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## **Are changes in pain, cognitive appraisals and coping strategies associated with changes in physical functioning in older adults with joint pain and chronic diseases?**

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## ABSTRACT

**Background:** As the population ages, the number of people with chronic diseases increases. Frequently, older people suffer from joint pain together with other chronic diseases, which can lead to decreased physical functioning.

**Aims:** To investigate the associations of the changes in cognitive appraisals, coping strategies and pain with the change in physical functioning in older people, who have chronic pain and chronic diseases.

**Methods:** Elderly persons (n=407, mean age 77 years, and 62% female), with self-reported joint pain and at least two chronic diseases, filled in questionnaires about cognitive appraisals, coping strategies, pain intensity and physical functioning at baseline, at 6-month and 18-month follow-ups. The associations of change in physical functioning with changes in cognitive appraisals, coping strategies and pain were modelled using generalized estimating equations (GEE).

**Results:** Increase in pain, in negative thinking about the consequences of pain, and in activity avoidance and decrease in self-efficacy beliefs were associated with a decline in physical functioning.

**Discussion:** Observed mean changes were small but large inter-individual variability was seen. This shows that cognitive appraisals and coping strategies are malleable. Statistical model of change clarifies the direction of longitudinal associations.

**Conclusions:** The longitudinal findings suggest that joint pain, cognitive appraisals and coping strategies may determine physical functioning in older people who have chronic pain and comorbidity.

**Keywords:** Physical functioning, coping strategies, cognitive appraisals, pain, older adults, chronic diseases

## INTRODUCTION

As the population ages, the number of people with chronic diseases increases. It is also common that older adults have many chronic diseases at the same time [1, 2]. Frequently, they suffer from musculoskeletal diseases, which together with other chronic diseases can lead to mobility limitations and disability [1, 3-5]. Even though some manage well in their daily living regardless of their pain or medical condition, Australian study shows that chronic pain interferes with physical functioning in a notable proportion (17%) of older persons after aged care rehabilitation [1].

The adjustment process to a chronic disease or pain is a dynamic process across multiple life domains and the course of the disease [6]. Cognitive appraisals and coping strategies are considered as important determinants of the outcome of the adjustment to a stress or illness [6]. Cognitive appraisals can be understood as a chain of cognitive reactions and feelings caused by a stress factor [7]. Cognitive appraisals represent the subjective meaning and significance of the stress (i.e. morbidity and pain), while coping is defined as the effort-requiring attempt to adapt and deal with the stress [7]. Successful outcome of the adjustment process can be understood as mastery of the disease-related adaptive tasks, leading to good functional status, good self-perceived quality of life, and low negative affect [6].

Salient associations of cognitive appraisals and coping strategies with physical functioning have been found. Especially self-efficacy beliefs, catastrophizing, activity avoidance and fear of movement have strong associations with physical functioning [8-20]. Also in numerous previous cross-sectional studies, pain catastrophizing has been found to be associated with poor physical functioning in patients with joint pain [21-23].

Thus far, coping strategies are considered to be rather stable characteristics. Recently published research on older adults with osteoarthritis suggests that utilization of coping strategies is actually malleable, and the preferred strategy may change over time [24]. In a two-year follow-up period, the use of refocusing, problem-solving, and wishful thinking increased and the use of stoicism and emotion-focused coping decreased [24]. These changes were predictive of endpoint disability level at two years follow-up [24].

In line with these findings, we hypothesize that (i) negative changes in cognitive appraisals and coping strategies and (ii) an increase in pain intensity are associated with deterioration in physical functioning. To the best of our knowledge, there are no studies on how change in pain-related cognitive appraisals and change in coping strategies affect change in physical

functioning in older adults with multiple chronic diseases. Therefore, the aim of this study was to explore the longitudinal associations of change in cognitive appraisals, coping strategies, and pain with the change in physical functioning during 18-month follow-up in older people with chronic joint pain and comorbidity.

