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Original Research

Poor Mental Health Indicators in Individuals With Patellofemoral Pain

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Context: Patellofemoral pain (PFP) is a common source of knee pain in active individuals, accounting for a large number of knee injuries examined in sports medicine clinics. As a chronic condition, PFP can affect mental health. However, this effect has not yet been studied in individuals with PFP.

Objective: To determine how subjective physical and mental health measures in individuals with PFP differed from those measures in pain-free individuals.

Design: Case-control study.

Setting: Laboratory.

Patients or Other Participants: Volunteers for the study were 30 people with PFP (19 women, 11 men; age = 20.23 ± 3.32 years, height = 166.69 ± 6.41 cm, mass = 69.55 ± 13.15 kg) and 30 matched pain-free individuals (19 women, 11 men; age = 20.33 ± 3.37 years, height = 169.31 ± 9.30 cm, mass = 64.02 ± 11.00 kg).

Main Outcome Measure(s): Current and worst pain levels in the past 24 hours were determined using a visual analog scale (VAS). The Anterior Knee Pain Scale, Fear Avoidance Belief Questionnaire, and Lower Extremity Functional Scale were administered. Physical and mental health measures were obtained using a modified 12-item Short Form Health Survey. Scores for 2 subscales on the modified Short Form-12 were weighted and calculated: physical component and mental component.

Independent *t* tests were calculated to compare variables between groups. Coefficient correlations were used to measure the associations between the variables.

Results: Individuals with PFP reported lower levels of physical (pain free: 56.13 ± 1.63, PFP: 50.54 ± 7.10, $P < .001$) and mental (pain-free: 53.32 ± 4.71, PFP: 48.64 ± 10.53, $P = .03$) health. In the PFP group, we found moderate negative correlations between the VAS score for current pain and mental health ($r = -0.52$, $P < .01$) and between the VAS score for worst pain in the past 24 hours and mental health ($r = -0.46$, $P = .01$) and between activity limitations in individuals with PFP and fear avoidance beliefs ($r = -0.61$, $P < .01$).

Conclusions: Our results should encourage clinicians, especially musculoskeletal rehabilitation professionals, to acknowledge the importance of a whole-person approach when treating or planning rehabilitation programs for individuals with PFP.

Key Words: Short Form-12, fear avoidance, psychological impairment, cognitive deficits

Key Points

- Individuals with patellofemoral pain had poorer subjective mental and physical health.
- Pain was associated with mental health status.
- Increased fear was linked with worse lower extremity function.

Patellofemoral pain (PFP) is a prevalent chronic condition manifested as anterior knee pain during everyday activities that stress the patellofemoral joint[1] and one of the most common reasons for young adults with knee pain to consult a physician,[1] The cause of this condition is mostly unknown, but it is coupled with subsequent poorer rehabilitation outcomes.[1,2] Although several treatment modalities are used to treat individuals with PFP, the prevalence of chronic knee pain remains high, prompting researchers to further explore the factors associated with chronic pain that have not yet been identified. Among the strongest predictors of pain and disability in patients with chronic pain are cognitive and behavioral factors, such as emotional distress, anxiety, depression, and anger.[3]

An assortment of self-reported questionnaires have been used to identify the mental feelings of patients with PFP.[4] The importance of these subjective assessments increases significantly when considering factors such as fear avoidance beliefs, which are the strongest predictors of subjective functional outcome during rehabilitation, moreso than biomechanical and structural variables.[5] Moreover, the link between self-reported health beliefs related to PFP and a lower level of physical activity has been demonstrated.[6] It is interesting that kinesiophobia in individuals with PFP was more strongly associated with faulty movement patterns and self-reported pain and disability than with strength and patellofemoral joint loading.[7,8] In addition, a number of authors[6,9,10] have documented relationships between pain, fear avoidance activity, and subjective function and activity level using a a visual analog scale (VAS), the Anterior Knee Pain Scale (AKPS), and the Fear Avoidance Belief Questionnaire (FABQ). Although these instruments provide information about region-specific (AKPS) and dimension-specific (FABQ-Physical Activities) outcomes, they do not

Table. Participant Demographics and Subjective Physical and Mental Health Assessments

