							
Time × Age per 10 years							*0.039*
Age per 10 years at 1 year	587				*0.22*	*(−0.34, 0.77)*	
Age per 10 years at 3 year	543				*−0.44*	*(−1.08, 0.21)*	
TimexDisease group	666			0.017			*0.046*
At 1 year							
Neoplasms	40	1.90	(−1.06, 4.87)		*2.13*	*(−1.12, 5.37)*	
Nervous system	54	−3.80	(−6.23, −1.36)		*−4.04*	*(−6.66, −1.43)*	
Other	124	−0.06	(−1.86, 1.73)		*−0.24*	*(−1.71, 2.18)*	
Circulatory system	134	0.29	(−1.46, 2.04)		*0.20*	*(−1.93, 2.32)*	
Musculoskeletal system	314	0.00	(reference)		*0.00*	*(reference)*	
At 3 years							
Neoplasms	40	0.23	(−3.06, 3.52)		*−0.04*	*(−3.59, 3.52)*	
Nervous system	54	−2.22	(−5.06, 0.61)		*−2.78*	*(−5.79, 0.22)*	
Other	124	−1.62	(−3.71, 0.47)		*−1.56*	*(−3.82, 0.70)*	
Circulatory system	134	−2.17	(−4.16, −0.18)		*−2.06*	*(−4.42, 0.30)*	
Musculoskeletal system	314	0.00	(reference)		*0.00*	*(reference)*	

[a]Mixed linear regression model only adjusted for time; [b]results with interaction (Time × Variable).

PCS: Physical Component Summary (scale 0–100); SOC-13: Sense of Coherence (13–91); NRS: numerical rating sale (0–10); b: estimated regression coefficient; 95% CI: 95% confidence interval; Italic letters: statistically significant results.

Time. In both SF-36 components, time was associated with change. In the final adjusted model, there was greater improvement from baseline to 1 year compared with the change from baseline to 3 years (PCS: b= −4.80, $p = 0.035$; MCS b = −5.20, $p = 0.012$).

Sense of coherence. SOC was associated with change in both SF-36 components. In the final adjusted model, patients with a higher SOC at baseline showed greater improvement in PCS scores (b = 0.09, $p=0.001$) (Table III, Fig. 3), whereas patients with lower SOC scores at baseline had greater improvement in MCS scores (b = −0.13; $p<0.001$) (Table IV, Fig. 4).

Age. Changes in the PCS and MCS were associated with age (PCS: b = 0.22, $p=0.039$; MCS: b = 0.51, $p=0.006$). There were interactions with time both for PCS (Table III, Fig. 3) and MCS (Table IV, Fig. 4) ($p=0.039$ and 0.006 in the final adjusted models). Age per 10 years was a larger predictor from baseline to 1 year than from baseline to 3 years (b = 0.22 vs –0.44 for PCS, and 0.51 vs –0.46 for MCS) (Tables III and IV).

Level of education. A higher level of education was associated with greater improvement in MCS scores from baseline to 1 year (b = 3.02, $p=0.030$) (Table IV, Fig. 4).

Disease groups. In PCS scores, improvement was associated with disease groups ($p=0.046$), whereby participants in the neoplasm group had the greatest improvement, and those with

Table IV. Association between changes in scores of the Medical Outcome Study Short Form 36 (SF-36) mental component summary from baseline to follow-up at 1 and 3 years and characteristics of the rehabilitation patients included in the study cohort ($n=666$)