## **MATERIAL AND METHODS**

### **Participants**

We used data from a prospective cohort study on functioning in older adults, including 407 participants with joint pain and co-morbidity [25]. Participants were recruited from 22 general practices (GP) in the Amsterdam area, The Netherlands. The eligibility criteria of the study were: age of 65 or older, with two or more chronic diseases, and reporting joint pain in a screening questionnaire on most days during the past month, in at least one of eight joint pain sites: neck, back, shoulder, elbow, wrist/hand, hip, knee and ankle/foot. Patients were excluded if they lived in a nursing home, had cognitive impairment, life threatening illness or insufficient knowledge of Dutch language. The recruitment process took place in three steps. First, eligible patients over 65 years and having at least two chronic diseases were identified from the GP electronic records. Second, the general practitioner was asked whether the chronic diseases were still up to date and active. In the third phase the selected patients received the screening questionnaire for joint pain. Only respondents with joint pain on the most days, and being able to make a measurement appointment, were included in the study. Data were collected at baseline and at 6-, 12- and 18-month follow-ups.

### **Outcome measures**

Physical functioning was measured by the RAND-36 PF subscale (questionnaire), which consists of ten activities [26]. Each activity item was scored on an ordinal 3-point scale (severe, some, no limitations), summed into scale scores and transformed to 0-100 scores, where a lower score is indicating more severe limitations in the physical functioning.

Pain intensity was measured by the Chronic Pain Grade (CPG), where the mean score was calculated from the average, worst and present pain on a 0-100 rating scale [27]. The higher the score is, the worse the pain. Five main cognitive appraisals related to pain were measured using different measurement tools. The Brief Illness Perceptions Questionnaire (B-IPQ) was used to measure "concerns about pain" - worries because of the joint pain;

“consequences of the pain” - expected outcome of illness (i.e. joint pain); “emotional representations” – anger, fear and distress because of joint pain [28]. The short form of the 6-item Arthritis Self-Efficacy Scale [29] was used to measure the fourth appraisal “self-efficacy beliefs”, which means the self-confidence in one’s own possibilities to succeed with a task. Each ASES item was scored 1-10. We used a summated score over the six items; the summated score range is therefore 6-60, a higher score indicating better perceived self-efficacy. In our own exploratory factor analysis, we found high factor loadings in these 6 items and evidence for a one factor model (unpublished work). The fifth appraisal, “pain catastrophizing” was measured by two items of the Short Form of Coping Strategy Questionnaire (CSQ) [30]. The coping strategies “ignoring pain”, “positive self-statement” (meaning the positive and self-encouraging attitude towards activities, regardless of the pain), and “increasing activity levels” were also measured by CSQ, two items per strategy (4). The 5-item resting subscale of Pain Coping Inventory (PCI) was used to measure “activity avoidance behavior” [31].

At baseline the number of participants of this study was n=407, at follow-up assessments the number of participants was: n=364 at 6-month, n=337 at 12-month and n=317 at 18-month follow-up. The total drop-out rate was 22%. The most important reasons for dropping out were death or aggravated health condition.

### **Statistical analyses**

Patient characteristics are presented as means with standard deviations (SD) and counts with percentages. The baseline scores are presented as means with SD. Mean changes between each assessment time point (T0-T1, T1-T2 and T2-T3) are given with 95% confidence intervals (95%CI). The associations between the independent variables (change in pain, in coping strategies, and in cognitive appraisals) and the dependent variable (change in physical functioning) in the corresponding time periods were analyzed by generalized estimating equations (GEE), a longitudinal regression technique. GEE provides regression coefficients that have a combined between-participant and within-participant interpretation. Because our main goal was to investigate the longitudinal associations, a model of change was used, which is a way to remove the between-participant interpretation, leaving only the within – subject interpretation [32]. Changes between two consecutive measurements of both the dependent variable and the independent variables were modelled. To account for the dependency of observations within subjects over time, we used an independent working correlation matrix, which is considered most appropriate for the model of change [32]. GEE analysis was performed with and without adjusting for the time-

independent covariates age and sex. The results are expressed as regression coefficient (B) with 95% CI and as standardized coefficient beta ( $\beta$ ). The coefficient of determination ( $R^2$ ) was calculated for each model.

