Can physiotherapists predict the effect of a 12-week intervention for patients with PFP?: A secondary database analysis

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Abstract

OBJECTIVE: To examine if physiotherapists treating patients with PFP can predict the effect of a 12-week training intervention measured on function based on an initial assessment.

STUDY DESIGN: Secondary analysis of a randomized trial comparing quadriceps exercises with hip exercises in patients with patellofemoral pain as is two independent cohort studies that analyze the association between physiotherapists' prognosis and function and TransQ.

METHODS: Physiotherapists were asked to predict the prognosis of a total of 200 PFP patients on a 0-10 scale. Outcome measures consisted of changes from baseline to 12 and 26-weeks on the KUJALA questionnaire and dichotomized TransQ. Linear and logistic regression analyses were performed to assess the prediction of KUJALA and TransQ.

RESULTS: No association was found between physiotherapists' assessment of prognosis and changes in function using KUJALA for either QE or HE at 12 and 26-weeks (Slope = -0.39 to -0.46 with wide CIs). No association was found between physiotherapists' assessment of prognosis using TransQ for either QE or HE at 12 and 26 weeks (OR = 1.05 to 1.19 with wide CIs). The physiotherapists used previously validated prognostic factors such as symptom duration and pain intensity in their reason for prediction.

CONCLUSION: Physiotherapists' prediction of the prognosis is not associated with changes in function or treatment success based on initial assessment after 12 and 26-weeks for patients with PFP, despite using previously validated prognostic factors. Physiotherapists' prognoses are not useful as an additional source of information in decision-making and identifying patients with poor projected outcomes.

Keywords: Physiotherapy, Patellofemoral pain, Prognosis

Abstract (Dansk)

MÅL: At undersøge om fysioterapeuter der behandler patienter med PFP, kan forudsige effekten af en 12-ugers træningsintervention målt på funktion ud fra en indledende vurdering.

STUDIEDESIGN: Sekundær analyse af et randomiseret forsøg, der sammenligner quadriceps-øvelser med hofteøvelser hos patienter med patellofemorale smerter, der betragtes som to uafhængige kohortestudier, der undersøger associationen mellem fysioterapeutens prognose og funktion og TransQ.

METODE: Fysioterapeuter blev bedt om at forudsige prognosen på i alt 200 PFP-patienter på en 0-10 skala. Det primære resultatmål bestod af ændringer fra baseline til 12 og 26 uger på KUJALA og dikotomiseret TransQ. Lineære og logistiske regressionsanalyser blev udført for at vurdere forudsigelsen af KUJALA og TransQ.

RESULTATER: Der blev ikke fundet nogen sammenhæng mellem fysioterapeuters vurdering af prognose og ændringer i funktion ved brug af KUJALA for hverken QE eller HE efter 12 og 26 uger (Slope = -0,39 til -0,46 med et bredt CI). Der blev ikke fundet nogen sammenhæng mellem fysioterapeuters vurdering af prognosen ved brug af TransQ for hverken QE eller HE efter 12 og 26 uger (OR = 1,05 til 1,19 med et bredt CI). Fysioterapeuter fokuserede på tidligere validerede prognostiske faktorer, som varighed af symptomer og smerteintensitet i deres begrundelse for prognosen.

KONKLUSION: Fysioterapeuters forudsigelse af prognosen er ikke associeret med ændringer i funktion eller behandlingssucces baseret på indledende vurdering efter 12 og 26 uger for patienter med PFP, på trods af at have fokus på validerede prognostiske faktorer. Fysioterapeuters prognoser kan ikke bruges i de kliniske valg eller til at identificere patienter med dårligt forventet outcome.

Nøgleord: Fysioterapi, Patellofemorale smerter, Prognose

Preface

This master thesis has been completed as a part of the master's program in Musculoskeletal Physiotherapy at the Faculty of Health Sciences, Aalborg University. This article is intended to be published in the Journal of Orthopedic & Sports Physical therapy (JOSPT). JOSPT is a peer-review journal for physiotherapists and others in the field of health as well as research environments that aim to promote the musculoskeletal system and sports-related knowledge to create best practices. JOSPT was chosen for several reasons. In part, the content is musculoskeletal and sports-related area, to which patients with patellofemoral pain belongs. Partly JOSPT is mostly aimed at physiotherapists working with the musculoskeletal system and sports-related areas, which is the target group to be reached in this article. As the article as a form makes it difficult to answer all learning objectives, some learning objectives are answered and elaborated in the appendix. This includes the systematic literature searches *(Appendix 8)*, the study protocol *(Appendix 9)*, the statistical analysis plan *(Appendix 6)*, and the underlying assumptions as well as the performance of the statistical analysis *(Appendix 7)*. Firstly, a systematic literature search was conducted with the aim to find relevant literature, as well as a knowledge gap. Subsequently, a study protocol was prepared including the Statistical Analysis Plan (SAP) to clarify all prerequisites before the start of this master's thesis. Fig. 1. Illustrates the schedule for the preparation of the study protocol and the statistical analysis plan. The article regularly refers to appendices. The thesis was conducted in collaboration with Bispebjerg / Frederiksberg Hospital. In this regard, a huge thanks to Rudi Neergaard Hansen, Physiotherapist, MSc, Ph.D.-Student, for including me in this project and for good collaboration and professional sparring, and Marius Henriksen, Physiotherapist, Ph.D., Professor. Furthermore, thank you to the main supervisor Michael Skovdahl Rathleff, Physiotherapist, Ph.D., professor for educational and engaging guidance.

