# Self-efficacy and Emotional Distress in a Cohort With Patellofemoral Pain

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**Background:** Patellofemoral pain (PFP) is commonly described and approached in biomechanical terms despite strong evidence that psychosocial factors such as kinesiophobia, emotional distress, and self-efficacy are important in long-standing musculoskeletal pain.

**Purpose:** To describe levels of self-efficacy, emotional distress, kinesiophobia, and widespread pain in a cohort with long-standing PFP and determine their association with measures of pain, function, and health-related quality of life.

**Study Design:** Cross-sectional study; Level of evidence, 3.

**Methods:** Included were 112 patients with PFP (age range, 16-40 years) who had been recruited to a randomized controlled trial. Seven baseline factors (patient sex, pain duration, number of pain sites throughout the body, kinesiophobia [Tampa Scale of Kinesiophobia], emotional distress [Hopkins Symptom Checklist], self-efficacy, and knee extension strength) were investigated for associations with the following outcomes: symptoms of PFP (Anterior Knee Pain Scale), pain (worst and usual), and health-related quality of life (5-level EuroQol-5 Dimensions [EQ-5D-5L]). We used bivariate models and multivariable linear regression models with a stepwise backward removal method to find associations with the outcomes. Internal validation was conducted, and adjusted coefficients after shrinkage are presented.

**Results:** Of the study patients, 28% reported emotional distress (Hopkins Symptom Checklist $\geq$1.75), 69% reported multiple pain sites, and 33% had widespread pain. The kinesiophobia score was elevated, with a mean score of 35.4 ± 8.2. Self-efficacy was strongly associated with better function (Anterior Knee Pain Scale) and health-related quality of life (EQ-5D-5L) as well as lower pain scores in bivariate and multivariable models. Self-efficacy and emotional distress explained 50% of the variance in health-related quality of life (EQ-5D-5L).

**Conclusion:** Our findings support other studies of PFP suggesting elevated levels of kinesiophobia and emotional distress and higher rates of widespread pain compared with the general population or pain-free controls. Higher self-efficacy was associated with better function and health-related quality of life. Together with emotional distress, it explained half the variance of health-related life quality. The results underline the importance of approaching these patients in a biopsychosocial model.

**Registration:** NCT02114294 (ClinicalTrials.gov identifier).

**Keywords:** knee; patellofemoral pain; psychological; self-efficacy; widespread pain

Patellofemoral pain (PFP) is a common cause of pain in the lower extremity, with reported annual prevalence of 23% in the general population and affecting women approximately twice as commonly as men.[53] It can be defined as pain around or behind the patella, which is provoked by activities loading the patellofemoral joint.[13] Although PFP has traditionally been viewed as self-limiting, newer surveys have shown high degrees of chronicity, with the majority of patients still reporting pain at 2- to 8-year follow-up.[53]

The etiology of PFP is widely accepted to be multifactorial, with the underlying biomechanical premise being that PFP results from abnormal loading of the patellofemoral joint, which causes elevated joint stress.[46,50] A multitude of factors are proposed to influence patellofemoral joint loading, from patellofemoral joint and hip anatomy to reduced strength; flexibility; and/or coordination of quadriceps, hip, and/or trunk muscles.[46,50] Current guidelines are focused on biomechanically targeted interventions such as exercises promoting quadriceps and hip/trunk muscle strength, coordination, and neuromuscular control, thereby theoretically influencing patellofemoral joint mechanics.[5,46,65]

The biopsychosocial medical model suggests that integration of biopsychosocial aspects is necessary to fully understand disease and illness.[18] Within a broad spectrum of musculoskeletal pain conditions, there is evidence that

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psychosocial factors are strongly associated with symptom severity and are predictive of clinical outcomes, indicating that the biopsychosocial model is necessary to fully understand and treat musculoskeletal pain.[1,64] In particular, within the field of chronic pain, the biopsychosocial model is recognized as central to adequate patient-centered assessment and treatment.[42]

Psychological factors shown to be of interest in musculoskeletal pain include emotional distress (symptoms of anxiety or depression), kinesiophobia (fear of movement), and catastrophizing (exaggerated negative expectations). These are predictors of negative outcomes in other musculoskeletal pain conditions.[1,64] Self-efficacy (belief in one's ability to perform an activity or meet a challenge) and co-occurrence with multiple pain sites or widespread pain have also been found to be of importance in chronic musculoskeletal pain.[1,2,32] It is important to underline that relationships between pain and such psychological factors are likely to be bidirectional, meaning that they likely influence each other reciprocally.[41,61]