### **Compliance with ethical standards**

The study protocol was approved by the Medical Ethics Committee of the VU University Medical Center (Amsterdam, Netherlands). From all the participants a written informed consent was obtained. The cohort study was funded by the Netherlands Organization for Health Research and Development (ZonMw). Report writing was supported by Mobility Grant of University of Jyväskylä's Science Council (grant allocated to Mrs. Ilves). Authors report no conflicts of interest.

## **RESULTS**

In total, 407 participants (mean age 77 years, 62% female) were included in this study. Almost half of the participants (48%) had at least three chronic illnesses, from which ischemic heart disease was the most common condition (in 62% of the participants). The most commonly reported worst joint pain sites were lower back ( $n=109$ , 27%), knee ( $n=73$ , 18%) and wrist ( $n=61$ , 15%). Mean changes of all follow-up measures were small and the 95% confidence intervals were rather wide. Nevertheless, we found statistically significant changes. Physical functioning declined between 6-month and 12-month follow-up, while pain intensity and mood related to the pain (emotional representations) improved at the same time. Pain catastrophizing increased between baseline and 6-month follow-up, in later follow-ups it remained at the same level. No statistically significant changes were observed in coping strategies (Table 1).

The longitudinal association of change in pain, cognitive appraisals, and coping strategies with change in physical functioning are presented in table 2 (unadjusted models 1a -3a; adjusted for age and sex models 1b-3b). Increased pain intensity was associated with deterioration in physical functioning (models 1a and b) ( $B= -0.08$ , 95%CI -0.14 to -0.01). Increase in thinking about negative consequences of pain was associated with worsening in physical functioning in the unadjusted model 2a ( $B= -1.10$ , 95% CI -1.65 to -0.55) and also in the age and sex-adjusted model 2b ( $B= -1.11$ , 95%CI -1.66 to -0.56). A decrease in self-efficacy beliefs was associated with deterioration in physical functioning in the unadjusted

and adjusted models ( $B = 0.15$ , 95%CI 0.05 to 0.25). An increase in activity avoidance behavior was associated with decline in physical functioning in both unadjusted and adjusted models (3a and 3b), ( $B = 0.51$ , 95%CI -0.82 to -0.19). Older age at baseline was associated with decline in physical functioning in all models (Table 2).

The highest standardized regression coefficients ( $\beta$ ), indicating the strongest association with decline in physical functioning, were found for the increase in negative thinking about the consequences of the pain (-0.16), increase in activity avoidance behaviour (-0.11) and decline in self-efficacy beliefs (0.10). The coefficients of determination ( $R^2$ ) were small: The change in the five cognitive appraisals explained 5% ( $R^2=0.05$ ), the change in the four coping strategies explained 1% ( $R^2=0.01$ ) and the change in pain intensity explained 1% ( $R^2=0.01$ ) of the variance of the change in physical functioning (Table 2).

When we put all independent variables in the same model,  $R^2$  was 0.05 in both unadjusted and the age- and sex-adjusted models. The only finding different from the results of the models reported above was that there was no statistically significant association between change in pain intensity and change in physical functioning (data not shown).

## DISCUSSION

The aim of this study was to explore the longitudinal associations of changes in cognitive appraisals, coping strategies and perceived pain intensity with self-reported physical functioning. At group level, we found some changes in cognitive appraisals and coping strategies. Further, given the rather wide confidence intervals, there were considerable inter-individual differences within those changes. These results support recent findings suggesting that cognitive appraisals and coping strategies remain malleable in later life [24]. Our main findings regarding the associations were that increased pain intensity, negative thoughts about consequences of joint pain, and increased activity avoidance behavior were associated with concurrent decline in physical functioning, and improvement in self-efficacy beliefs was associated with concurrent improvement in physical functioning. The results of this study are in line with several aspects of the theory on adjustment to chronic disease and pain, [6, 7].