Task	Start date	End date
Systematic literature search	1. February 2022	6. February 2022
Background	6. February 2022	19. February 2022
Statistical Analysis Plan	19. February 2022	1. March 2022
Method and Materials	1. March 2022	10. March 2022
Study protocol	10. March 2022	23. March 2022

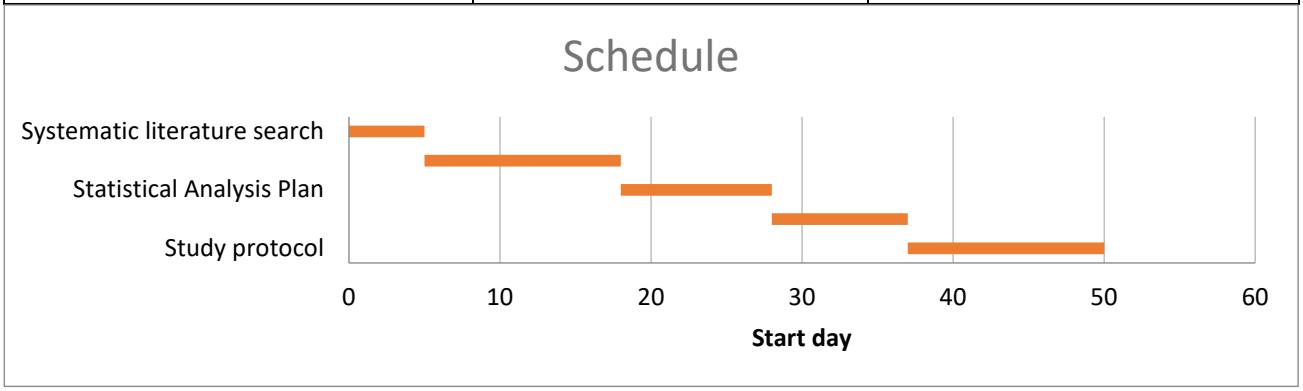

Fig. 1: Gannt diagram preparation for the study

Table of content

Introduction

Patellofemoral pain (PFP) is a common knee problem that primarily occurs in adolescents and young adults[27]. PFP is characterized by retropatellar or/and peripatellar pain often provoked by activities loading the patellofemoral joint, leading to physical inactivity, less participation in sports, and impaired quality of life[7]. PFP is a long-lasting condition with the majority of patients reporting knee pain 5-8 years after the initial diagnosis[22]. The treatment of PFP typically includes a combination of physical treatment and patient education[33]. PFP is complex and multifactional, leading to a heterogeneous clinical presentation[21]. This makes it challenging for clinicians to predict the prognosis of PFP[21]. Physiotherapists have an important role in the management and treatment, where the prognosis and prediction of outcome are important for clinical treatment decisions[4,13]. In general clinical practice, physiotherapists use a combination of decision-making methods to predict the prognosis based on several factors such as pattern recognition, patients' previous experience, own knowledge, and personal interaction with the patient[14,15,24,26]. Prognostic factors and treatment effect modifiers might be helpful tools for clinicians to predict the prognosis of PFP[23]. Previous studies have identified numerous prognostic factors that can predict a poor outcome for patients with PFP, e.g., longer pain duration, female sex, and lack of sports participation[16,17,23], but the heterogeneity in the available data makes it impossible to test the independent effect of each prognostic factors[16,23]. A systematic review identified 22 treatment effect modifiers, but because of significant methodological limitations is it unclear whether these patient characteristics can actually predict success following a specific treatment[23].

Previously, it has been shown that physiotherapists' prognoses based on the initial assessment of patients with lower back and neck pain could predict the actual clinical outcome[3]. The same association is seen for patients having total knee replacement (TKA)[15]. In a study including patients with lower back pain, general practitioners were as good as screening tools at predicting the outcome[18], however, it is unknown whether physiotherapists can predict the outcome of patients with PFP and what underlying reasons are behind the physiotherapists' prediction of the prognosis. Therefore, this study aims to explore if physiotherapists treating patients with PFP can predict the effect of a 12-week training intervention measured on function based on an initial assessment. Furthermore, we aim to qualitatively thematize the physiotherapists' reasons for prediction.

Materials & Methods

Study design

This is a secondary database analysis of a pragmatic randomized trial. Data were conducted from February 2017 to March 2022. The randomized trial compared changes in self-reported pain and function in individuals with PFP based on two exercise programs (quadriceps exercise (QE) or hip exercise (HE)) for 12 weeks with a 26-week follow-up. Furthermore, the secondary aim was to explore candidate patient characteristics that predict differential responses to the two exercise programs (QE or HE) on self-reported pain and physical function in individuals with PFP. All patients enrolled in the study signed an informed consent statement. The protocol for the original study is registered at http://www.clinicaltrials.gov (Identifier: NCT03069547). This study considered the two intervention groups as two independent cohort studies.

