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Patient-reported outcome measures after hip fracture in patients with chronic cognitive impairment

RESULTS FROM 34,675 PATIENTS IN THE NORWEGIAN HIP FRACTURE REGISTER

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Aims

Hip fracture patients have high morbidity and mortality. Patient-reported outcome measures (PROMs) assess the quality of care of patients with hip fracture, including those with chronic cognitive impairment (CCI). Our aim was to compare PROMs from hip fracture patients with and without CCI, using the Norwegian Hip Fracture Register (NHFR).

Methods

PROM questionnaires at four months (n = 34,675) and 12 months (n = 24,510) after a hip fracture reported from 2005 to 2018 were analyzed. Pre-injury score was reported in the four-month questionnaire. The questionnaires included the EuroQol five-dimension three-level (EQ-5D-3L) questionnaire, and information about who completed the questionnaire.

Results

Of the 34,675 included patients, 5,643 (16%) had CCI. Patients with CCI were older (85 years vs 81 years) ($p < 0.001$), and had a higher American Society of Anesthesiologists (ASA) classification compared to patients without CCI. CCI was unrelated to fracture type and treatment method. EQ-5D index scores were lower in patients with CCI after four months (0.37 vs 0.60; $p < 0.001$) and 12 months (0.39 vs 0.64; $p < 0.001$). Patients with CCI had lower scores for all dimensions of the EQ-5D-3L pre-fracture and at four and 12 months.

Conclusion

Patients with CCI reported lower health-related quality of life pre-fracture, at four and 12 months after the hip fracture. PROM data from hip fracture patients with CCI are valuable in the assessment of treatment. Patients with CCI should be included in future studies.

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Introduction

Hip fracture patients with chronic cognitive impairment (CCI) represent up to 37% of the hip fracture population,[1] and are often vulnerable.[2] Patients with CCI are often excluded from studies because of the difficulty in obtaining informed consent from patients or proxies. Excluding these patients can lead to systematic bias in existing knowledge of hip fracture patients.[3] The traditional method of assessing outcome after hip fracture has been to measure physical functioning, reoperations, complications and mortality.[4,5] A hip fracture also has a considerable impact on patients' health-related quality of life (HRQoL).[6-8] Several studies have therefore advocated including patient-reported outcome measures (PROMs) in the assessment of outcomes following a hip fracture.[5,9]

There are few published studies on hip fracture patients using PROMs that include patients with CCI and there is thus a need for more studies to explore the relevant outcomes.[10,11]

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The Norwegian Hip Fracture Register (NHFR) is one of the few registries that routinely collect PROM data from patients, including cognitively impaired patients. Information on who filled in the form is also available.

Methods

Study design. Our aim was to compare PROM data after hip fracture in patients with and without CCI. This study was a prospective observational study based on data from the NHFR.

The NHFR has collected data from all hospitals in Norway treating patients with hip fractures since 2005.[12] On a one-page form, the surgeon reports information such as fracture type, operation method and patient information, including assessment of CCI. The surgeon evaluates patients' chronic cognitive function by examining their medical chart, asking them or their relatives, or using the clock drawing test.[13] The information on chronic cognitive function is based on preoperative information. No other standardized diagnostic tools for assessment of cognitive function are normally used in this setting. The question on CCI on the form is, 'Does the patient have cognitive impairment?' with the options of 'Yes', 'No', or 'Uncertain'. The data on CCI in the NHFR have been previously validated against two hospital quality databases and the positive predictive value of the data reported to the NHFR on CCI was 78%.[14]

Fractures were classified as undisplaced femoral neck, displaced femoral neck, basocervical, throchanteric A1, A2, A3, or subtrochanteric. Primary operations were classified as screw osteosynthesis, hemiartroplasty, sliding hip screw, and short/long intramedullary nail.

PROM questionnaires were sent from the NHFR by mail directly to patients. Patients responded with use of a pre-paid envelope. No reminders were sent to patients not responding. PROMs reported in questionnaires at four and 12 months were analyzed. The questionnaires include the Norwegian translation of EuroQol five-dimension three-level (EQ-5D-3L), which covers five dimensions of HRQoL: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression.[15] There are three levels of response for each dimension: from level 1 (indicating no problems or best state) to level 3 (indicating severe problems or worst state).[15] Pre-fracture EQ-5D-3L data were collected retrospectively together with the EQ-5D-3L data in the four-month questionnaire. The preference scores (EQ-5D index scores) were generated from a large European population, [16] ranging from a score of 1 (indicating the best possible state of health) to a score of -0.217 (indicating a state of health worse than death), while 0 indicates a state of health equal to death. Each questionnaire also includes information on who completed the form: the patient, a relative, a clinician, or other.

Patient selection. Between 1 January 2005 and 31 December 2018, 113,447 patients were reported to the NHFR. Patients with pathological fractures and patients below the age of 65 years were excluded (Figure 1). Patients treated with total hip arthroplasty (THA) were excluded because they were reported on forms that did not include information on cognitive status. Patients recorded in the NHFR with missing information on chronic cognitive status and patients with 'uncertain' cognitive status were also excluded. Patients who died within four months were also excluded. Finally, 60,847 patients received and 34,675 patients (57%) completed the four-month questionnaire.

We primarily analyzed the data from patients responding to the four-month questionnaire. Pre-fracture EQ-5D data were answered together with the four months questionnaire. Out of these patients, 32,484 (94%) received and 24,510 (75%) answered the 12-month questionnaire.

Secondly, we examined the group answering both the four- and 12-month questionnaires in order to analyze information on changes in a long-term perspective. Thus, 24,510 patients could be included in the analysis comparing PROMs at four and 12 months (Figure 1).

Statistical analysis. Pearson's chi-squared test was used to compare categorical variables, while an independent samples *t*-test was used for continuous variables in independent groups.