Although the bulk of existing research within PFP is biomechanically oriented, there is increasing evidence paralleling that in the other musculoskeletal pain conditions mentioned earlier, suggesting that psychological factors may be important to consider also in PFP.[38] A recent systematic review found that anxiety, depression, catastrophizing, and pain-related fear may be elevated in individuals with PFP.[38] In addition, several studies focusing on kinesiophobia have shown this to be associated more strongly with function in PFP compared with physical factors such as patellofemoral joint loading variables, muscle strength, and flexibility.[14,16,17,43-45] Another recent study found that comorbid anxiety and depression may be increased in patients with PFP.[66] More detailed knowledge about the importance of such factors within PFP would not only improve our understanding of etiological mechanisms but might also inform development of psychologically targeted interventions. Within other musculoskeletal pain conditions such as low back pain, psychologically or cognitively oriented treatments have been shown to be effective.[3,9,22]

The aim of the present study was to examine the levels of kinesiophobia, emotional distress, self-efficacy, and widespread pain in a cohort with PFP and to determine their association with measures of pain, function, and health-related quality of life. We hypothesized that there would be significant associations between these psychological factors and levels of pain, function, and health-related quality of life.

## METHODS

### Study Design

A post hoc analysis was performed using data from a previously reported single-blind, single-center, randomized controlled trial (RCT) that compared traditional quadriceps exercise to isolated hip exercise or free physical activity. The trial protocol and results have been published previously.[27,29,30] The trial was registered with the ClinicalTrials.gov database (reference No. NCT02114294). Ethical approval was granted for this study, and written informed consent was provided by all participants.

### Participants

Patients were recruited via referrals from primary care physicians or other medical specialists (eg, orthopaedic surgeons, rheumatologists) to the Department of Physical Medicine and Rehabilitation, Sørlandet Hospital, between September 2014 and September 2017. All patients underwent clinical examination, plain radiography, and magnetic resonance imaging (MRI) at inclusion to determine study eligibility.

Eligible patients were between 16 and 40 years of age and had peri- or retropatellar pain $\geq$3 on a visual analog scale (VAS; range, 0-10) during the past week that had been present for at least 3 months. The pain had to be reproduced by at least 2 activities (stair ascent/descent, jumping, running, prolonged sitting, squatting, or kneeling) as well as present on at least 1 clinical test (compression of the patella, palpation of the patellar facets). If patients had bilateral pain, the more painful knee was included.

Exclusion criteria were as follows: (1) clinical, radiographic, or MRI findings indicative of other significant, specific pathology, including meniscal, ligamentous, or cartilage injury, osteoarthritis, apophysitis, significant knee joint effusion, significant patellar instability evidenced by recurrent patellar subluxation or dislocation; (2) significant pain from the back or the hip that hindered the ability to perform prescribed exercises; (3) previous surgery to the knee joint; (4) extended use of nonsteroidal anti-inflammatory drugs or cortisone; (5) previous significant trauma to the knee joint affecting the clinical presentation; (6) physical therapy or

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Ethical approval for this study was obtained from the Ethics Committee, Health Region South-East, Norway (ref No. 2013/1860/REKsør-øst).