Participants

200 participants were enrolled in the primary study. Participants were recruited from the Institute of Sports Medicine Copenhagen (ISMC), Bispebjerg-Frederiksberg Hospital, Denmark. The inclusion criteria were: A clinical diagnosis of PFP in at least one knee confirmed by an experienced sports medicine doctor, visual analog score rating of pain during activities of daily living during the previous week at a minimum of 3 on a 10 cm scale, insidious onset of symptoms unrelated to trauma and persistent for at least 4 weeks, pain in the

anterior knee associated with at least 3 of the following: During or after activity, prolonged sitting, stair ascent or descent, squatting. The exclusion criteria were: Meniscal or another intra-articular injury, cruciate or collateral ligament laxity or tenderness, patellar tendon, iliotibial band, or pes anserine tenderness, Osgood-Schlatter or Sinding-Larsen-Johansson syndrome, history of recurrent patellar subluxation or dislocation, history of surgery to the knee joint, history of head injury or vestibular disorder within the last 6 months. All participating patients signed an informed consent. After informed consent and baseline assessments were gathered, each participant was randomly assigned to a group that received either the quadriceps exercise program (QE) or the hip exercise program (HE). The randomization was performed by using a computer-generated list permuted in blocks of 4 and 6. All rights of the eligible participants were protected.

Intervention

Both groups received advice and information on the background of PFP from the leaflet *"Managing my Patellofemoral pain"*[1]. The two exercise programs (hip exercise program or quadriceps exercise program) were scheduled to last 12 weeks with a 26-week follow-up. The programs were home-based and transferable to a clinical setting in which it is not possible to monitor the patients on a daily or weekly basis. The exercise sessions were scheduled 3 times per week with a monthly follow-up with a physiotherapist for adjustment of technique and intensity. *(Appendix 3a and 3b for the exercise programs).*

Data collection

For the demographic variables, the participants completed self-reported questionnaires at baseline, at 12 and 26 weeks. Following domains were assessed by questionnaires at baseline and follow-up: (1) Demographics: Age, sex, weight, height, etc. (only at baseline), (2) Knee symptoms: Functional limitations measured with the KUJALA questionnaire, (3) Physiotherapists' prognosis measured 1-10, (4) Experienced recovery (not assessed at baseline) measured on a 7-point Likert scale.

Outcomes

Primary outcome

The primary outcome was changes on the KUJALA patellofemoral scale from baseline to 12 and 26-weeks. The KUJALA is a 13-item self-report questionnaire specifically developed to assess the patients' perspective of the outcome following PFP ranging from 0 (complete disability) to 100 (fully functional)[20]. It documents responses to 6 activities (walking, running, jumping, climbing stairs, squatting, and sitting for prolonged periods with knees bent). It documents symptoms such as limp, inability to bear weight, swelling, abnormal patellar movement, muscle atrophy, and limitations in knee flexion[20]. The KUJALA is reliable, valid, and sensitive to clinically important changes over time[5]. The minimal clinically important difference is reported to range from 8 to 19 points in patients with PFP[8]. (*An exemplar version of the questionnaire is given in appendix 1)*

Secondary outcome

TransQ

As a secondary outcome, the primary study applied a transition question at follow-up to compare the patients' current state with the state at baseline. The participants initially answered if their current state is "unchanged, worse" or "better" compared to the baseline visit. An "unchanged" equals a transition score of 0. If the participant answered "worse", he/she was asked to rate the degree of worsening on a 7-point Likert scale, and the corresponding scores range from -1 to -7. If a participant answered "better," he/she was asked to rate the degree of improvement on a 7-point Likert scale, and the corresponding scores range from 1 to 7. Thus, the transition score ranging from -7 (worsening) to 7 (improvement), with the mid-point – 0 – representing no

change. TRANSQ was dichotomized with those who answered "3 or better" as treatment success and those who answered "2 or worse" as unsuccessful treatment. TransQ was used to assess overall knee-related health status. This approach had limitations regarding recall bias and the influence of numerous known and unknown parameters. (*An exemplar version of the question is given in appendix 2)*

Physiotherapists estimated prognosis and prediction reasons

This secondary analysis included 8 sports medicine-oriented physiotherapists with experience ranging from 6 to 27 years with the mean being 16.5 years. The physiotherapists estimated each patients' potential for a successful outcome after 12 and 26-weeks based on initial assessment and professional appraisal. The physiotherapists were asked to appraise all component parts of their evaluation in their prediction of each patient. The consultation was scheduled for 30 min including instructing the patients in the allocated exercise program to appraise the patients' muscle strength, and thereby determine the adequate resistance for the exercises. The prognosis was predicted based on group allocation judging the participants' prognosis based on allocated treatment. The physiotherapists were instructed to score each patient on a 1–10 Likert scale (1 representing a very poor projected outcome, 10 representing an excellent projected outcome). The physiotherapists scored each patient following their first encounter with the patient. This included information from journals, anamnesis, interactions with the patients, education, and instructions of the exercises. The physiotherapists were asked to write a comment based on the initial assessment. The prognosis was not disclosed to the participants. (*An exemplar version of the questionnaire is given in appendix 4)*