The number of patients reaching their pre-fracture EQ-5D status was calculated in percentages. The change in EQ-5D was calculated for each patient as the difference between EQ-5D index score and EQ-5D index score pre-fracture. Sub analyses with stratification on males/females and different age groups were performed.

The statistical software package IBM SPSS Statistics (v. 26.0; IBM, USA) was used for statistical analysis. This study was performed in accordance with the REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) statement.[17]

Ethics, funding, and potential conflict of interest. The NHFR has authorization from the Norwegian Data Protection Authority to collect and store data on hip fracture patients (authorization issued on 3 January 2005: reference number 2004/1658 to 2 SVE/-). The patients provided written, informed consent; if unable to understand or sign, a relative could sign the consent form on their behalf. The NHFR is financed by the Western Norway Regional Health Authority. No competing interests were declared by the authors.

Results

The four-month questionnaire was completed by 34,675 patients, and 24,510 patients completed both the four- and 12 month questionnaires. The majority of the questionnaires from patients with CCI were filled in by a proxy

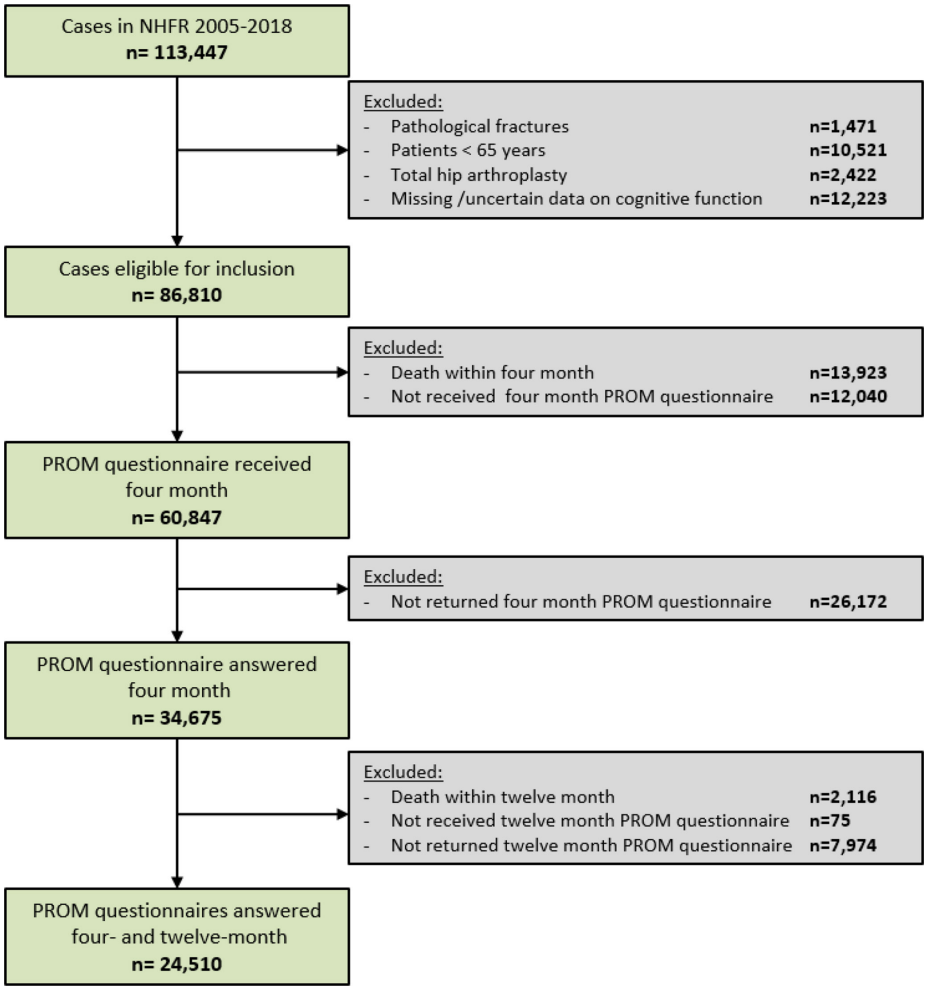

Fig. 1
Flowchart of the study.

Table I. Completion of four-month questionnaires (n = 34,675) and 12-month questionnaires (n = 24,510) by cognitive function.

Variable	Four months			12 months		
	Chronic cognitive impairment			Chronic cognitive impairment		
	Total, n (%)	**No, n (%)**	**Yes, n (%)**	**Total, n (%)**	**No, n (%)**	**Yes, n (%)**
Total	34,675	29,032	5,643	24,510	21,852	2,658
Patient	20,280 (59)	19,517(67)	763 (14)	16,464 (67)	15,943 (73)	521 (20)
Proxy						
Relative	9,828 (28)	7,121(25)	2,707 (48)	5,777 (24)	4,495 (21)	1,282 (48)
Clinician	3,616 (10)	1,604 (5.5)	2,012 (36)	1,703 (6.9)	920 (4.2)	783 (30)
Other	582 (1.6)	479 (1.6)	103 (1.8)	342 (1.4)	296 (1.4)	46 (1.7)
Wrong/missing	369 (1.0)	311 (1.1)	58 (1.0)	224 (0.9)	198 (0.9)	26 (1.0)

(four months 84%; 12months 78.2%), whereas most questionnaires from patients without CCI were filled in by the patients themselves (four months 67.2%; 12 months 73.0%) (Table I).

The baseline characteristics of responders and non-responders of the four-month questionnaire are presented in Table II. The non-responders of this questionnaire were older (mean age 83 years vs 82 years) ($p < 0.001$, independent Student's *t*-test), included more females (75% vs 73%) ($p < 0.001$, Pearson's chi-squared test) and more patients with CCI (38% vs 16%) ($p < 0.001$), and had higher ASA scores (ASA 3 + 4; 66% vs 54%) ($p < 0.001$, Pearson's chi-squared test) compared to the responders. There were no clinically important differences in fracture type or operation method of the different fracture types between responders and non-responders, but due to the

Table II. Characteristics of patients who received the four-month patient-reported outcome measure (PROM) questionnaire.