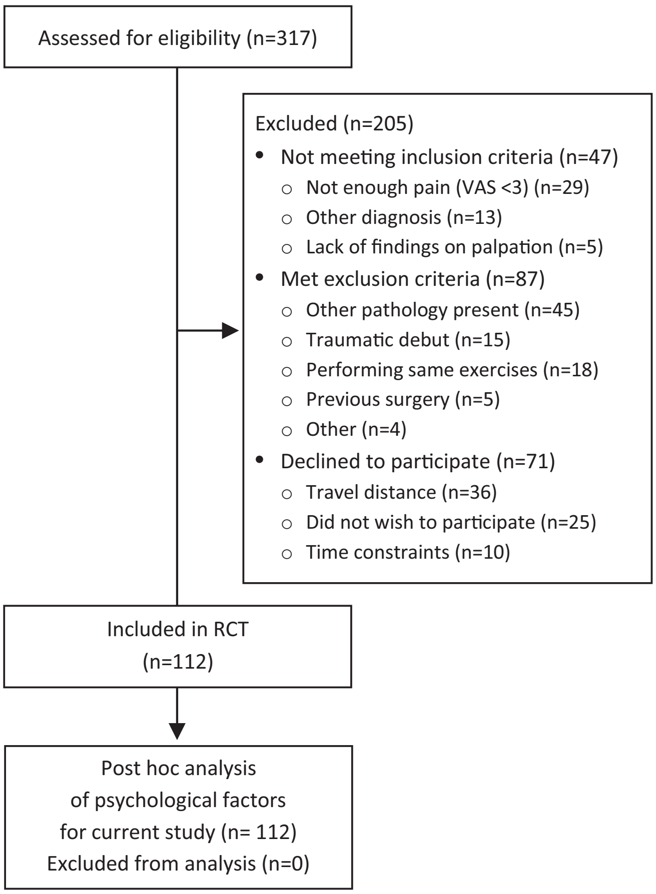


**Figure 1.** CONSORT flowchart of patient enrollment. CONSORT, Consolidated Standards of Reporting Trials; RCT, randomized controlled trial; VAS, visual analog scale.

other similar exercises for PFP within the previous 3 months.

We evaluated 317 patients for inclusion, and 205 patients were excluded. Thus, 112 patients were included in the RCT, the baseline data of whom form the basis for this post hoc analysis.[29] The CONSORT (Consolidated Standards of Reporting Trials) flowchart of the patient selection process is shown in Figure 1.

## Patient Education

At recruitment/inclusion, all patients attended a 45- to 60-minute consultation with a specialist in physical medicine and rehabilitation (A.H.). The consultation was loosely based on "the good back consultation."[35] Important elements include a patient-centered history and thorough, pedagogically oriented physical examination, during which findings on clinical examination were explained in a reassuring manner. The consultation included a portion of the standardized patient education package for the RCT. Since this portion of patient education was carried out at the first contact with the patient, it occurred before collection of baseline measures.

The content of the patient education was intended to address kinesiophobia and encourage self-mastery of symptoms. The benign nature of PFP was underlined, referring to PFP as a "loading pain" as opposed to an "injury." The presumed importance of muscle strength and coordination in controlling the patella, including that it is not known whether structured exercise is better than free physical activity, was explained. Patients were encouraged to gradually increase loading in the knee without excessively provoking pain. Traditional advice on "correct" biomechanics and avoiding certain activities was not given, as we theorized that this could contribute to increasing kinesiophobia. Information was provided in oral and written format.

## Data Collection

Data collected at baseline were used for this post hoc analysis. Baseline data collection occurred after the recruitment/inclusion consultation described earlier, in which a portion of the patient education was given. Participants filled out the self-report questionnaires without assistance. Questionnaires and strength measurements were collected by blinded observers not otherwise involved in the study. Descriptive measures included age, sex, body mass index, education, work/sick leave, pain duration, and presence of unilateral or bilateral pain.

## Study Outcomes

The main outcome measure of this study was the Anterior Knee Pain Scale (AKPS), which is a self-report questionnaire consisting of 13 questions regarding pain, symptoms, and function.[31,34] The total score ranges from 0 to 100 (least pain and disability). The score has been translated into Norwegian and cross-culturally validated in conjunction with this study.[31]

Secondary outcomes included pain intensity on a VAS (range, 0-10 [most pain]), in which patients rated their usual pain and worst pain during the previous week. In addition, the Euro-Qol-5 Dimensions (EQ-5D-5L) was used to measure health-related quality of life.[6] Respondents rate their health on 5 dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. The Danish validated index value calculator was used (range, –0.62 to 1.00 [best possible]).[48] The EQ-5D-5L is used widely and is found to have excellent measurement properties across a broad range of diagnoses, populations, and settings.[20]

The Tampa Scale for Kinesiophobia (TSK-13) is a 13-item self-report questionnaire used to assess fear of movement/reinjury (range, 13-52 [most]).[23] It has been previously translated and validated in Norwegian.[23] To allow comparison with other cohorts that have used the 17-item version (TSK-17; range, 17-68), we converted our average score by calculating an average score per item and scaling this up to correspond to the 17-item questionnaire.

The Knee Self-Efficacy Scale (K-SES) was used to assess self-efficacy (range, 0-10 [highest]).[58] Questions pertain to how confident respondents feel about performing various activities now and in the future. The K-SES has been shown to be associated with higher functional recovery from anterior cruciate ligament injury[59] and has been validated in populations with mixed knee injuries.[19] For the purpose of this study, nonprofessional translators performed forward and back translation from Swedish to Norwegian according to published guidelines.[4]

Emotional distress was assessed using the Hopkins Symptom Checklist (HSCL-10). The HSCL-10 consists of 10 questions assessing symptoms of anxiety and depression (range, 1-4 [most symptoms]).[15,56] Comparisons of different versions of the HSCL indicate that the 10-question version has measurement properties comparable with those of longer versions.[56] Scores $\geq$1.75 are indicative of increased emotional distress.[51]

Number of pain sites in the body during the past week was assessed using an adaptation of the Standardized Nordic Questionnaire. Patients record presence of pain (yes/no) in 9 body areas (head, neck, shoulder, elbow, hand, upper back, hip, knee, and ankle).[33] Only 1 point is scored per bodily area; thus, the score does not differentiate between bilateral and unilateral pain. In this article, we defined multiple pain sites as at least 2 sites, and widespread pain as at least 4 sites.