Statistical analysis

Demographic variables and baseline characteristics such as age, sex, weight, height, BMI, KUJALA scores, TRANSQ, and Physiotherapists' prognosis were summarized by treatment group. Means, standard deviations, medians, and ranges were used for continuous variables. Counts and proportions were used for categorical variables. The statistical analysis was performed for each group (i.e., QE and HE) and timepoint (i.e., 12 and 26 weeks) separately. Linear regression analysis was applied to estimate the association of the change from baseline to 12 and 26 weeks with the physiotherapists' prognosis for the KUJALA scores. The model contained the KUJALA change scores at 12 and 26 weeks as the dependent variable, and physiotherapists' prognosis as the independent variable. Logistic regression was used to estimate the association between the physiotherapists' prognostic scores and the dichotomous TRANSQ with the physiotherapists' prognostic scores as the independent variable and TRANSQ as the dependent variable. The predictive performance of the physiotherapists' prognostic scores was analyzed using calibration and discrimination measures. Discrimination measures differentiate between those who have the outcome (answered "better" to the TRANSQ question as achieved Treatment Success from those who have answered "worse" as did not achieve treatment success[28]. The discrimination measures were evaluated by calculating the areas under the receiver operating characteristic curves (AUC), and Nagelkerke R^2 as an indication of explained variation. Calibration refers to the agreement between the observed outcomes and predictions[28] and was evaluated by means of calibration plots, in which patients are classified by the predicted risk of the observed prognostic scores, assisted by a graphical assessment of calibration by using a loess algorithm[28]. Perfect prediction should be on 45◦ line for agreement with the observed outcome[28]. Intention to treat population was used for the statistical analysis. The statistical analysis was carried out using STATA/MP 17.0. P-values of $P<0.05$ was considered statistically significant. The reasons for prediction were analyzed through the "Framework Analysis" approach[9] and carried out using NVIVO 12 PRO. First, the investigator (JEVJ) familiarized himself with the data. After, a thematic framework of themes and subthemes was created, and indexed. Main themes were divided into relevant subthemes and were used to determine any associations between the physiotherapists' reasons for the prediction based on allocated groups. *(Full description of statistical analysis plan, Appendix 6)*

Results

From February 2017 to March 2022 a total of 200 participants were enrolled in the primary study. 100 participants (66% women) were randomly divided into the quadriceps group (QE) and 100 participants (72% women) were randomly divided into the hip group (HE) (Table 1). At 12 weeks 13 participants were lost to follow-up, and at 26 weeks 20 participants were lost to follow-up for QE. For HE at 12 weeks 12 participants were lost to follow-up and at 26 weeks 18 participants were lost to follow-up (Fig. 2).