Variable	Group		*P* Value
	Patellofemoral Pain (n = 30)	Healthy (n = 30)	
Sex, females/males	19/11	19/11	
Age, y	20.23 ± 3.32	20.33 ± 3.37	.878
Height, cm	166.69 ± 6.41	169.31 ± 9.30	.517
Mass, kg	69.55 ± 13.15	64.02 ± 11.00	.082
Score			
Tegner Activity Scale	6.86 ± 1.78	6.82 ± 1.02	.91
Visual Analog Scale			
Current pain	2.15 ± 1.64[a]	0.00 ± 0.00	<.001
Worst pain in last 24 h	4.84 ± 1.53[a]	0.00 ± 0.00	<.001
Anterior Knee Pain Scale	77.22 ± 9.20[a]	100.00 ± 0.00	<.001
Fear Avoidance Belief Questionnaire	18.00 ± 10.59[a]	0.13 ± 0.7	<.001
Short Form-12			
Physical Component Scale[b]	50.54 ± 7.10[a]	56.13 ± 1.63	<.001
Mental Component Scale	48.64 ± 10.53[a]	53.32 ± 4.71	.031
Lower Extremity Functional Scale	63.03 ± 8.17[a]	80.00 ± 0.00	<.001

[a] Indicates a difference ($P < .05$).
[b] Effect sizes (95% CIs) for the Physical and Mental Component Scales were 1.09 (0.54, 1.63) and 0.57 (0.06, 1.09), respectively.

offer a complete picture of the broad effects on mental and physical health in these patients.

In accordance with the biopsychosocial model for more effective management of a condition, a whole-person assessment using self-reported assessment methods and treatment approaches is recommended to understand and treat patients with musculoskeletal conditions.[11–13] Mental health impairments are recognized as barriers to recovery and factors that can restrict prospective improvements during physical impairment–based rehabilitation.[13–15] When devising comprehensive treatment protocols, clinicians must assess mental health impairments and subjective feelings about an individual's physical health due to a musculoskeletal condition.[16] Individuals with PFP displayed poorer quality of life on the 36-Item Short Form Health Survey (SF-36).[9] However, the SF-36 is a long and complex scale; a shorter, yet adequate and meaningful version, the 12-Item Short Form Health Survey (SF-12), is available.[17–19] The SF-12 performs as well as the SF-36 and still yields Physical and Mental Component summaries. The SF-12 has been recommended for use in health-related quality of life measurements in patients with chronic musculoskeletal conditions, such as low back pain trials,[20] but it has yet to be explored in individuals with PFP. Determining the relationship between anterior knee pain levels and mental health measures can significantly contribute to the growing literature on psychological impairments in PFP. Moreover, examining the association between fear avoidance beliefs and limitation of activity due to lower extremity dysfunction can further enhance our understanding of the psychological aspects in individuals with PFP. Consequently, the Lower Extremity Functional Scale (LEFS) has been used to understand activity limitations because of lower extremity musculoskeletal dysfunction and explore the association with FABQ scores.[21] Therefore, the purpose of our study was to understand how subjective physical and mental health differed between individuals with PFP and pain-free individuals. We hypothesized that those with PFP would have poorer subjective physical and mental health than the pain-free group. Secondarily, we intended to determine the association between pain levels and mental health status, as well as the relationship between fear avoidance beliefs and activity changes because of lower extremity function.

METHODS

This case-control study was designed to compare differences between individuals with PFP and a pain-free population. The independent variable was groups with 2 levels (PFP and pain free). The dependent variables were self-reported physical and mental health via current and worst pain in the past 24 hours on a VAS, the AKPS, FABQ, modified SF-12, and LEFS.

Participants

A total of 60 participants (30 pain free, 30 with PFP) between the ages of 18 and 37 years were involved in this study. Demographic information is provided in the Table. Institutional review board approval was obtained for this project, and all participants provided written consent before data collection. The participants were recruited to the pain-free group if they had no previous lower extremity surgery, no history of ankle sprain, no lower extremity injury in the 6 months before enrollment, and no known neurologic dysfunction. Additional inclusion criteria for participants with PFP were based on previous literature.[1,22] These were an insidious symptom onset without a history of trauma, persistent pain for >3 months, and retropatellar pain during ≥2 of the following activities: stair ascent or descent, kneeling, squatting, running, prolonged sitting, isometric quadriceps contraction, jumping, or palpation of the lateral or medial aspect of the patella.[1,22] Also, participants with PFP had to score ≥3.0 cm on a 10-cm VAS for the worst pain in the 72 hours before testing and ≤85 on the AKPS (Table).[1,22] Recruits were excluded if they had any other ligamentous injury in the knee, instability, or any other source of anterior knee or ankle pain.