Isometric muscle strength (in N/kg) was measured for knee extension. Positioning and external stabilization with straps were employed based on validated techniques.[60] Portable fixed dynamometry using a force sensor (MuscleLab 6000 ML Force Sensor 300 kg; Ergotest Innovation) was used instead of a handheld dynamometer, as it was considered a superior measurement device. Standardized procedures are based on existing techniques.[60]

## Comparators

Recruitment of a pain-free control group was not achievable because of lack of resources. In order to form a basis for comparisons of levels of emotional distress, kinesiophobia, self-efficacy, and widespread pain, we performed a broad search of relevant literature to find relevant comparators. We found it relevant to compare with other studies of patients with PFP, other chronic pain conditions, pain-free controls, and the general population.

## Statistical Analysis

All statistical analyses were performed using SPSS Version 23 (IBM Corp), Stata/SE 16.1 for Windows (StataCorp LLC), and R (R Core Team 2020).[57] Data were checked for normality and outliers using stem-and-leaf plot and *Q–Q* plots. Scatter-plots for bivariate correlations were inspected for outliers.

*Missing Values.* Missing values for AKPS, HSCL-10, K-SES, and TSK were handled as follows: if <25% of items were missing, the values were substituted via the arithmetic mean of the available items.[10] If $\geq$25% of items were missing, the outcome was considered missing for the patient. If an item was missing for the Nordic Questionnaire, the total score was considered missing.

*Bivariate Models.* Pearson correlation ($r$) was used for parametric measures, whereas the Spearman correlation (rho) was considered appropriate for nonparametric measures.

*Multivariable Models.* Selection of dependent and independent variables was based on findings in previous studies and clinical judgment and defined a priori.[24,54] The dependent variables were those we considered to be central indicators of pain, function, and life-quality for the patient group. Models were constructed for the 3 dependent variables: AKPS, worst pain, and EQ-5D-5L. Independent variables entered in the model were limited to 7 based on our sample size of 112.[24] Based on previous research and clinical judgment, we included features with established or presumed importance in PFP (sex, pain duration, and knee extension strength).[40,50] Inclusion of closely related independent variables should be avoided,[24] so this precluded inclusion of >1 isometric strength measure, as these were highly correlated with each other. As the aim of this study was to examine associations with widespread pain and psychological factors (kinesiophobia, emotional distress, and self-efficacy), the following 7 baseline measures were entered in each model as independent variables: sex, pain duration (categories: 3-6 months, 6-12 months, 12-24 months, >24 months), number of pain sites, kinesiophobia (TSK), emotional distress (HSCL-10), self-efficacy (K-SES), and knee extension strength.

Multivariable linear regression models were then constructed using the outcome in question as the dependent variable (AKPS, worst pain, or quality of life) and all other associated factors as independent variables.[54] A backward stepwise elimination ($P \leq .10$) was used to identify a group of factors that was associated with outcomes of symptoms, pain, or life quality. The final model is presented using the constant (Y-intercept) and the unstandardized regression coefficients (B) with their 95% CIs. A $P$ value $< .05$ was used to define statistical significance in the final model. The amount of variance accounted for by the final model is expressed as adjusted $R^2$. The variance inflation factor was used to check models for collinearity.

All multivariable linear regression models with backward stepwise elimination were internally validated via bootstrapping using 1000 bootstrap samples to assess overfitting (ie, better model performance in the development sample than in new samples with other participants),[54] providing shrinkage factors for adjusting regression coefficients and adjusted model intercepts for use in prediction formulas and to assess optimism-corrected model performance measures.[55] Internal validation was conducted using the R package rms.[57] Adjusted coefficients after shrinkage are presented in Tables 3-5. We assessed the model performance in terms of $R^2$ and calibration slope (where 1.00 is ideal and estimated <1.00 indicates overfitting). The model performance was estimated as apparent (estimated directly from the dataset used to develop the prediction model), training (average performance in each of the bootstrap samples with replacement), test (average estimate determined by developing the model in each