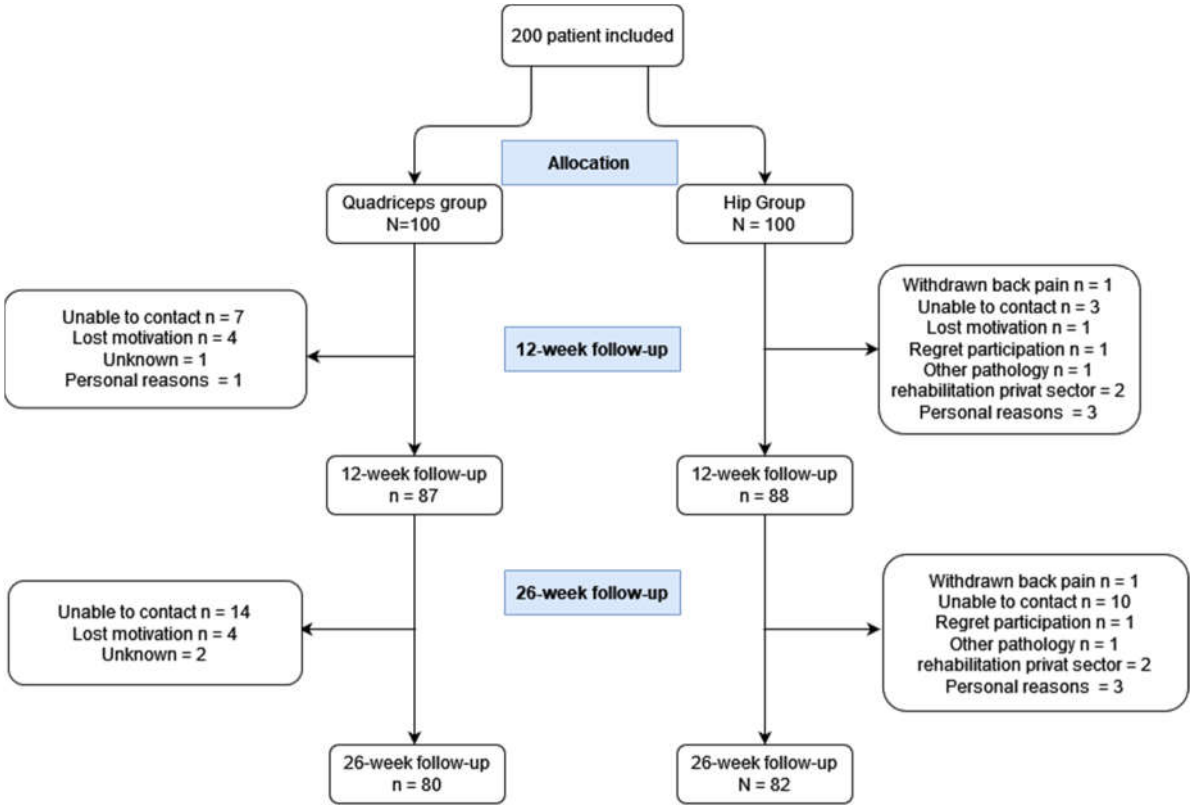

Fig. 2 Study flowchart

Table 1: Age, Sex, Height, Weight, BMI, KUJALA, Symptoms duration, TRANSQ, and Prognostic scores at baseline, and follow-up among all invited participants

	Quadriceps group (QE) (n=100)	Hip group (HE) (n=100)
Age, Mean (SD)	27.5 years (6.61)	27.0 years (6.26)
Female, n (%)	66 (66%)	72 (72%)
Height, Mean (SD)	172.6 cm (8.44)	173.0 cm (10.70)
Weight, Mean (SD)	68.2 kg (12.21)	67.6 kg (13.14)
BMI, Mean (SD)	22.8 (2.96)	22,45 (2.94)
Symptoms duration, median (IQR)	36 weeks (12,60)	30 weeks (12,72)
KUJALA (0-100), Mean (SD)		
Baseline	74.3 (11.43)	73.5 (12.77)
12-weeks	82.1 (11.61)	80.7 (11.52)
26-weeks	83.8 (12.01)	82.7 (12.54)
TransQ, n (%)		
Treatment success		
12 weeks	34 (39.08%)	37 (40.66%)
26 weeks	37 (47.44%)	42 (51.85%)
Treatment unsuccessful		
12 weeks	53 (60.92%)	54 (59.34%)
26 weeks	41 (52.56%)	39 (48.15%)
PT Prognosis, n (%)		
10	1 (1%)	2 (2%)
9	7 (7%)	16 (16%)
8	20 (20%)	33 (33%)
7	14 (14%)	16 (16%)
6	8 (8%)	12 (12%)
5	16 (16%)	6 (6%)
4	11 (11%)	2 (2%)
3	18 (18%)	10 (10%)
2	4 (4%)	3 (3%)
1	1 (1%)	-
Median (IQR)	5,5 (4,8)	8 (6,8)

PT, Physiotherapist. SD, Standard deviation. Treatment success, TransQ ≥ 3. Unsuccessful treatment, TransQ ≤ 2

Table 2 outlines the results of the linear regressions for QE and HE at week 12 and week 26. The linear regressions established that the physiotherapists' prognosis could not statistically significantly predict the KUJALA-score for QE at week 12 and week 26 with limited explained variance ($R^2 < 0.0098$). The linear regressions for HE at week 12 and week 26 showed non-statistically significant prediction at week 12 and week 26 with limited explained variance ($R^2 < 0.0048$).

Table 2 Results of the linear regression analyses with the physiotherapists' prognostic scores as predictors.

	Quadriceps Group						Hip Group					
Dependent variable	12 Weeks			26 Weeks			**Dependent variable**	12 Weeks			26 Weeks	
KUJALA	Slope [95% CI]	P	R^2	Slope [95% CI]	P	R^2	**KUJALA**	Slope [95% CI]	P	R^2	Slope [95% CI]	P	R^2
	-0.16 [-1.05;0.73]	0.721	0.0015	-0.46 [-1.51;0.58]	0.381	0.0098		-0.23 [-1.30;0.85]	0.675	0.0020	-0.39 [-1.63;0.85]	0.536	0.0048

CI, Confidence Interval; P, P-value; R^2, The proportion of the variance

Logistic regressions presented in Table 3 established that there was no significant association between the physiotherapists' estimated prognosis and the TRANSQ for QE at either 12 or 26 weeks. Similar non-statistically significant results were found for HE at 12 or 26 weeks.

Table 3 Results of the logistic regression analyses with the physiotherapists' prognostic scores as predictors.

Quadriceps Group							Hip Group						
Dependent variable	12 Weeks			26 Weeks			Dependent variable	12 Weeks			26 Weeks		
TransQ	Odds ratio	P	CI 95%	Odds ratio	P	CI 95%	TransQ	Odds ratio	P	CI 95%	Odds ratio	P	CI 95%
	0.96	0.676	[0.76;1.18]	1.05	0.655	[0.84;1.31]		1.09	0.481	[0.86;1.36]	1.19	0.152	[0.94;1.50]

CI, Confidence Interval; P, P-value

The performance of the logistic regressions in terms of discrimination for QE and HE at week 12 and week 26 were presented in Table 4. The prediction of achieving treatment success (TransQ ≥ 3) at week 12 and week 26 for QE was not statistically significant and with poor discrimination (AUC < 0.54). Similar results were found for HE at week 12 and at week 26 with poor discrimination (AUC < 0.59).