		SF-36, Mental Component Summary (MCS)					
Variable		Unadjusted models[a]			Final adjusted model ($n=605$)		
Category	*n*	b	95% CI	*p*-value	b	95% CI	*p*-value
Intercept	666				*12.05*	*(5.52, 18.58)*	*<0.001*
Time	666			0.443			*0.012*
1 year	587	0.34	(−0.51, 1.18)		*−5.20*	*(−9.27, −1.14)*	
3 years	543	0.00	(reference)		*0.00*	*(reference)*	
Sex	666			0.084			0.316
Female	405	1.28	(−0.17, 2.27)		0.83	(−0.79, 2.44)	
Male	261	0.00	(reference)		0.00	(reference)	
Place of residence	666			0.804			0.979
Rural	332	−0.18	(−1.59, 1.24)		−0.02	(−1.47, 1.43)	
Urban	334	0.00	(reference)		0.00	(reference)	
Level of education	661			0.043			*0.030*
University	209	2.72	(0.57, 4.87)		*3.02*	*(0.77, 5.27)*	
High school	343	1.56	(−0.45, 3.56)		*1.81*	*(−0.31, 3.93)*	
Elementary school	109	0.00	(reference)		*0.00*	*(reference)*	
Disease group	666			0.324			0.348
Neoplasms	40	2.35	(−0.75, 5.46)		1.97	(−1.31, 5.24)	
Nervous system	54	−1.30	(−3.94, 1.35)		−1.43	(−4.18, 1.32)	
Other	124	−0.89	(−2.82, 1.05)		−0.46	(−2.49, 1.58)	
Circulatory system	134	0.17	(−1−7, 2.04)		1.03	(−1.23, 3.29)	
Musculoskeletal system	314	0.00	(reference)		0.00	(reference)	
Exercise habits baseline	662			0.074			0.060
Never	29	−0.45	(−4.14, 3.24)		−0.93	(−4.64, 2.79)	
Less than once a week	90	−0.78	(−3.21, 16.64)		−0.70	(−3.16, 1.76)	
Once a week	130	−2.02	(−4.20, 0.17)		−2.15	(−4.36, 0.06)	
2–3 times a week	265	−2.54	(−4.40, −0.68)		−2.77	(−4.55, 0.78)	
Almost every day	148	0.00	(reference)		0.00	(reference)	
SOC-13 Baseline	651	−0.10	(−0.16, −0.05)	<0.001	*−0.13*	*(−0.19, −0.07)*	*<0.001*
Pain Baseline (NRS)	624	0.04	(−0.22, 0.30)	0.756	−0.08	(−0.39, 0.25)	0.638
Age per 10 years	666	−0.23	(−0.77, 0.31)	0.394			
Time×Variable[b]							
Time×Age per 10 years							*0.006*
Age per 10 years at 1 year	587				*0.51*	*(−0.11, 1.14)*	
Age per 10 years at 3 years	543				*−0.46*	*(−1.20, 0.28)*	

[a]Mixed linear regression model only adjusted for time; [b]results with interaction (Time × Variable).

MCS: Mental Component Summary (scale 0–100); SOC-13: Sense of Coherence (13–91); NRS: numerical rating scale (0–10); b:estimated regression coefficient; 95% CI: 95% confidence interval; Italic letters: statistically significant results.

neurological diseases the least improvement (Table III, Fig. 3).

Non-significant findings

Sex, place of residence, exercise habits and level of pain were not significant as predictors of change over time in either component of SF-36 (Tables III and IV).

DISCUSSION

This study followed 666 rehabilitation patients over a period of 3 years. It was found that participants' mental and physical function, measured by SF-36 component summary scores, improved in the total group, both from baseline to 1 year and from baseline to 3 years. Most of the improvement occurred within the first year when the patients also underwent rehabilitation. Participants with diseases in the neoplasm group had the greatest

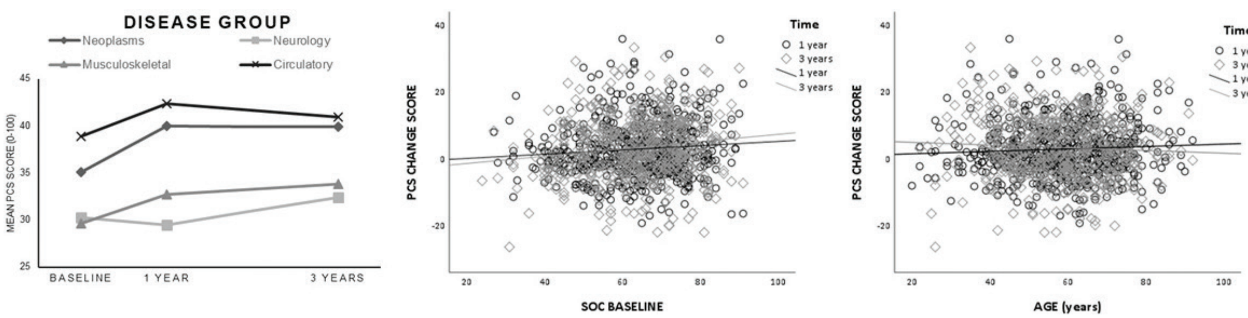

Fig. 3. Mean Physical Component Summary (scale 0–100) (PSC) scores and mean PCS scores on disease group at baseline, 1 year and 3 years. *(left)* Change scores of PCS on Sense of Coherence (scale 13–91) (SOC) (*middle*) and age (*right*) at 1 year and 3 years, ($n=666$).