Variable	Total	Answered four-month PROM	PROM not returned	p-value
Total, n (%)	60,847	34,675 (57)	26,172 (43)	
Age, yrs (range; SD)	82 (65 to 106; 7.7)	82 (65 to 105; 7.7)	83 (65 to 106; 7.6)	< 0.001*
Female, n (%)	44,817 (74)	25,280 (73)	19,537 (75)	< 0.001†
Chronic cognitive impairment, n (%)	15,517 (26)	5,643 (16)	9,874(38)	< 0.001†
ASA score, n (%)				< 0.001†
1	2,219 (3.6)	1,643 (4.7)	576 (2.2)	
2	22,322 (37)	14,144 (41)	8,178 (31)	
3	32,645 (54)	17,112 (49)	15,533 (59)	
4 + 5	2,953(4.8)	1,361(3.9)	1,592(6.1)	
Missing	708(1.2)	451(1.2)	293(1.1)	
Fracture type, n (%)				< 0.001†
Undisplaced FNF	8,501 (14.0)	5,027 (14.5)	3,474 (13.3)	
Displaced FNF	24,741 (40.7)	14,420(41.6)	10,321 (39.4)	
Basocervical FNF	2,018 (3.3)	1,098 (3.2)	920 (3.5)	
Trochanteric A1‡	9,959 (16.4)	5,401 (15.6)	4,558 (17.4)	
Trochanteric A2‡	10,284 16.9)	5,697(16.4)	4,587 (17.5)	
Trochanteric A3‡	1,219 (2.0)	723 (2.1)	496 (1.9)	
Subtrochanteric	3,543 (5.8)	2,010 (5.8)	1,553 (5.9)	
Primary operation, n (%)				< 0.001†
Screw osteosynthesis	10495 (17.2)	6,123 (17.7)	4,372 (16.7)	
Hemiarthroplasty	22,649 (37.2)	13,233 (38.1)	9,416 (36.0)	
Sliding hip screw	18,205 (29.9)	10,000 (28.8)	8,205 (31.4)	
Short IM nail	6,013 (9.9)	3,328 (10.1)	2,685 (10.3)	
Long IM nail	3,379 (5.6)	1,936 (5.6)	1,443 (5.5)	
Other	106 (0.2)	55 (0.2)	51 (0.2)	

*Student´s *t*-test.
†Pearson's chi-squared test.
‡AO/OTA classification.
ASA, American Society of Anesthesiologists; FNF, femoral neck fracture; IM, intramedullary; SD, standard deviation.

high number of cases the differences reached statistically significance (Table II).

Patients answering four-month questionnaire (n = 34,675). Of the 34,675 patients answering the four-month questionnaire, 5,673 (16.3%) had CCI. Patients with CCI were older (85 years vs 81 years) (p < 0.001, independent Student's *t*-test), there were more females (77% vs 73%) (p < 0.001, Pearson's chi-squared test), and they had higher comorbidity (ASA 3 + 4; 73% vs 50%) (p < 0.001, Pearson's chi-squared test) compared to patients without CCI.

All five dimensions of the health profiles deteriorated from pre-fracture to four months regardless of cognitive function (Table III), but the patients with CCI reported greater problems in this respect.

The hip fracture had a dramatic impact on patients' mobility. The proportion of patients with CCI confined to bed increased five-fold from 3% to 16%, whereas patients without CCI showed an increase of 0.9% to 3.0% after four months (p < 0.001, Pearson's chi-squared test). The proportion of patients with CCI unable to wash or dress almost doubled from 25% to 48%. Further, the proportion of patients with CCI unable to perform usual activities increased from 45% to 63%. Hip fracture patients with CCI also reported an increase in both moderate and extreme pain/discomfort from 44% to 64% and 5.7% to 8.9%. Regarding anxiety and depression, hip fracture patients with CCI reported an increase in extreme symptoms from 7.4% to 9.7% after four months (Table III).

Patients answering both the four- and 12-month questionnaire (n = 24,510). The patients with CCI were older (85 years vs 81 years) (p < 0.001, independent Student's *t*-test), were more often female (77% vs 72%) (p < 0.001, Pearson's chi-squared test), and had higher comorbidity (ASA 3 + 4: 71 vs 47%)(p < 0.001) than patients without CCI. There were no differences in fracture type (p = 0.48, Pearson's chi-squared test) or operation method (p = 0.52, Pearson's chi-squared test) between patients with and without CCI (Table IV).

The changes in responses in the EQ-5D-3L from preoperative to 12 months postoperative are shown in Figure 2 (walking ability), Figure 3 (self-care), and Figure 4 (usual activities).

The patients with CCI had a lower EQ-5D index score after both four months (0.37 vs 0.60; p < 0.001, independent Student's *t*-test) and 12 months (0.39 vs 0.64; p < 0.001, independent Student's *t*-test) compared

Table III. EuroQol five-dimension results before the fracture and at four months by chronic cognitive function (CCI) (n = 34,675).