Table 4 Performance of prediction for QE and HE groups at week 12 and week 26

Quadriceps Group			Hip Group		
	AUC [95% CI]	R^2		AUC [95% CI]	R^2
TRANSQ negative answer			TRANSQ negative answer		
12 weeks	0.52 [0.40;0.64]	0.001	12 weeks	0.55 [0.43;0.68]	0.007
26 weeks	0.54 [0.42;0.67]	0.008	26 weeks	0.59 [0.47;0.71]	0.035

AUC, Area Under the Curve; CI, Confidence Interval; R^2, The proportion of the variance

Calibration plots were presented in Fig. 3 to show the performance of the models for achieving treatment success (TRANSQ ≥ 3) for QE at week 12, and week 26 and for HE at week 12, and week 26.

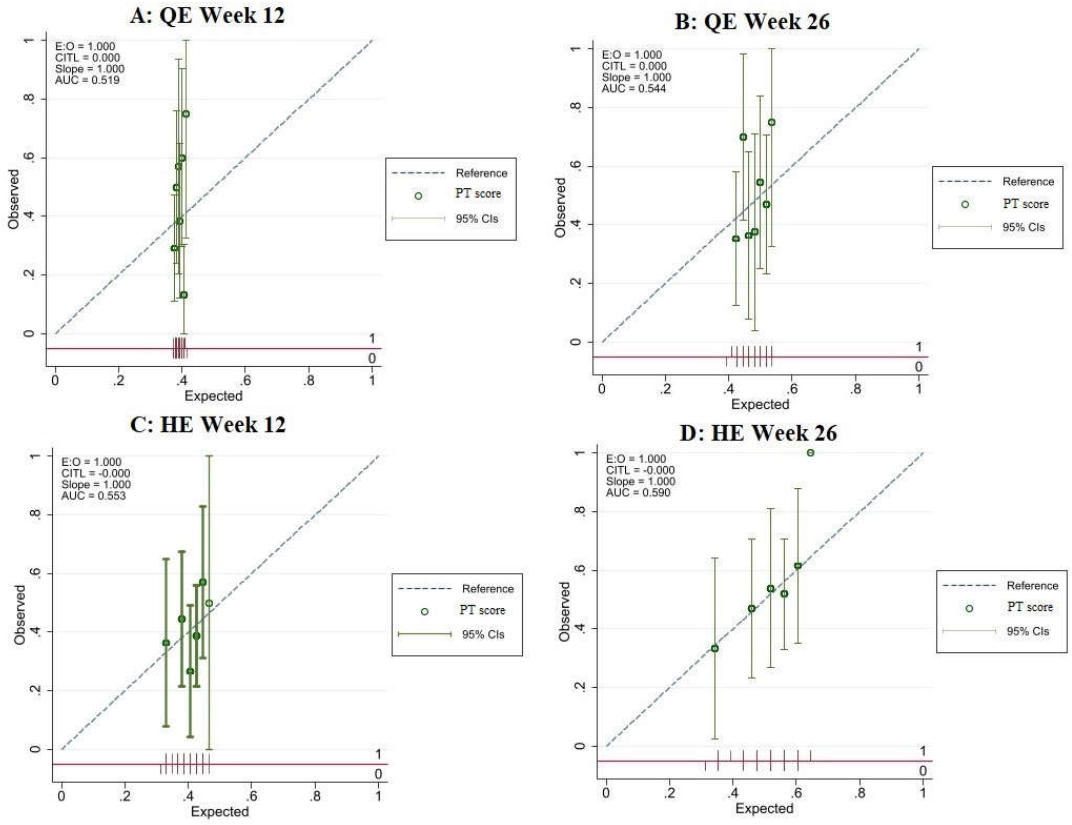

Fig. 3 Calibration plot for TransQ. Treatment Success is given on the *x*-axis. the observed probability is given on the *y*-axis. The dashed diagonal line represents the perfect agreement between the predicted and actual probability of TRANSQ. The dots represent the physiotherapists' prognostic scores. Error bars are 95% confidence intervals. At the *x*-axis, the distribution of the predicted probabilities is shown.