Procedures

Demographics (age, height, body mass, duration of pain) were obtained, and the Tegner Activity Scale and lower extremity pain questionnaires (VAS and AKPS) were completed.

The worst pain in the past 24 hours was assessed using the VAS. On a 10-cm line scaled from *no pain* to *worst pain imaginable*, participants were instructed to place a vertical mark on the point representing the worst pain they experienced in their knee over the previous 24 hours. Current pain at the time of testing was similarly assessed on a 10-cm VAS. We then measured the length of the line from the left edge (*no pain*) to the participant's mark (cm).

The AKPS is a 13-item questionnaire for evaluating subjective function and pain during tasks that are commonly difficult for patients with PFP. This is scored out of 100 points; higher scores indicate fewer functional impairments and less pain during the tasks.[23]

The FABQ measures fear-avoidance beliefs in patients according to 2 categories: fear avoidance during work activities (FABQ-W) and fear avoidance during physical activities (FABQ-PA). The highest possible score is 24 points; the higher the score, the greater the subjective fear-avoidance beliefs.

Participants then completed the modified SF-12 to assess their general physical and mental health. The modified SF-12 consists of 12 general health-related quality of life items that are combined to provide a physical component summary score (PCS-12) and a mental component summary score (MCS-12). The mean score in the general population is 50, with an SD of 10; higher scores indicate better health-related quality of life.

Participants also completed the LEFS, which is a validated patient-reported outcome measure that is used to measure activity limitations due to lower extremity musculoskeletal conditions.[21] The 20 questions are assessed on a 5-point scale (0 = *extreme difficulty or unable to perform*, 4 = *no difficulty*). The total score ranges from 0 (*extreme limitation*) to 80 (*no limitation*).[21]

Data Processing

We scored responses to the modified SF-12, PCS-12, and MCS-12 summary scales using norm-based methods based on predetermined weights via the Optum scoring package.[17] The FABQ and LEFS results were evaluated on the basis of the previously defined scoring criteria.

Statistical Analysis

Data were analyzed with SPSS (version 23.0; IBM Corp). Skewness, kurtosis, and normality of variance ($P > .05$) assessment using the Shapiro-Wilk test showed normally distributed data for the primary dependent variables of interest. We conducted parametric statistical analyses for all variables of interest. Independent 2-tailed t tests with a P value of .05 were calculated to compare the group demographics (age, height, body mass, current and worst pain in the past 24 hours on the VAS, AKPS, FABQ, PCS-12, MCS-12, and LEFS). Cohen d effect sizes with 95% CIs were computed to compare the magnitudes of difference in the PCS-12, MCS-12, and LEFS scores, with thresholds of 0.2 as *small*, 0.5 as *moderate*, and 0.8 as *large*.[24] We generated Pearson r correlations to evaluate associations between subjective measures pain (current and worst VAS pain levels) and MCS-12 score, as well as between the FABQ and LEFS scores in the PFP group. Thresholds were set a priori at 0.0–0.4 (*weak*), 0.4–0.7 (*moderate*), and 0.7–1.0 (*strong*).[25]

RESULTS

All data were normally distributed ($P > .05$) with equal variances. No differences were found with respect to age, height, mass, or activity levels between the groups (P values $> .05$; Table). Differences were identified on the VAS current pain and worst pain in the past 24 hours, AKPS, and FABQ (Table). Individuals with PFP had a lower level of function (effect size [ES; 95% CI] = 3.50 [2.70, 4.31]) and greater pain and fear avoidance (ES = 1.85 [1.25, 2.46] and ES = 2.38 [1.72, 3.04], respectively) than pain-free individuals. Those with PFP also displayed lower levels of subjective physical and mental health (ES = 1.09 [0.54, 1.63] and ES = 0.57 [0.06, 1.09], respectively). In the PFP group, a moderate negative correlation was present between the VAS current pain and MCS-12 score ($r = -0.52$, $P < .01$), as well as between the VAS for worst pain in the past 24 hours and MCS-12 score ($r = -0.46$, $P = .01$) and between the FABQ and LEFS scores ($r = -0.61$, $P < .01$; Figure).

DISCUSSION

Our findings confirmed our hypothesis that individuals with PFP would have poorer subjective mental and physical health. The PFP group reported worse physical and mental health than did the pain-free group. A significant negative correlation occurred between the VAS current pain and the MCS-12 score (Figure A). A similar significant negative correlation was noted between the VAS worst pain in past 24 hours and the MCS-12 score (Figure B). With an increase in pain level, the mental health of individuals with PFP deteriorated. In addition, we found a significant negative correlation between the FABQ and LEFS scores; thus, with the increase in fear after injury, participants with PFP displayed poorer subjective lower extremity function (Figure C).