It can be challenging to distinguish between catastrophizing and negative perceptions of the consequences of pain. The terms and meanings may overlap, but in general, catastrophizing

can be understood more distorted and exaggerated view of negative consequences. In the present study, increased catastrophizing was not associated with decline in physical functioning, as hypothesized; but increased negative perceptions of the consequences of the pain were associated with decline in physical functioning. In the previous studies, catastrophizing has largely been viewed as an important predictor of the future outcome among low back pain and neck pain patients [20, 33] while the role of negative perceptions was not shown to be that salient.

Interestingly, changes in negative feelings regarding joint pain (emotional representations) were not associated with changes in physical functioning in the present study, while increase in self-efficacy beliefs seemed to lead to improvement in physical functioning. These findings are in accordance with previous theory, that strong efficacy beliefs improves the personal performance [34]. Although our study concerns longitudinal associations and not predictions, a relationship was seen in a study with osteoarthritis patients, where poor self-efficacy beliefs was identified as a strong predictor of disability [35].

Avoiding painful activities is a natural and reasonable reaction when experiencing acute pain, but in patients with chronic pain, fear of movement and activity avoidance behavior, particularly when coupled with pain catastrophizing and hypervigilance, can be construed as maladaptive behavior, restricting normal life [36, 37]. According to previous studies in patients with knee or hip osteoarthritis [38, 39], activity avoidance causes a loss of muscle strength, resulting in more limitations in activities. Our findings support the theory suggested by Holla et al. (2014) that pain-related fear of activities (i.e. fear that physical activities may induce pain or joint damage) could make people avoid certain movements or tasks; and this avoidance of activity exacerbates the decline in physical functioning. In older people this decline could happen even more rapidly.

In a previous study of Hermsen et. al. (2016) using the same data, we investigated how cognitive appraisal and coping strategies at a certain moment in time predict subsequent change in physical functioning (physical function six months later, corrected for the previous score) [8]. The present study looked into the longitudinal association of change scores in concurrent time points: the present study gives new insight into how change in cognitive appraisals, coping and pain are related to change in physical functioning. This approach was chosen based on recent findings showing that coping and appraisals may change over time [24]. To a certain extent, the variables that we found to be associated overlap with the variables that showed significant associations in the previous study [8]. However, there is a

fundamental difference in the interpretation of these findings. For example, Hermsen et al. found that an elevated level of activity avoidance predicted a subsequent decrease in physical functioning. We found that an increase in activity avoidance is associated with a decrease in physical functioning. Thus, activity avoidance predicts subsequent worsening of physical functioning [8], and an increase in activity avoidance is associated with a decrease in physical functioning (present study). Activity avoidance induces worsening of physical functioning [8] and if activity avoidance increases it is associated with a further worsening of physical functioning (present study). The present study therefore adds substantially to our understanding of the role of avoidance behavior in physical functioning of older adults with joint pain and co-morbidity. The same applies to consequences of pain and self-efficacy beliefs: pain and low self-efficacy beliefs induce worsening of physical functioning [8] and if pain and low self-efficacy beliefs worsen, this is associated with worsening of physical functioning (present study).