The physiotherapists' reasons for the prediction

The Framework analysis identified five themes and 13 subthemes for the hip group and four themes and 11 subthemes for the quadriceps group, including 'Psychological factors', 'Comorbidities', 'Pain', 'Physiological factors', and 'Training groups' which is detailed in Fig. 4. The most frequent themes represented across all patients in the quadriceps group were 'Psychological factors' (77/100 patients) and 'Pain' (26/100 patients) and the most frequent subthemes represented were 'Previous experiences' (21/200 patients), 'Compliance' (20/100 patients), and 'Muscle strength' (18/100). The most frequent themes for the hip group were 'Psychological factors' (79/100 patients) and 'Physiological factors' (20/100 patients). The most frequent subthemes were 'Motivation' (24/100 patients), 'Muscle strength' (20/100 patients), and 'Understanding the exercises' (17/100 patients). *(Full description of the themes and subthemes are detailed in appendix 5)*

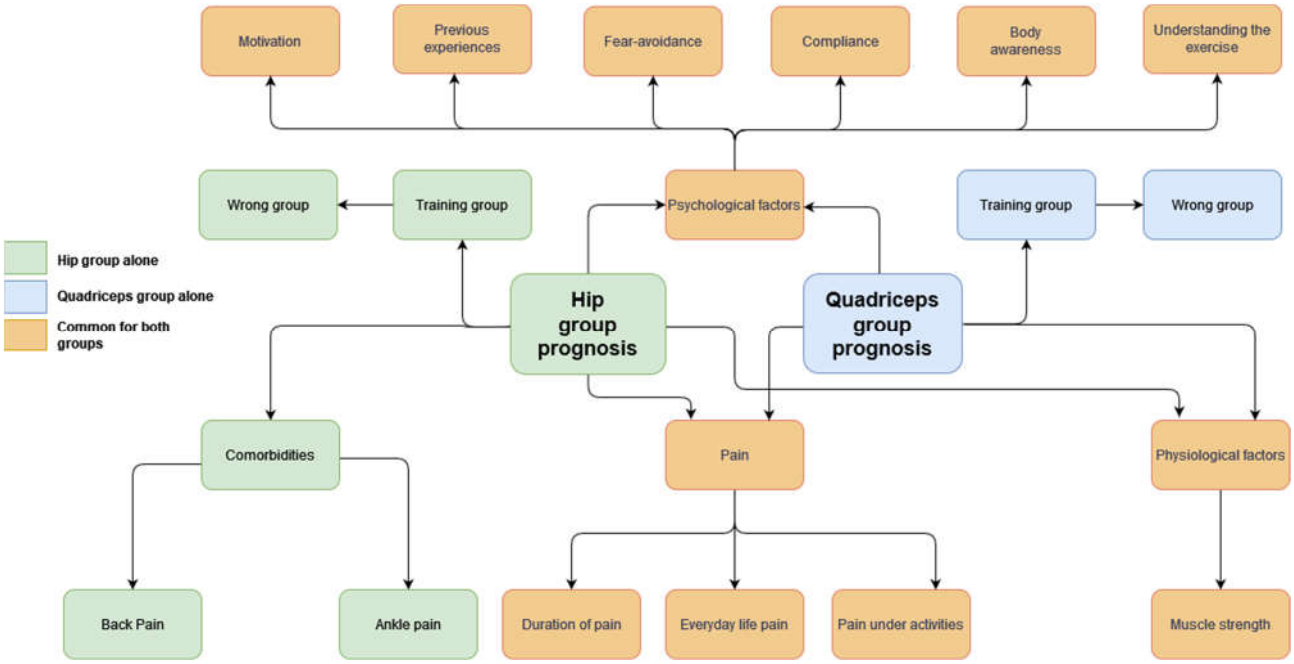

Fig. 4: Inter-relationship between themes and associated subthemes that emerged from exploring the physiotherapists' reasons for the prediction for the hip and quadriceps group. The green-colored boxes represent themes and subthemes for the hip group alone. The blue-colored boxes represent themes and subthemes for the quadriceps group alone. The orange-colored boxes represent themes and subthemes that are common in both the hip and quadriceps groups.

In several cases, the physiotherapists described more than one reason for their estimated prognosis representing various factors within the individual patient. This is seen both in the quadriceps group, e.g.,

(ID 80, score 1): *"The patient is experiencing pain with all exercises regardless of correction or change of load. The patient is challenged in relation to the pain as she has previously done similar training with aggravation of the pain and thus, the motivation is low."*

And in the hip group, e.g.

(ID 30, score 9): *"The patient is very motivated and is not afraid of pain. The patient already workouts a lot and has a very good body awareness and understanding of the exercises."*

Theme 1: Psychological factors

The most frequent theme in both the hip and quadriceps group is "Psychological factors". The physiotherapists describe the psychological factors that may have an impact on the patients' prognosis. More specifically if the

patients are afraid of their pain, have any previous experiences (good or bad), and/or are motivated. An exemplary quote from a physiotherapist explaining the anticipated prognosis of a patient in the quadriceps group.

(ID 150, score 8): *"Motivated for training and not afraid of the pain. Has even tried to work with progression before, but not guided by a physiotherapist".*

However, there was a tendency that patients in the quadriceps group to mostly had bad previous experiences.

(ID 161, score 3): *"Good compliance, but has already been doing the exercises before without any effect"*

Contrarily, the hip group had both good and bad previous experiences, but most of them being good.

(ID 16, score 9): *"Previously ran and trained without pain. Want to do that again"*

For both groups, the patients were more likely to be rated with a poor prognosis if they had difficulties understanding the exercises or had poor body awareness. This is exemplified in the quadriceps group.