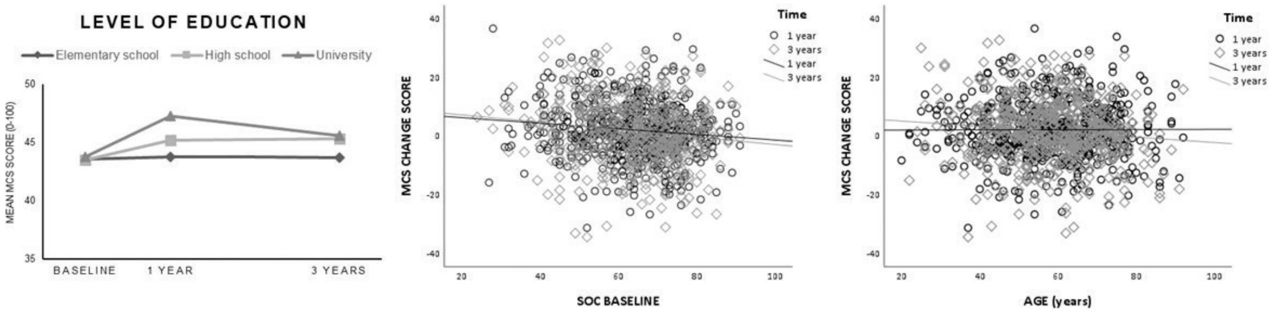

Fig. 4. Mean Mental Component Summary (scale 0–100) (MCS) scores and mean MCS scores on level of education at baseline, 1 year and 3 years. (*left*) Change scores of MCS on Sense of Coherence (scale 13–91) (SOC) (*middle*) and age (*right*) at 1 year and 3 years, ($n=666$).

improvement in PCS, and those with neurological diseases the least impovement in PCS. Lower coping resources at baseline, measured by SOC, were associated with the greatest improvement in MCS scores, and the least improvement in PCS scores. Higher level of education was associated with greater improvement in MCS scores.

Change in physical and mental function

Compared with normative data from the Norwegian population, the current study participants had baseline PCS and MCS scores that were 15 and 8 points lower, respectively (22), which is reasonable since this is a rehabilitation population. The SF-36 scores improved at both follow-ups. Greater improvement from baseline to 1 year may be expected, as this year included a period of rehabilitation, but it was encouraging to see that the improvement continued over time. However, the mean SF-36 scores were still lower at both follow-ups compared with the normative population in Norway, suggesting that, despite improvement, the study cohort still experienced some reduced function. This may imply that they have reached their potential to recover or indicate a need for repeated rehabilitation to improve further.

The improvement at the group level was relatively modest. The large variation in the literature concerning clinically important change in PCS and MCS scores (32–34), means that it is challenging to determine whether the changes were clinically important. Nevertheless, the improvements in component scores from baseline to 1 year are in line with changes seen in a 1-year functional rehabilitation trajectory study conducted in Norway (15), and similar to reported improvements in the moderate outcome category in a Dutch 1-year follow-up study (16). The current study provides new knowledge that improvement achieved at 1 year after rehabilitation seems to persist over time.

Change related to the explanatory variables

The older participants underwent their greatest improvement from baseline to 1 year and that change diminished over time. A previous study among rehabilitation patients aged >65 years found that patients were more likely to report improvement in functional outcomes 1 year after rehabilitation if they were followed up in outpatient rehabilitation after inpatient rehabilitation (35). Another study reported that increasing age and comorbidities predicted functional difficulties in functional trajectories from midlife to old age (7). The finding of the current study, that change declined with age, was therefore as expected. With increasing age, the rehabilitation goal might not always be to regain or improve function, as it could be to sustain or limit further reduction.

The current study found a decrease in PCS scores after 1 year in the neurological group, but an increase after 3 years. This may illustrate the nature of neurological diseases, and could suggest that this group need more time to achieve stable improvement or to stagnate further decline. The other disease groups showed greater improvement at 1 year and their functioning stayed relatively stable at 3 years except for the musculoskeletal group, which showed even further improvement in PCS at 3 years. This pattern was also present when adjusting for patient characteristics in the regression model. Differences in longitudinal change between disease groups are reported in other studies. Preede et al. (15) found that diseases not associated with neurology had better rehabilitation outcomes. A study of age-related functional trajectories found that memory-related diseases, stroke, pulmonary diseases and arthritis were associated with higher difficulties in physical functioning over time compared with other diseases (7). Differences between disease groups in the current study confirm the heterogeneity in a rehabilitation population.