TABLE 1
Baseline Characteristics of Study Participants (N = 112)[a]

| Variable | Mean ± SD or n (%) |
|---|---|
| Age, y | 27.6 ± 7.3 |
| Sex, female/male, n (%) | 73 (65)/39 (35) |
| Body mass index | 26.4 ± 4.9 |
| Bilateral pain | 81 (72) |
| Symptom duration, mo | |
| 3-6 | 8 (7) |
| 6-12 | 23 (21) |
| 12-24 | 24 (21) |
| >24 | 57 (51) |
| Higher education, >13 y | 33 (29) |
| Sick-listed[b] | 15 (13) |
| Regular use of analgesics | 19 (17) |
| Usual pain, VAS 0-10 | 4.1 ± 1.9 |
| Worst pain, VAS 0-10 | 6.1 ± 2.1 |
| AKPS, 0-100 | 65.7 ± 12.1 |
| Self-efficacy K-SES, 0-10 | 6.0 ± 1.8 |
| Kinesiophobia TSK-13, 13-52 | 27.1 ± 6.3 |
| Kinesiophobia TSK-17 equivalent, 17-68 | 35.4 ± 8.2 |
| Emotional distress, HSCL, 1-4 | 1.6 ± 0.6 |
| Emotionally distressed, HSCL, >1.75 | 31 (28) |
| No. of pain sites, range 0-9 | |
| 0-1 | 29 (26) |
| 2-3 | 40 (36) |
| ≥4 | 37 (33) |
| Missing | 6 (5) |

[a]AKPS, Anterior Knee Pain Scale; HSCL, Hopkins Symptom Checklist; K-SES, Knee Self-Efficacy Scale; TSK, Tampa Scale for Kinesiophobia; VAS, visual analog scale.
[b]On sick leave.

bootstrap sample and applying the bootstrap model in the original sample), optimism (average difference between model performance in bootstrap data and test performance in the original dataset), and optimism corrected (subtracting average optimism from apparent performance).

## RESULTS

The baseline values for the 112 included participants are presented in Table 1. There were few missing data, except for the Nordic pain questionnaire (number of pain sites) in which 5 (5%) total scores were incomplete and treated as missing. A total of 28% of patients were emotionally distressed (HSCL, ≥1.75), with a cohort average of 1.6 ± 0.6. The average transformed kinesiophobia score (TSK-17 equivalent) was 35.4 ± 8.2. Pain in multiple body parts (≥2 pain sites) during the previous week was reported by 69% of the patients, with 33% reporting pain from at least 4 body parts.

### Bivariate Correlations

The strongest correlations were found between self-efficacy and PFP symptoms as measured using AKPS (Pearson *r* 0.60; $P < .01$) and quality of life as measured using EQ-5D-5L (Pearson *r*, −0.59; $P < .01$) as well as between emotional distress (HSCL) and quality of life (Pearson *r*, −0.60; $P < .01$). Weaker correlations were found for several other independent variables and outcomes (Table 2).

TABLE 2
Bivariate Correlations Between Outcomes for Pain, Function, and Health-Related Quality of Life and Measures of Psychological and Physical Function at Baseline[a]

| | | Pain[d] | | |
|---|---|---|---|---|
| Variable[b] | AKPS[c] | Usual | Worst | Health-Related Quality of Life[e] |
| Age | 0.19[g] | −0.03 | −0.11 | 0.34[h] |
| Sex[f] | −0.12 | 0.10 | 0.08 | −0.20[g] |
| Pain duration [f] | −0.23[g] | 0.12 | 0.10 | −0.22[g] |
| No. of pain sites | −0.21[g] | 0.18 | 0.14 | −0.18[g] |
| Kinesiophobia | −0.26[h] | 0.17 | 0.15 | −0.31[h] |
| Knee self-efficacy | 0.60[h] | −0.41[h] | −0.40[h] | 0.59[h] |
| Emotional distress | −0.32[h] | 0.21[g] | 0.21[g] | −0.60[h] |
| Knee extension strength | 0.34[h] | −0.39[h] | −0.32[h] | 0.27[h] |