Variable		Before operation			Four months postoperatively			
	Total, n (%)	No CCI, n (%)	CCI, n (%)	p-value*	Total, n (%)	No CCI,n (%)	CCI,n (%)	p-value*
Total	34,675	29,032	5,643		34,675	29,032	5,643	
Mobility				0.001				0.001
No problems in walking around	19,183 (55)	17,148 (59)	2,035 (36)		5,753 (17)	5,261 (18)	492 (8.7)	
Some problems in walking around	14,512 (42)	11,206 (38.6)	3,306 (59)		26,386 (76)	22,356 (77)	4,030 (71)	
Confined to bed	442 (1.3)	273 (0.9)	169 (3.0)		176 (5.1)	860 (3.0)	901 (16)	
Wrong/missing	538 (1.5)	405 (1.4)	133 (2.3)		775 (2.2)	555 (1.9)	220 (3.9)	
Self-care				0.001				0.001
No problems with self-care	24,044 (69)	22,386 (77)	1,658 (29)		15,780 (46)	15,096 (52)	684 (12)	
Some problems with self-care	7,813 (23)	5,383 (19)	2,430 (43)		13,132 (38)	10,981 (38)	2,151 (38)	
Unable to wash or dress	2,309 (6.7)	891 (3.1)	1,418 (25)		5,187 (15)	2,504 (8.6)	2,683 (48)	
Wrong/missing	509 (1.5)	372 (1.3)	137 (2.4)		576 (1.6)	451 (1.6)	125 (2.2)	
Usual activities				0.001				0.001
No problems in performing usual activities	17,766 (51)	16,824 (58)	942 (17)		7,529 (22)	7,214 (25)	315 (5.6)	
Some problems in performing usual activities	11,435 (33)	9,464 (33)	1,971 (35)		17,335 (50)	15,756 (54)	1,579 (28)	
Unable to perform usual activities	4,819 (14)	2,291 (8)	2,528 (45)		9,003 (26)	5,450 (19)	3,553 (63)	
Wrong	655 (1.9)	453 (1.6)	202 (3.6)		808 (2.3)	612 (2.1)	196 (3.4)	
Pain/discomfort				0.001				0.001
No pain or discomfort	19,660 (57)	16,960 (58)	2,700 (48)		9,063 (26)	7,697 (27)	1,366 (24)	
Moderate pain or discomfort	12,591 (36)	10,134 (35)	2,457 (44)		21,870 (63)	18,272 (63)	3,598 (64)	
Extreme pain or discomfort	1,767 (5.1)	1,446 (5.0)	321 (5.7)		3,023 (8.7)	2,522 (8.7)	501 (8.9)	
Wrong/missing	657 (1.9)	492 (1.7)	165 (2.9)		719 (2.1)	541 (1.9)	178 (3.2)	
Anxiety/depression				0.001				0.001
Not anxious or depressed	23,658 (68)	21,159 (73)	2,499 (44)		19,830 (57)	17,759 (61)	2,071 (37)	
Moderately anxious or depressed	9,042 (26)	6,547 (23)	2,495 (44)		12,252 (35)	9,476 (33)	2,776 (49)	
Extremely anxious or depressed	1,184 (3.4)	768 (2.6)	416 (7.4)		1,741 (5.0)	1,192 (4.1)	549 (9.7)	
Wrong/missing	791 (2.3)	558 (1.9)	233 (4.1)		852 (2.5)	605 (2.1)	247 (4.4)	

The sum in each column is not the same as not all patients answered all questions correctly.
*Pearson's chi-squared test.

to patients without CCI (Table V). Stratifying into age groups, the youngest patient groups had higher EQ-5D index scores, both among patients with and without CCI (Table VI). There were statistically significant differences in EQ-5D index scores between patients with and without CCI for all age groups both at four and 12 months. The change in EQ-5D was higher among patients without CCI than among patients with CCI at four months (-0.19 to -0.17; $p < 0.001$, independent Student's *t*-test), but not at 12 months ($p = 0.35$, independent Student's *t*-test) when investigating all patients. There were, however, differences between the patients with and without CCI at age 65 years to 74 years at both four (-0.13 to -0.19; $p = 0.002$, independent Student's *t*-test) and 12 months (-0.11 to -0.14; $p = 0.003$, independent Student's *t*-test), and among patients over 90 years at four months (-0.16 to -0.20; $p < 0.001$, independent Student's *t*-test). There was no difference between patients with and without CCI in the proportion who achieved their pre-fracture EQ-5D status after four months ($p = 0.074$, Pearson's chi-squared test). After 12 months, a lower proportion of patients with CCI had reached their preoperative EQ-5D than those without CCI (28% vs 33%; $p < 0.001$, Pearson's chi-squared test) (Table V). The proportion of patients who reached their preoperative EQ-5D at four and 12 months decreased with age (Table VI).

Discussion

Postoperatively, HRQoL decreased for all hip fracture patients. Patients with CCI showed an even greater decline than those without CCI following a hip fracture. This was particularly due to a reduction in walking function, self-care capacity, and the ability to perform usual activities.

Our results concur with a previous review reporting that CCI has a negative impact on HRQoL after a hip fracture.[18]

The seven-fold increase in the number of patients with CCI who were confined to bed one year after a hip fracture is dramatic. Mukka et al[19] reported that 28% were non-walkers one year after the hip fracture. Milte et al[10] also found a decrease in walking ability, but their study measured the EQ-5D only one month postoperatively.

The tendency was the same for self-care capacity, where the proportion of hip fracture patients with CCI unable to wash or dress almost doubled after 12 months, which is in accordance with a previous study by Osnes et al.[20]

Table IV. Baseline characteristics of patients answering both four- and 12-month patient-reported outcome measure PROM questionnaire by chronic cognitive function.