Between-Groups Comparisons

Our PFP group's PCS-12 score was comparable with the national average,[17] whereas their MCS-12 score was lower than the national average. However, the pain-free group's scores were higher than the national average of 50 for both components of the SF-12 (Table). One reason for this could be the recruitment of participants from university settings who may have been relatively physically active. Yet the groups were matched on the basis of their physical activity levels using the Tegner Activity Scale. Notably, although demographically matched, scores for both components, and especially for mental health, were lower in the PFP group than in the pain-free group. Our characterization of mental health status in the PFP group was similar to that of Valovich McLeod et al,[26] who reported lower health-related

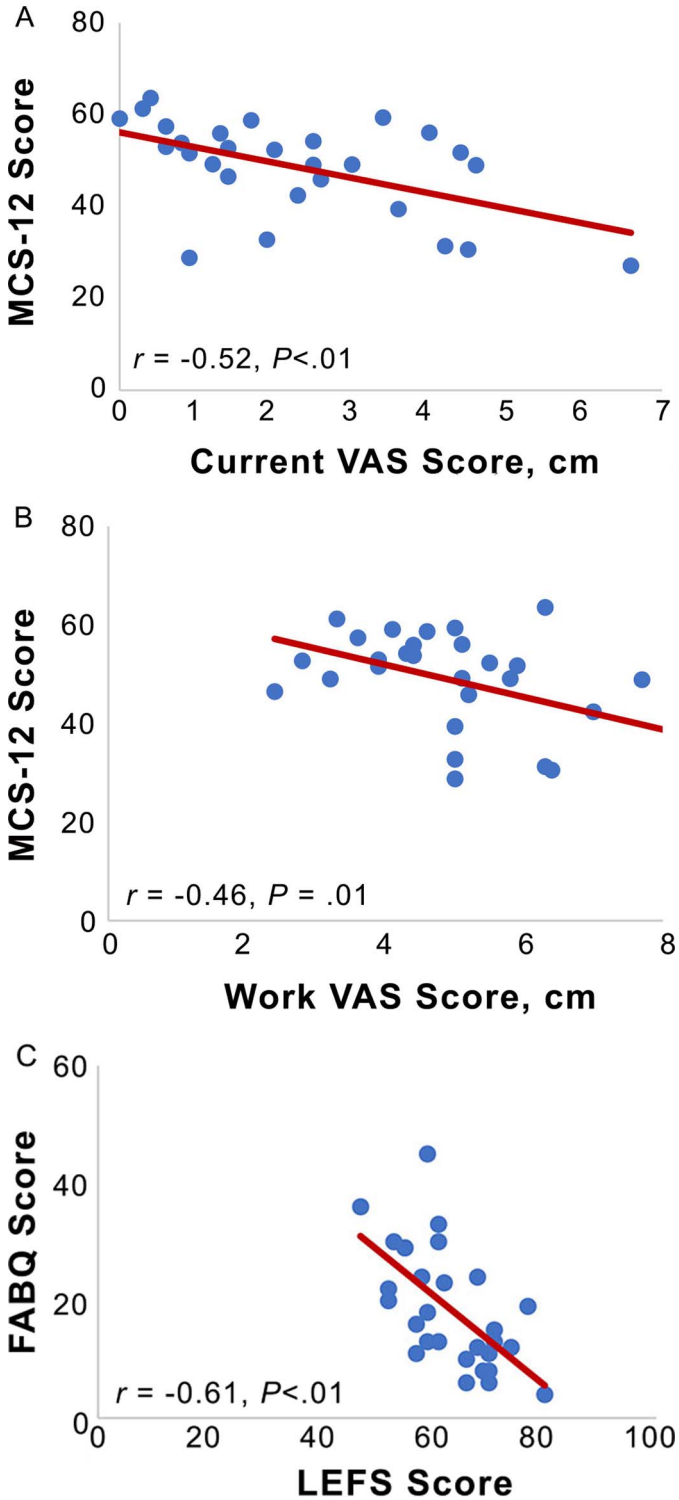

Figure. Scatter plots. A, Scatter plot between MCS-12 and VAS current pain scores. B, Scatter plot between MCS-12 and VAS worst pain in the past 24 hours scores. C, Scatter plot between FABQ and LEFS scores. Abbreviations: FABQ, Fear Avoidance Belief Questionnaire; LEFS, Lower Extremity Functional Scale; MCS-12, Mental Component Scale; VAS, visual analog scale.

quality-of-life scores in an injured group than in an uninjured group. McAllister et al[27] also suggested similar trends in collegiate athletes with mild and serious injuries who described worse health-related quality of life than individuals in an uninjured, pain-free group.