The current study found that coping resources measured by SOC at baseline, were associated with future change in both PCS and MCS scores. Previous studies summarized by Eriksson & Lindstrøm (18) reported that the relationship between SOC and MCS was stronger than with PCS. This was also found in the current study where SOC baseline correlated with both MCS scores at baseline and MCS change scores. Thus, one might regard the association with change in MCS as the most relevant. Improvement in MCS in the current study was greater in participants with lower SOC at baseline than in those with higher SOC. This was consistent with the results of a previous study among rehabilitation patients with osteoarthritis (36). Studies have found that lower SOC is associated with factors such as anxiety and hopelessness (18), and that participants who reported having experienced negative life events had lower SOC than those who did not report such negative events (37). In addition, Antonovsky (17) stated that people with lower SOC need support to manage stressors. Thus, the result of the current study might suggest that participants with lower SOC reported lower MCS scores, initially as a reflection of their need of support, and then consequently showed greater improvement after rehabilitation.

A Swedish study among patients with chronic pain reported that better initial coping resources (not measured by SOC) was associated with improved PCS scores 1 year after rehabilitation (38). Likewise, in the current study, it appears it is difficult for participants with low SOC scores at baseline to achieve PCS improvement. This is in contrast with participants with high SOC scores who improved their PCS scores, it might suggest that coping resources and higher MCS scores are relevant for further improvement in PCS scores. The current study results indicate the importance of including coping strategies in rehabilitation to promote better physical and mental functioning. Given the right tools, patients with lower coping resources may initially still achieve improved function over time.

The current study finding that lower level of education was associated with less improvement in MCS scores over time is consistent with previous findings where associations between socioeconomic factors and mental health were investigated (39). In addition, previous studies report that patients with lower level of education had poorer rehabilitation outcomes (35, 40). This may confirm the relevance of contextual factors described in the ICF (6) and suggest that patients with a lower level of education may need extra attention.

Level of pain was not found to predict change over time in the current study, in contrast with other studies (15, 16). This may be because the current study measured level of pain at baseline, and other studies measured pain at discharge (16). In addition, it may be because of the characteristics of participants in the current study who reported a moderate level of pain at baseline.

Strengths and limitations

A strength of the current study was the longitudinal design with a 3-year follow-up. The study cohort represented patients with different diseases commonly encountered in rehabilitation. Few studies have followed a large heterogeneous group of patients over such a long time, making it possible to study disease-overarching factors in rehabilitation. In addition, the relatively large group allowed us to compare subgroups within the study cohort.

The use of validated instruments increases the external validity and possibility to compare the results with other studies.

Although the current study-population consists of nearly 1,000 patients, the main limitation interpreting results was the low response rate at baseline (34% of eligible participants responded). At the follow-ups, 69% (1 year) and 64% (3 years) of the participants included at baseline responded. However, using LMMs as a statistical method and including all 3 surveys made it possible to include 68% of the baseline population. With only 3 measuring points, the current study might not have been able to detect the nuanced picture of change. Furthermore, since we have not measurement at discharge the results cannot be interpreted as an effect of specialized rehabilitation. In addition, we have limited information on the content of rehabilitation within the different disease groups, other interventions and follow-ups after returning to rehabilitation in primary care.

The patients in the current study do not represent the entire rehabilitation group; for example, patients with severe functional limitations receive specialized rehabilitation at hospital-based rehabilitation units. The neoplasms group in the current study may have a high representation of patients who responded well to treatment before entering rehabilitation.

Furthermore, the study cohort were older, with a higher mean SOC score and higher level of education, compared with those who responded at baseline but failed to respond to follow-ups. Unfortunately, the current study has no information regarding non-respondents within the eligible population. Hence, the results should be interpreted with caution, especially given the differences in baseline scores between the study cohort and patients from the baseline cohort that were not included in the study.

Implications and future directions

We regard SOC as a predictor for functional improvement after rehabilitation as the most evident finding in the current study. Previous research has found that SOC is not as stable as first predicted (25). Thus, further research to investigate change in SOC scores after rehabilitation and its relevance to other rehabilitation outcomes as return to work is needed.

To summarize, this study, identified improvement in both physical and mental function among rehabilitation patients with different diseases over a 3-year period after rehabilitation. For most diseases, improvement in physical function was greater from baseline to 1 year than from baseline to 3 years. However, patients with neurological diseases showed most improvement from baseline to 3 years. In addition, the current study found that SOC at baseline was associated with changes in both physical and mental function, suggesting that patients' coping resources should be addressed as an important part of rehabilitation to achieve results over time.

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