[a]Data are reported as Pearson correlation (*r*) unless otherwise stated. AKPS, Anterior Knee Pain Scale; EQ-5D-5L, health-related quality of life (5-level EuroQol-5 Dimensions); HSCL, Hopkins Symptom Checklist; K-SES, Knee Self-Efficacy Scale; TSK, Tampa Scale of Kinesiophobia; VAS, visual analog scale.
[b]Sex (0, male; 1, female); pain duration (0, 3-6 mo; 1, >6-12 mo; 2, >12-24 mo; 3, >2 y); number of pain sites throughout the body during the past week (0-9); kinesiophobia on TSK (13-52 [most kinesiophobia]); self-efficacy on K-SES (0-10 [highest self-efficacy]); emotional distress on HSCL (1-4 [most symptoms]); knee extension strength (N/kg body weight).
[c]AKPS (0-100 [least symptoms]).
[d]Usual and worst pain as measured on a VAS score (0-10) in the past week.
[e]EQ-5D-5L (−0.62 to 1.00).
[f]Spearman rho for nonparametric correlations.
[g]$P < .05$.
[h]$P < .01$.

### Multivariable Models

*Anterior Knee Pain Scale.* Self-efficacy, number of pain sites, and pain duration best associated with symptoms of PFP as measured using the AKPS. The model explained 42% of the variance in the AKPS ($R^2$). Variance ($R^2$) corrected for optimism was 33% (Table 3).

*Health-Related Quality of Life.* Higher self-efficacy and less emotional distress were best associated with higher health-related quality of life as measured using the EQ-5D-5L. These factors together explained 50% of the variance in health-related quality of life ($R^2$). Variance ($R^2$) corrected for optimism was 45% (see Table 4).

*Worst Pain.* Higher self-efficacy and higher knee extension strength were best associated with lower ratings of worst pain in the past week. The model explained 19% of the variance in worst pain ($R^2$). Variance ($R^2$) corrected for optimism was 9% (Table 5). Models were also constructed for usual pain, which gave nearly identical results to the model for worst pain; thus, we chose to present only results for worst pain.

TABLE 3
Multivariable Linear Regressions for the AKPS[a]

| | | | | $R^{2b}$ | |
|---|---|---|---|---|---|
| Predictor[c] | B (95% CI) | *P* | $B_{adj}$[d] | Apparent | Optimism Corrected |
| Constant | 49.4 (41.3 to 57.5) | <.01 | 50.4 | 0.42 | 0.33 |
| Pain duration | −1.7 (−3.4 to 0.47) | .06 | −1.6 | | |
| Self-efficacy | 3.8 (2.8 to 4.8) | <.01 | 3.5 | | |
| No. of pain sites | −1.1 (−2.0 to −0.1) | .03 | −1.0 | | |

[a]AKPS, Anterior Knee Pain Scale; K-SES, Knee Self-Efficacy Scale.
[b]$R^2$ apparent, estimated directly from dataset used to develop prediction model; $R^2$ optimism corrected, corrected for overfitting by internal validation.
[c]Constant, Y-intercept of the model; pain duration (0, 3-6 mo; 1, 6-12 mo; 2, 12-24 mo; 3, >2 y); self-efficacy on K-SES (0-10 [highest self-efficacy]); number of pain sites throughout body during the past week (0-9). Excluded predictor variables after stepwise elimination: sex, kinesiophobia, emotional distress, and knee extension strength.
[d]$B_{adj}$, adjusted regression coefficients after shrinkage with internal validation.

TABLE 4
Multivariable Linear Regressions for Health-Related Quality of Life[a]

| | | | | $R^{2b}$ | |
|---|---|---|---|---|---|
| Predictor[c] | B (95% CI) | *P* | $B_{adj}$[d] | Apparent | Optimism Corrected |
| Constant | 0.7 (0.6 to 0.8) | <.01 | 0.7 | 0.50 | 0.45 |
| Self-efficacy | 0.03 (0.02 to 0.04) | <.01 | 0.03 | | |
| Emotional distress | −0.1 (−0.13 to −0.06) | <.01 | −0.1 | | |

[a]EQ-5D-5L (−0.62 to 1.00). EQ-5D-5L, health-related quality of life (5-level EuroQol-5 Dimensions); HSCL, Hopkins Symptom Checklist; K-SES, Knee Self-Efficacy Scale.
[b]$R^2$ apparent, estimated directly from dataset that was used to develop prediction model; $R^2$ optimism corrected, corrected for overfitting by internal validation.
[c]Constant, Y-intercept of the model; self-efficacy on K-SES (0-10 [highest self-efficacy]); emotional distress on HSCL (1-4 [most symptoms]). Excluded predictor variables after stepwise elimination: sex, pain duration, number of pain sites throughout body during the past week, kinesiophobia, and knee extension strength.
[d]$B_{adj}$, adjusted regression coefficients after shrinkage with internal validation.