Correlation Analyses

Another interesting finding in our study was the higher FABQ score for the PFP group versus the pain-free group. The FABQ scores were negatively correlated with LEFS scores. Therefore, with the increase in fear, performing everyday tasks became more difficult. It is possible that individuals with PFP had developed the psychological constraint of fear avoidance, which affected lower extremity function in everyday tasks. Earlier researchers[28] determined that fear of pain or reinjury resulted in the self-selected behavior of limiting or manipulating physical function, which might prevent the potential harmful effects of pain or reinjury. Piva et al[5] observed that psychological factors were associated with function and pain in a PFP cohort. Patients with greater limitations in physical function had higher FABQ scores, reflecting greater fear-avoidance beliefs. Greater fear conclusively resulted in motor impairment and enhanced psychological constraints that developed due to the chronicity of PFP.[5] Psychological constraints, including lower mental health scores and greater fear-avoidance beliefs, remain largely ignored in physical therapy impairment-based rehabilitation. Perhaps this is the reason why, despite the vast number and availability of impairment-based rehabilitation programs, the prevalence of PFP remains high.[22] More than 57% of individuals with PFP who received physical therapy treatment still had poor outcomes.[2,29]

Clinical Implications

We believe our work will guide clinicians, especially musculoskeletal rehabilitation professionals, to acknowledge the importance of a whole-person approach when treating or planning rehabilitation programs for patients with PFP. Chronic knee pain can induce mental health problems, in addition to reducing lower extremity function, ultimately resulting in pain-related fear of movement.[30] Chronic pain exacerbation and relapses with the fear of reinjury produce a vicious cycle that takes a toll on the mental and physical health of individuals with chronic musculoskeletal problems. Fear of not achieving a normal level of function postinjury has been noted by patients, even after multiple reassurances from clinicians.[31] We suggest that similar fears are seen in those with PFP, which leads to deterioration of their mental and physical health. In a study of patients with PFP before they started physiotherapy, Smith et al[30] identified 5 major themes regarding the experiences and effects of living with PFP: effects on self; uncertainty, confusion, and sense making; exercise and activity beliefs; behavioral coping strategies; and expectations for the future.[30] The authors concluded that, although the previous focus was on pain and biomechanics, the current focus should be on biopsychosocial interventions aimed at the beliefs and pain-related fear of those with PFP.

Some investigators[32,33] have used psychologically informed physical therapy interventions that have shown some promising results in improving psychological as well as physical impairments in individuals with PFP. Incorporating mindfulness techniques into exercise therapy during PFP rehabilitation also improved psychological symptoms such as fear of movement and pain catastrophizing, with large ESs versus an exercise-only group.[34] It is imperative for clinicians to incorporate mental health assessments as part of their regular clinical practice. In addition, further exploring

new psychologically informed physical therapy techniques can provide a more wholesome treatment approach to target these psychological impairments.[32] Moreover, some widely used treatment modalities, such as knee bracing and taping, enhanced kinesiophobia.[35,36] These can be considered a treatment adjunct to improve kinesiophobia while addressing physical impairments through exercise.[34,36]

Our study had several limitations. First, the sample was composed of active college-aged participants, which limits the applicability of our findings to this population. Further research is needed in different age groups to enhance the external validity of these results. Second, the design was case-control, so although relationships were present, we could not determine causality. Longitudinal studies will help us evaluate a cause-and-effect relationship among fear avoidance, pain, and physical activity. Also, future research is needed to understand the change in these scores using impairment-based rehabilitation. Impairment-based rehabilitation techniques must be designed to include strategies that address mental health challenges from PFP.

CONCLUSIONS

We assessed a young population with a chronic orthopaedic injury and found worse quality of life self-reported in both the physical and mental health components. None of our participants were at risk, yet these relationships may have ramifications for the participants' lifetimes. When designing and administering rehabilitation protocols for patients with PFP, clinicians should assess their mental health. Pain on a VAS, fear avoidance, and subjective physical and mental health status should be taken into account in order to treat the whole patient with PFP.

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