This study has got some limitations and strengths as well. As a limitation, we have to mention that the follow-up time was relatively short, which may have made the average changes in variables rather small. The statistical models used in this study explained small proportions (1-5%) of the variation of the changes in physical functioning. A possible explanation is that the follow-up time was only 18 months. With longer follow-up, larger changes could have occurred. There may also be other factors contributing to changes in physical functioning, which we did not measure. We used only self-report measures in this study. The total drop-out rate was 22%, which is common in a study population consisting of older people. Most drop outs were based on death or deterioration of health. It is possible that loss to follow-up mainly occurred among those participants who had major negative changes in their physical functioning, which could have resulted in rather small changes in the remaining subjects. Nevertheless, the large sample of older adults with chronic diseases, recruited from the primary care setting, can be considered as a strength of this study. We used regression analysis according to a model of change, which enabled us to analyze longitudinal associations at the level of the individual [32].

Our findings suggest a new perspective on deterioration in physical functioning. The findings suggest that changes in joint pain, cognitive appraisals and coping strategies may determine physical functioning in older people who have chronic joint pain and comorbidity. However, further research is needed to establish causal relationships.

## **CONCLUSIONS**

At group level, the changes in physical functioning, pain, cognitive appraisals and coping strategies were small, but there was a notable individual variability in those changes.

Increase in pain intensity, in activity avoidance behavior and in negative thoughts about the consequences of joint pain are associated with a decline in physical functioning, while improvement in self-efficacy beliefs is associated with improvement in physical functioning, in older adults with joint pain and chronic diseases in one and a half year follow up.

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Table 1. Patient characteristics (N=407) in baseline and changes in physical functioning scores, pain intensity, cognitive appraisals and coping strategies.

		Baseline	T1-T0	T2-T1	T3-T2
	Score		Mean change (95%CI)	Mean change	Mean change
	Range	N=407	N=364	(95%CI)	(95%CI)
				N=331	N=313
Patient characteristics:					
Female, n (%)		254 (62.4)			
Age, mean (SD)		76.9 (6.3)			
Living arrangements: living together, n (%)		242 (59.5)			
Number of chronic diseases $\geq 3$ , n (%)		197 (48.4)			
Chronic diseases, top 3, n (%):					
Chronic ischemic heart disease		254 (62.4)			
Diabetes mellitus		152 (37.3)			
Chronic respiratory disease		113 (27.8)			
Number of joint pain sites, (1-8), mean (SD)		4 (1.9)			
Physical functioning <sup>a</sup> , mean (SD)	0-100	48.7 (25.8)	0.74 (-0.66 to 2.14)	-1.56 (-3.11 to -0.01)	-0.82 (-2.48 to 0.84)
Pain intensity, mean (SD)	0-100	64.4 (17.3)	0.34 (-1.40 to 2.09)	-2.69 (-4.63 to -0.76)	1.05 (-0.78 to 2.88)
Cognitive appraisals, mean (SD):					
Concerns about pain	0-10	5.5 (3.0)	-0.05 (-0.3 to 0.23)	-0.19 (-0.48 to 0.10)	0.04 (-0.27 to 0.34)
Consequences of pain	0-10	5.3 (2.7)	-0.22 (-0.44 to 0.01)	-0.01 (-0.24 to 0.22)	-0.01 (-0.24 to 0.23)
Emotional representations	0-10	4.2 (3.0)	0.18 (-0.10 to 0.47)	-0.32 (-0.61 to -0.03)	0.06 (-0.21 to 0.23)
Self-efficacy beliefs <sup>a</sup>	6-60	33.8 (12.5)	0.28 (-0.77 to 1.33)	0.64 (-0.15 to 0.28)	0.05 (-1.09 to 1.19)
Pain catastrophizing	0-6	1.8 (1.5)	0.17 (0.0003 to 0.34)	-0.07 (-0.24 to 0.10)	0.007 (-0.16 to 0.18)
Coping strategies, mean (SD):					
Ignoring pain <sup>a</sup>	0-6	2.9 (1.4)	-0.006 (-0.20 to 0.19)	0.04 (-0.15 to 0.23)	-0.11 (-0.30 to 0.09)
Positive self-statement <sup>a</sup>	0-6	3.5 (1.8)	-0.10 (-0.30 to 0.09)	-0.16 (-0.34 to 0.05)	0.03 (-0.18 to 0.24)
Increasing activity levels <sup>a</sup>	0-6	3.4 (1.7)	0.09 (-0.10 to 0.28)	0.02 (-0.16 to 0.20)	-0.14 (-0.33 to 0.05)
Activity avoidance behavior	5-20	12.2 (3.5)	-0.04 (-0.38 to 0.30)	0.28 (-0.06 to 0.62)	-0.11 (-0.47 to 0.24)