TABLE 5
Multivariable Linear Regressions for Worst Pain[a]

| | | | | $R^{2b}$ | |
|---|---|---|---|---|---|
| Predictor[c] | B (95% CI) | *P* | $B_{adj}$[d] | Apparent | Optimism Corrected |
| Constant | 9.5 (8.1 to 11.0) | <.01 | 9.0 | 0.19 | 0.09 |
| Self-efficacy | −0.3 (−0.6 to −0.1) | <.01 | −0.3 | | |
| Knee extension strength | −0.3 (−0.6 to −0.0) | .04 | −0.3 | | |

[a]Worst pain on VAS for worst pain in the past week (0-10). K-SES, Knee Self-Efficacy Scale; VAS, visual analog scale.
[b]$R^2$ apparent, estimated directly from dataset that was used to develop prediction model; $R^2$ optimism corrected, corrected for overfitting by internal validation.
[c]Constant, Y-intercept of the model; self-efficacy on K-SES (0-10 [highest self-efficacy]); knee extension strength (N/kg body weight). Excluded predictor variables after stepwise elimination: sex, pain duration, number of pain sites throughout body during the past week, kinesiophobia, and emotional distress.
[d]$B_{adj}$, adjusted regression coefficients after shrinkage with internal validation.

## DISCUSSION

In this study, we described scores for various psychological features for this cohort of patients with PFP. Our results support those of other studies suggesting increased levels of emotional distress and kinesiophobia compared with the general population and/or pain-free controls. The vast majority of participants (69%) reported multiple pain sites during the past week, with 1 in 3 reporting widespread pain. Higher self-efficacy was consistently associated with lower pain intensity, better function, and higher health-related quality of life in multivariable models. Self-efficacy together with emotional distress explained nearly half the variance in health-related quality of life. Knee extension strength was not associated with function or life-quality in multivariable models.

## Psychological Profile Compared With Other Populations

*Emotional Distress.* More patients reported increased emotional distress than did the general population. In total, 28% of our cohort had scores corresponding to elevated levels of emotional distress (HSCL ≥1.75) compared with 33% in a Norwegian population with mixed chronic pain conditions (eg, low back pain or neck pain)[49] and 11% in the general Norwegian population.[56] A survey of persons in the United Kingdom reporting anterior knee pain found that 33% had scores corresponding to depression on the Hospital Anxiety and Depression Scale,[66] which is comparable with this cohort. Scores for emotional distress in this cohort were comparable with other chronic pain conditions. The average HSCL-10 score of the cohort was 1.6. This average is comparable with averages of 1.6 to 1.8 reported in Norwegian populations with chronic neck or back pain,[25,36] while a population attending the largest multidisciplinary pain center in Norway averaged 2.2.[21]

*Self-Efficacy.* Self-efficacy refers to the way that a person judges their own ability to perform an activity or meet a challenge.[2] The K-SES gauges how certain respondents feel about performing various knee-related activities and has been shown to be associated with higher functional recovery from anterior cruciate ligament injury.[59] To our knowledge, knee self-efficacy has not been previously reported within populations with PFP. The cohort reported mean scores of 6.1 on a 0 to 10 scale for knee self-efficacy, which is comparable with average scores in a population with mixed knee injuries attending outpatient physical therapy.[19]

*Widespread Pain.* The vast majority of participants (69%) in this study reported pain in >1 body area during the past week, and 1 in 3 reported widespread pain (≥4 pain areas). This is consistent with previous data from 2 other studies in which 3 of 4 participants with knee pain reported pain in other body areas during the past week.[33,37] A Danish study of young women with PFP found that 60% reported pain in other body areas and nearly 1 in 4 fulfilled criteria for widespread pain.[26] For comparison, a Norwegian population-based survey including adults 24 to 76 years of age found that 26.6% reported pain in ≥4 body areas during the past week.[33]

The co-occurrence of PFP with widespread pain may be indicative of a more complex clinical presentation than isolated knee pain and is important to recognize as a prognostic factor. We have previously reported that widespread pain was a consistent predictor of poorer outcomes at 1 year in this same cohort.[28] This parallels data identifying widespread pain as a generic prognostic factor in musculoskeletal pain,[1] which is closely associated with anxiety and depression.[11,12]

*Kinesiophobia.* The transformed average kinesiophobia score of 35.4 for this cohort is comparable with that of other cohorts with PFP (range, 34.4-39.3)[37,39,43,47] and elevated compared with that of pain-free controls.[47] Elevated levels of kinesiophobia in PFP suggest that the fear-avoidance model of musculoskeletal pain is relevant to consider in approaching PFP.[63] This appears to be confirmed by studies showing kinesiophobia to be associated more strongly with function than physical factors in PFP.[14,17,43,44,47]

## Associations With PFP Symptoms and Quality of Life

Using both bivariate and multivariate models, we found that higher self-efficacy was consistently associated with fewer symptoms of PFP and higher health-related life quality. Together with self-efficacy, emotional distress explained nearly half the variance in health-related life quality in this cohort. Knee extension strength was not associated with function or life-quality in multivariable models but explained a small portion of variance in pain when combined with self-efficacy in multivariable models.