Variable		Chronic cognitive impairment		
	Total	No	Yes	p-value
Total, n (%)	24,510	21,852 (89.2)	2,658 (10.8)	
Age, yrs (range; SD)	81 (65 to 106; 7.7)	81 (65 to 106; 7.7)	85 (65 to 101; 6.8)	< 0.001*
Female, %	73	72	77	< 0.001†
ASA score n (%)				< 0.001†
1	1,334 (5.4)	1,306 (6.0)	28 (1.1)	
2	10,850 (44)	10,133 (46)	717 (27)	
3	11,280 (46)	9,549 (44)	1,731 (65)	
4 + 5	758 (3.1)	605 (2.8)	153 (5.7)	
Missing	288 (1.2)	259 (1.2)	29 (1.1)	
Fracture type, n (%)				0.480†
Undisplaced FNF	3587 (14.6)	3,219 (14.7)	368 (13.8)	
Displaced FNF	10,351 (42.2)	9,179 (42.0)	1,172 (44.1)	
Basocervical FNF	762 (3.1)	688 (3.1)	74 (2.8)	
Trochanteric A1 ‡	3,719 (15.2)	3,326 (15.2)	393 (14.8)	
Trochanteric A2 ‡	3,937 (16.1)	3,500 (16.0)	437 (16.4)	
Trochanteric A3 ‡	500 (2.0)	452 (2.1)	48 (1.8)	
Subtrochanteric	1,449 (5.9)	1,303 (6.0)	146 (5.5)	
Primary operation, n (%)				0.520†
Screw osteosynthesis	4,315 (17.6)	3,855 (17.7)	460 (17.1)	
Hemiarthroplasty	9,558 (39.0)	8,488 (38.9)	1,070 (40.2)	
Sliding hip screw	6,527 (26.6)	5,835 (26.7)	692 (26.0)	
Short IM nail	2,271 (9.4)	2,003 (9.2)	268 (10.1)	
Long IM nail	1,404 (5.7)	1,275 (5.8)	129 (4.9)	
Other	435 (1.8)	395 (1.9)	39 (1,5)	

*Independent Student's *t*-test.
†Pearson's chi-squared test.
‡AO/OTA classification.
ASA, American Society of Anesthesiologists; FNF, femoral neck fracture; IM, intramedullary; SD, standard deviation.

The decrease in EQ-5D index according to age found in our study concur with earlier studies of all hip fractures.[5] The decrease in hip fracture patients reaching their pre-fracture HRQoL could be a sign of general decrease in physical and mental status. Peeters et al also found inferior results for female gender.[21]

Few studies have included hip fracture patients with CCI.[3] One reason could be challenges in including patients that might not understand the purpose of the study. It can be difficult to obtain informed consent. The researcher might also find it difficult to trust and interpret answers from patients with CCI. However, patients with CCI represent a significant proportion of the hip fracture population, and should not be excluded from studies.

PROMs at four months were completed by a proxy in 86% of the cases with CCI and 41% of cases without CCI. At 12 months, the corresponding proportions were 80% and 33%. Some would argue that PROMs collected from patients with CCI are unreliable. However, several studies have found that persons with CCI are capable of expressing their HRQoL of life via EQ-5D.[22-24] Further, studies have reported that the EQ-5D is a good tool for measuring outcome for patients recovering from hip fracture, including patients with CCI.[21-23,25] It has also been shown that responses given by a proxy can be trusted. However, a closer relationship to the patient led to more agreement in the proxies' answers.[24,26] We would argue that a proxy can normally judge the patient's walking ability and ability to perform self-care and usual activities using the simple three-level categorization in the EQ-5D-3L. However, it is important to acknowledge that the results presented in this study is, to a certain extent, represent a comparison between PROMS by patients without CCI and PROMS completed by proxy for patients with CCI.

The EuroQol also contains a visual analogue scale (EQ-VAS). We chose to exclude these data, acknowledging the uncertainty in interpreting visual analogue scales for persons with CCI.[22]

There was no substantial change in quality of life between four months 12 months despite improvement in walking ability. This finding might be an argument for only measuring PROMs at four months, thereby reducing the burden of data collection by researchers and those responsible for monitoring PROMs.

Strengths and limitations. One strength of our study is the high number of patients included, and the inclusion of a large number of patients with CCI. To our knowledge,