<sup>a</sup> higher score is positive

n=frequency, SD=standard deviation, T0=baseline, T1=6-month follow up, T2=12-month follow-up, T3=18-month follow-up

Table 2. Results of longitudinal generalized estimating equations analyses of the associations of changes between pain, cognitive appraisals, coping strategies and physical functioning (dependent variable). Unadjusted models (a) and age and sex adjusted models (b).

Unadjusted Models	18-month follow-up				Adjusted models	18-month follow-up			
	Score range	B (95% CI)	$\beta$	R <sup>2</sup>		Score range	B (95% CI)	$\beta$	R <sup>2</sup>
1a	Change in pain			0.01	1b	Change in pain			0.01
	Pain intensity	0-100	-0.08 (-0.14 to -0.01)	-0.09		Pain intensity	0-100	-0.08 (-0.14 to -0.01)	-0.09
						Age		-0.10 (-0.19 to -0.01)	-0.042
						Sex		0.03 (-1.11 to 1.18)	0.001
2a	Changes in cognitive appraisals:			0.05	2b	Changes in cognitive appraisals:			0.05
	Concerns about pain	0-10	0.07 (-0.39 to 0.53)	0.01		Concerns about pain	0-10	0.07 (-0.39 to 0.53)	0.01
	Consequences of pain	0-10	-1.10 (-1.65 to -0.55)	-0.16		Consequences of pain	0-10	-1.11 (-1.66 to -0.56)	-0.16
	Emotional representations	0-10	-0.39 (-0.88 to 0.10)	-0.07		Emotional representations	0-10	-0.39 (-0.87 to 0.10)	-0.07
	Self-efficacy beliefs <sup>a</sup>	6-60	0.15 (0.05 to 0.25)	0.10		Self-efficacy beliefs <sup>a</sup>	6-60	0.15 (0.05 to 0.25)	0.10
	Pain catastrophizing	0-6	-0.08 (-0.71 to 0.55)	-0.01		Pain catastrophizing	0-6	-0.09 (-0.71 to 0.54)	-0.01
						Age		-0.10 (-0.19 to -0.01)	-0.04
						Sex		-0.40 (-1.54 to 0.73)	-0.01
3a	Changes in coping strategies:			0.01	3b	Changes in coping strategies:			0.01
	Ignoring pain <sup>a</sup>	0-6	-0.08 (-0.70 to 0.54)	-0.01		Ignoring pain <sup>a</sup>	0-6	-0.07 (-0.69 to 0.54)	-0.01
	Positive self-statement <sup>a</sup>	0-6	0.08 (-0.49 to 0.65)	0.01		Positive self-statement <sup>a</sup>	0-6	0.09 (-0.48 to 0.65)	0.01
	Increasing activity levels <sup>a</sup>	0-6	0.34 (-0.35 to 1.04)	0.04		Increasing activity levels <sup>a</sup>	0-6	0.34 (-0.35 to 1.03)	0.04
	Activity avoidance behavior	5-20	-0.51 (-0.82 to -0.19)	-0.11		Activity avoidance behavior	5-20	-0.51 (-0.82 to -0.19)	-0.11
						Age		-0.10 (-0.19 to -0.01)	-0.04
						Sex		-0.36 (-1.54 to 0.83)	-0.01

<sup>a</sup> higher score is positive

B (95%CI)= regression coefficient (95% confidence interval),  $\beta$ = standardized regression coefficient, R<sup>2</sup>= coefficient of determination