Self-efficacy refers to the way that a person judges their own ability to perform an activity or meet a challenge.[2] It is thought to affect coping strategies when faced with challenges, including how much effort and persistence a person will exhibit before giving up.[2,32] Higher self-efficacy is predictive of more positive health outcomes in a broad spectrum of pain conditions.[32,41] Higher knee self-efficacy, or the belief in one's ability to perform knee-related activities, is closely associated with better outcomes in cohorts who have sustained ACL injuries.[59] Emotional distress (symptoms of anxiety and depression), on the other hand, is strongly associated with poorer outcomes of pain and function in musculoskeletal pain.[61] The relationship between emotional distress and pain appears to be reciprocal.[41,61]

In this cohort, quadriceps strength was not significantly associated with symptoms of PFP as measured using the AKPS or with quality of life in multivariable models. This lack of association runs counter to explanatory models for PFP in which quadriceps strength is an important factor influencing patellofemoral joint loading and thereby development of pain.[46,50] It is, however, consistent with other research within PFP, which showed that psychological factors may be more important to consider in PFP than physical factors.[14,44] The correlation between knee extension strength and pain was weak in this population. We point out that, although low quadriceps strength is assumed to be a cause of PFP,[46,52] the opposite is also true, in that pain affects performance in strength testing.[8]

## Limitations

There are several limitations in the current study. The cross-sectional design is only suitable for showing associations that should not be interpreted as causal. Relationships between pain and psychological factors are likely to be bidirectional.[41,61] Further, we lacked resources to include an asymptomatic control group as a comparator. Thus, in order to give context to the reported measures, we have compared with normal values for the scores in question, with reported scores in the general population, and with pain-free controls reported in other studies. This is methodically inferior to comparing with a matched control group. The fact that baseline measures were collected after a consultation including patient education intended to influence kinesiophobia and self-mastery of symptoms may have influenced and lowered the scores. Thus, this consultation may represent a confounding factor for which we are unable to adjust. We cannot exclude that baseline scores, eg, kinesiophobia scores in this cohort, are systematically lower compared with those of other cohorts with otherwise similar levels of pain and disability. Further, the choice of independent and dependent factors for multivariate analysis is inherently subjective and a potential source of bias even when recommendations are followed.[24] The generalizability of the data from this cohort may be limited by the relatively strict inclusion criteria used in the RCT, the limited size of the cohort, and the setting in a specialist clinic for physical medicine and rehabilitation. All of these factors might reasonably be expected to influence the levels of psychological measures in the population. The cohort did not include any patients with pain duration $<$4 months; thus, these results are applicable to patients with long-standing pain. We also point out the inherent clinimetric limitations of self-report measures for pain, feelings, or thoughts. Transformations of such factors to numbers are unlikely to be linear as the scales imply, and results based on such analyses should be interpreted with caution.[7]

## Implications for Future Research and Clinical Practice

The current results suggest that PFP is no exception among musculoskeletal pain conditions in requiring integration of psychological factors in a biopsychosocial model. Support for the notion that biomechanical factors alone explain variations in pain and function in PFP can be described as, at best, inconsistent,[46,52,62] and several studies, including this one, have suggested that psychological factors may play a more important role than physical factors.[37,39,43,47,66] While most of the previous studies in PFP have focused on kinesiophobia, the current study highlights the importance of assessing self-efficacy and emotional distress pain in these patients, in both research and clinical settings. We suggest that future research within PFP should include psychologically targeted interventions.

## CONCLUSION

Psychological features of this cohort are comparable with those seen in other studies within PFP, suggesting increased emotional distress and kinesiophobia compared with the general population and pain-free controls. Higher self-efficacy was consistently associated with better function and health-related life quality in bivariate and multivariable models. Together with emotional distress, self-efficacy explained half the variance in health-related life quality in this cohort. These results underline the importance of approaching these patients in a biopsychosocial model.

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