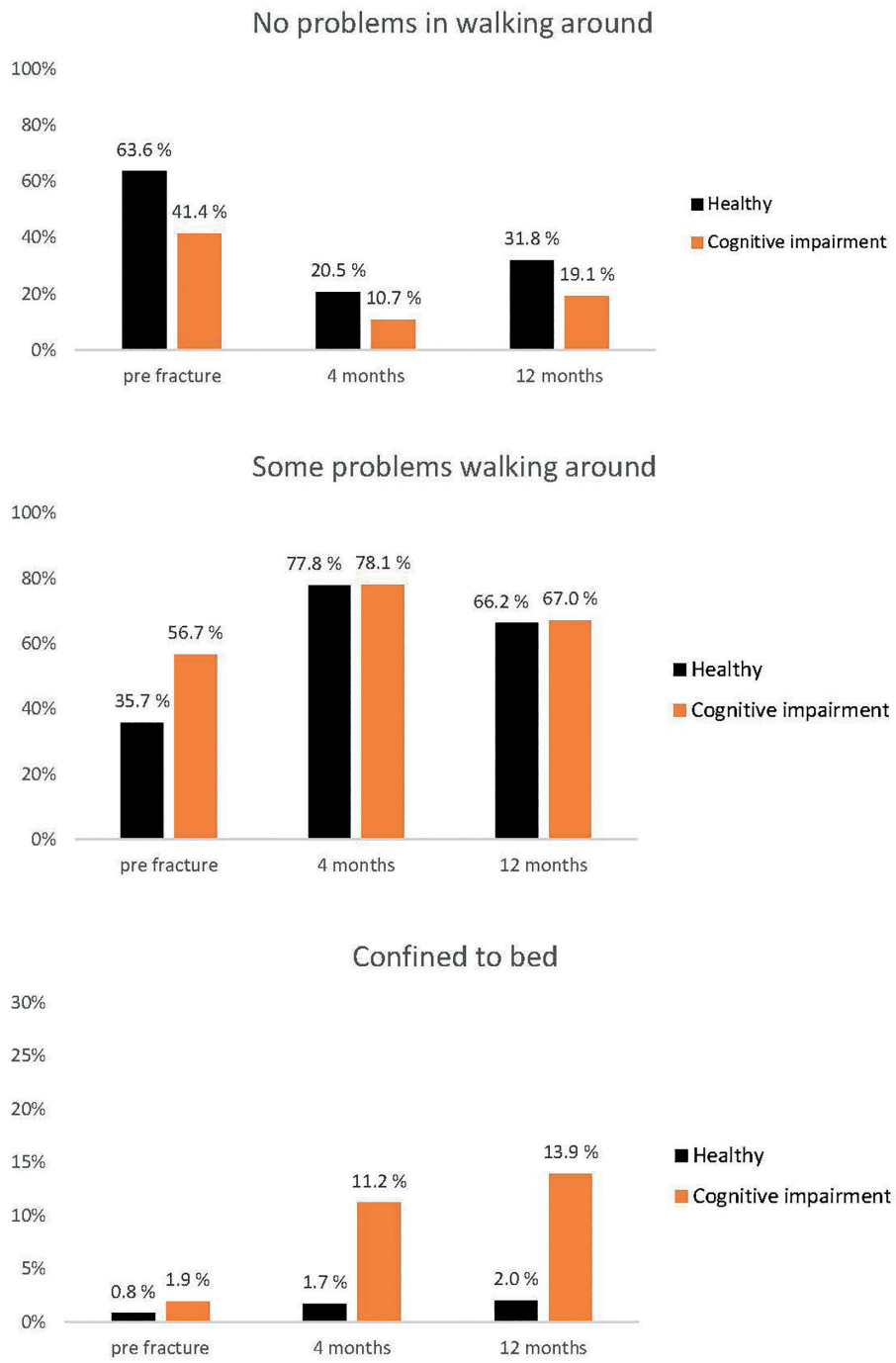

Fig. 2

Changes in the mobility dimension of EuroQol five-dimension three-level from pre-fracture to four and 12 months postoperatively.

this is the largest study on PROM data from hip fracture patients with CCI ever reported.

Our data represent nationwide results, including all types of hip fractures and operation methods, except fractures treated with a THA. This makes the data more representative than a small sample of patients and accordingly increases the external validity.

The NHFR has high completeness of data: 88% for cases of osteosynthesis and 94% for hemiarthroplasties.[27]

The main limitation of the study is nevertheless the methods used to identify cognitive impairment. The surgeon assessed the patient's cognitive function by use of different sources of information, including the patient's medical journal and discussion with relatives or with

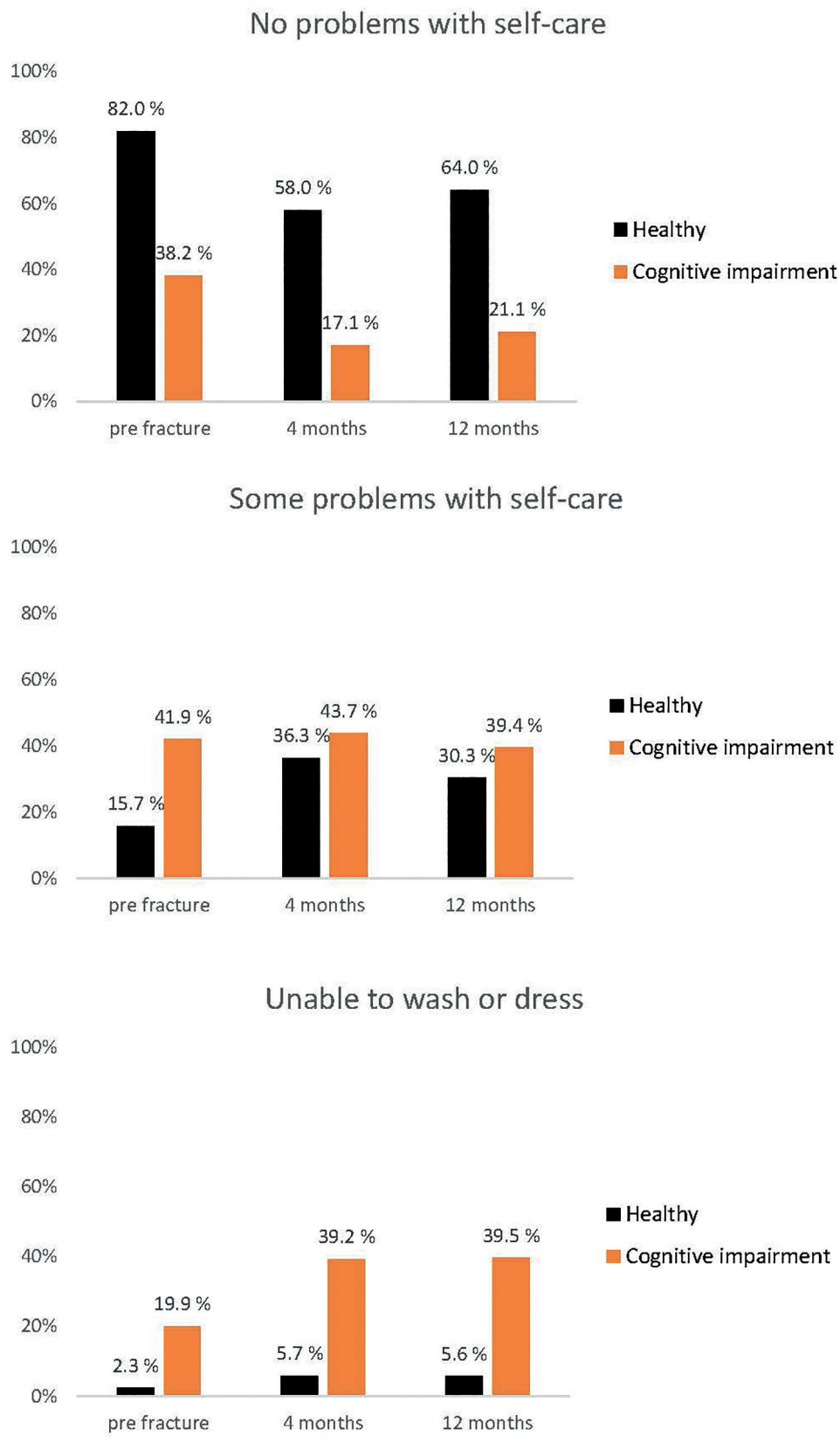

Fig. 3

Changes in the self-care dimension of EuroQol five-dimension three-level from pre-fracture to four and 12 months postoperatively.

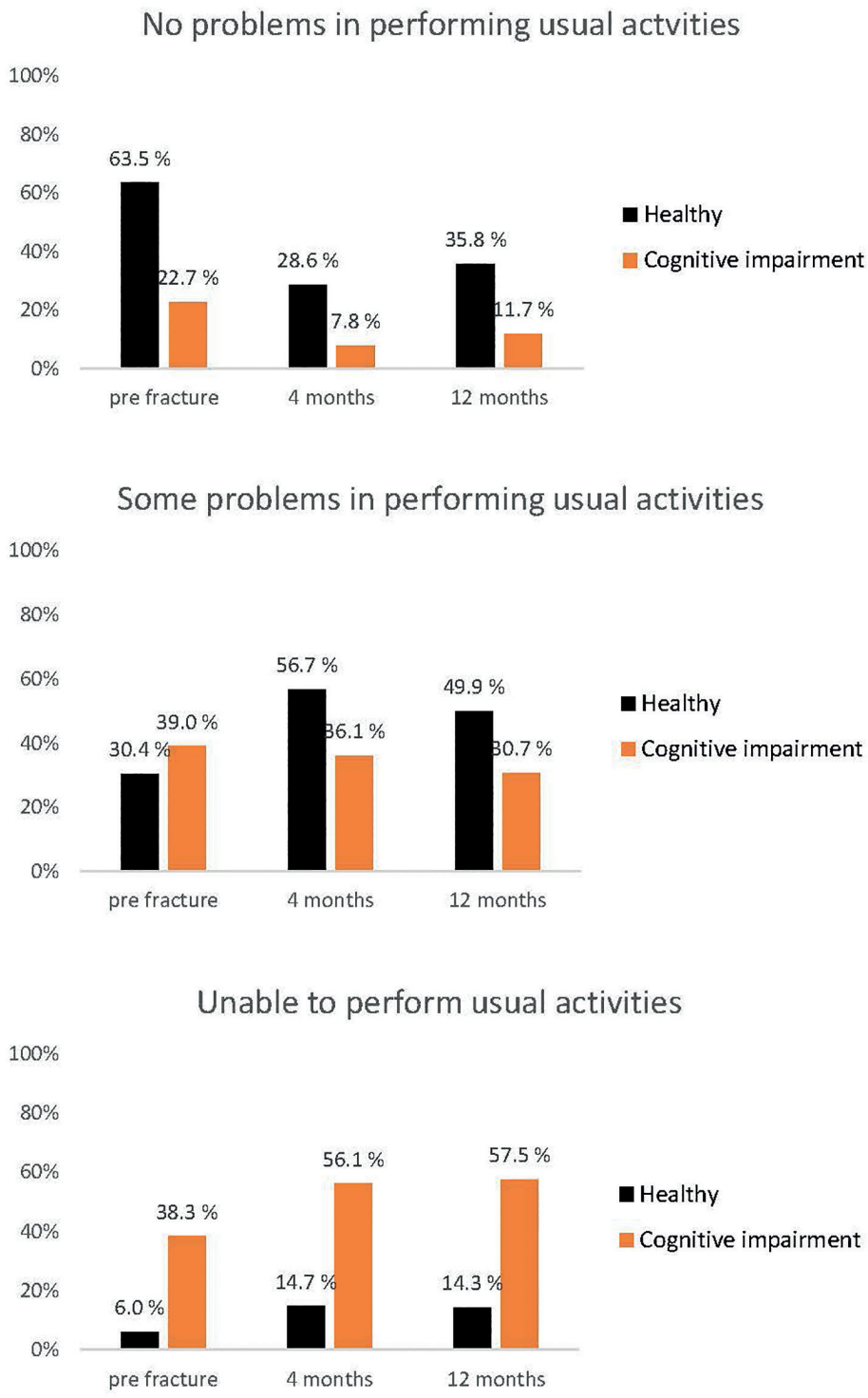

Fig. 4

Changes in the usual activities dimension of EuroQol five-dimension three-level from pre-fracture to four and 12 months postoperatively.

the patient. However, no standardized tool/approach to diagnose cognitive impairment were normally used. Cognitive function was assessed preoperatively, and in cases where this assessment was based solely on conversation with the patient presence of delirium could have complicated this assessment. The data on CCI and reporting have also been previously validated against two local hospital databases with a sensitivity of 69% and a specificity of 90%.[14] Still, we acknowledge some uncertainty in our classification of cognitive function, and that

Table V. Comparison of patient-reported outcome measures (PROMs) four and 12 months after hip fracture by sex (n = 24,510).

	Four months			12 months		
	Chronic cognitive impairment			Chronic cognitive impairment		
PROMs	**No**	**Yes**	**p-value**	**No**	**Yes**	**p-value**
EQ-5D index	0.60	0.37	< 0.001*	0.64	0.39	< 0.001*
Males	0.61	0.38	< 0.001*	0.64	0.41	< 0.001*
Females	0.60	0.37	< 0.001*	0.63	0.39	< 0.001*
Change in EQ-5D	-0.19	-0.17	< 0.001*	-0.15	-0.14	0.348*
Males	-0.20	-0.19	0.609*	-0.16	-0.15	0.007*
Females	-0.17	-0.16	0.885*	-0.14	-0.14	0.690*
Reached pre-fracture EQ-5D, %	28.0	29.6	0.074†	33.1	28.4	< 0.001†
Males	27.1	27.5	0.823†	31.8	29.5	0.245†
Females	28.3	30.2	0.069†	33.6	28.0	< 0.001†

*Independent Student's *t*-test
†Pearson's chi-squared test.
EQ-5D, EuroQol five-dimension.

Table VI. Comparison of patient-reported outcome measures (PROMs) at four and 12 months after hip fracture by age (n = 24,510).

	Four months			12 months		
	Chronic cognitive impairment			Chronic cognitive impairment		
Variable	**No**	**Yes**	**p-value**	**No**	**Yes**	**p-value**
EQ-5D index, age, yrs	0.60	0.37	< 0.001*	0.64	0.39	< 0.001*
65 to 74	0.64	0.43	< 0.001*	0.69	0.45	< 0.001*
75 to 79	0.63	0.39	< 0.001*	0.67	0.42	< 0.001*
80 to 84	0.61	0.39	< 0.001*	0.64	0.41	< 0.001*
85 to 89	0.57	0.37	< 0.001*	0.61	0.40	< 0.001*
≥ 90	0.53	0.34	< 0.001*	0.56	0.35	0.007*
Change in EQ-5D, age, yrs	-0.19	-0.17	< 0.001*	-0.15	-0.14	0.348*
65 to 74	-0.19	-0.13	0.002*	-0.14	-0.11	0.003*
75 to 79	-0.17	-0.16	0.129*	-0.14	-0.13	0.063*
80 to 84	-0.18	-0.16	0.744*	-0.14	-0.14	0.456*
85 to 89	-0.19	-0.18	0.708*	-0.15	-0.15	0.818*
≥ 90	-0.20	-0.16	< 0.001*	-0.17	-0.15	0.634*
Reached pre-fracture EQ-5D, age, yrs %	28.0	29.6	0.074†	33.1	28.4	< 0.001†
65 to 74	29.7	35.6	0.060†	35.3	32.4	0.385†
75 to 79	29.9	32.6	0.291†	34.8	30.1	0.071†
80 to 84	28.6	31.5	0.129†	33.0	29.9	0.122†
85 to 89	26.2	26.3	0.941†	31.2	27.4	0.033†
≥ 90	23.6	28.2	0.150†	29.8	25.8	0.043†

*Independent Student's *t*-test
†Pearson's chi-squared test.
EQ-5S, EuroQol five-dimension.

the results, in particular where small differences were found, must be interpreted with some caution.

The response rates for the PROM questionnaires were low and they were lower for patients with CCI than for those without CCI. This is to be expected, as it is presumably difficult, and in severe cases impossible, for patients with CCI to respond adequately to the questionnaire themselves. Due to the combination of high mortality and low response rate among patients with CCI only 16% and 10% of patients responding to the four and 12 months questionnaires respectively had CCI. These proportions were lower than the equivalent proportion for the total population recorded in the NHFR.[27] Further, the responders were younger and healthier than the non-responders. Our data on quality of life after hip fracture therefore probably represent a best-case scenario, including patients expected to have better quality of life than non-responders.

EQ-5D-3L is a validated and frequently used questionnaire measuring HRQoL. This makes our results comparable to other studies of hip fracture patients and other illnesses.[25]

Finally, we present the descriptive health profiles of the EQ-5D-3L questionnaire to provide more complete information on the patients' quality of life, not only the EQ-5D index. Presenting both the four- and 12-month

PROM data allows us to examine trajectories in long-term follow-up.

We cannot conclude that the changes in HRQoL occurred only because of the hip fracture. Patients with dementia are expected to deteriorate in daily functioning during a one-year follow-up. The response rate of our study was low, as could be expected due to high age and comorbidities. We did not send out reminders to the patients, which might have led to a greater response rate.

The pre-fracture PROM data were collected retrospectively in the four-month questionnaire. This could have led to recall bias. However, studies have reported moderate to good correlation when comparing recalled data to prospective data following arthroplasty.[28]

Only 2,116 patients (6%) of the patients responding to the four-month questionnaire died between distributions of the four- and 12-month questionnaires. Previous studies have reported 90-day mortality of 13% and one-year mortality of 23%.[2] The low mortality rate between four and 12 months could be an expression of selection bias, meaning that only the healthiest patients responded to the four-month questionnaire. This is also supported by the differences found in the baseline data between responders and non-responders at four months.

Our study did not assess the severity of the CCI. In the acute setting, cognitive function can be difficult to evaluate due to delirium and acute injury. Some patients were probably misclassified as having chronic CI because they were delirious.

One previous study has confirmed that self-report is not sufficient to assess pain in elderly people with cognitive impairment.[17] Still, it has been shown that patients with mild to moderate dementia are able to complete 99% of the EQ-5D domains.[23] A ceiling/floor effect of patients' ratings has been found as a limitation of the three response alternatives of the EQ-5D questionnaire.

We have no information on rehabilitation in our study. This could be a confounder, since there could be differences in rehabilitation offered to patients with and without CCI after a hip fracture, which could affect outcomes such as walking ability and anxiety and depression.

Our study did not include THA patients due to missing information on cognitive function. However, THA patients only represent 2.4% of patients in the NHFR and we assume that very few of these patients have CCI.

In conclusion, this study found that patients with CCI reported lower HRQoL four and 12 months after a hip fracture compared with hip fracture patients without CCI. PROM data from hip fracture patients with CCI is valuable in the assessment of the treatment of this particular vulnerable group. Patients with CCI should be included in future studies and for an orthopaedic registry it is important to establish good and simple methods to facilitate collection of PROMs from frail and cognitively impaired patients.

Take home message

- A hip fracture has a dramatic impact on patients' quality of life.
- Hip fracture patients with chronic cognitive impairment have lower quality of life than those without cognitive impairment both before and after the hip fracture.
- One in seven hip fracture patients with chronic cognitive impairment are confined to bed one year postoperatively.
- Four in ten hip fracture patients with chronic cognitive impairment are unable to wash or dress one year postoperatively.

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