(ID 18, score 2): *"The patient has no body awareness and finds it difficult to perform the exercises"*

However, if they had a good understanding of the exercises and good body awareness, they were more likely to be rated with a good prognosis, exemplified by the hip group.

(ID 182, score 9): *"Good understanding of the exercises and body awareness"*

The physiotherapists also acknowledged if the patients had poor compliance that could affect the prognosis. This is demonstrated by the quadriceps group.

(ID 185, score 5): *"The patient is very strong, and therefore it is difficult to progress the exercises. Compliance is a bit challenged with this patient."*

Equally, if they had good compliance, which could contribute positively to the prognosis, which is exemplified by the hip group.

(ID 90, score 9):" Happy *about the exercises, not afraid of pain, good compliance"*

Theme 2: Comorbidities

The physiotherapists have comorbidities in their consideration when assessing the prognosis and how it may have an influence on the prognosis. This is only represented in the hip group.

(ID 5, score 5): *"At first a good prognosis, but the patient had poor body awareness and a long-term back problem which can lead to poorer prognosis"*

(ID 98, score 5): *"Has weak muscles and training potential. However, several problems with the knee and ankle over many years"*

Theme 3: Pain

This theme represents how the prognosis can be explained by the intensity and duration of pain. How it can affect the prognosis negatively is exemplified in the quadriceps group.

(ID 200, score 3): *"Long duration of pain, the patient is used to working out, and has done so throughout for a long time. Has tried these exercises before. Is already super strong"*

How the duration of pain can have a positive impact on the prognosis is exemplified in the hip group.

(ID 49, score 10): *"The patient has only had pain for 3 months. It started after a lot of impact training. The patient had prior to this a fracture in the under extremities, which had not been rehabilitated.*

The physiotherapists also assessed the pain in everyday life functions and activities and what influence it could have on the prognosis. In the quadriceps group, there was a trend towards a poorer anticipated prognosis if the patients had pain in everyday life functions and activities, and a better prognosis, if the patient was not that affected by pain.

(ID 130, score 4): *"The patient has a lot of pain in simple everyday life functions and a lot of inconvenience during knee-loading exercises. Possibly better with hip training for the moment in the start-up phase"*

(ID 179, score 9): *"Almost no pain, used to run short distances"*

This is also represented in the hip group.

ID 40, score 3): *"The patient has quite severe pain. Has done very relevant training - with aggravation. Immediately no pattern in her pain."*

(ID 122, score 9): *"Good understanding of the exercises, almost no pain when performing the exercises."*

Theme 4: Physiological factors

This theme represents if the patients had training potential, more specifically, if the targeted muscles were weak and if the patients were able to become stronger. This theme is well represented in both the quadriceps- and hip groups. The muscle strength seems to have had an impact on the prognosis in the quadriceps group both positively and negatively, e.g.

(ID 85, score 7): *"Fairly good "basic level", the patient can even feel that she is weak in the gluteal region, so the question is whether she gets strengthened enough in this group. She notices the weakness in the performance of the lunges"*

(ID 28, score 4): *"Quite well-trained, training potential in terms of strength is limited"*

This is also represented in the hip group.

(ID 165, score 3): *"The patient is already very strong and has done these exercises before for a long period."*

(ID 35, score 9): *"The patient is looking forward to the training. Has great training potential and does not have constant pain.*

Theme 5: Training groups.

The assessment of the prognosis of the patients was done after the patients were allocated to the intervention groups and therefore the physiotherapists evaluated if the patients would have better suited in the other group.

The theme is most frequent in the quadriceps group and influenced the prognosis both positively and negatively.

(ID 155, score 8): *"Good compliance and motivation. Had, however, fit better in the other group in terms of alignment."*

(ID 92, score 3): *"The exercises cause pain and despite corrections, it is assessed that pt. would have benefited from the other group."*

Contrarily, there is a trend toward a negative influence in the hip group.

(ID 105, score 5): *"Had probably benefited more from other exercises but is ok challenged with the exercise in this group - and has no pain with them."*

Discussion

We found no association between physiotherapists' assessment of prognosis using TransQ and the changes in function at either 12 or 26-week follow-up. Neither did we find an association between prognosis and the self-reported overall change. This translated into poor discrimination between those who achieved treatment success and those who did not achieve treatment success in both groups at 12 and 26-week follow-up. The calibration plots suggested no linear relationship between the predicted and observed probability of treatment success for both QE and HE at 12 and 26-week follow-up. Thus, the physiotherapists' prognostic scores cannot be used to guide the future course of a PFP patient. In the qualitative assessment, we established themes and subthemes of the reasons for the physiotherapists' predictions. Despite focusing on prognostic factors validated in the literature[23], the physiotherapists could not predict changes in function or treatment success. This could possibly be due to the complex and multifactorial nature of PFP[23]. The etiology and pathogenesis of PFP are not fully understood[25], and multiple interactive pathways are suggested to contribute to its onset and course, making it challenging to predict the outcome[6,32]. In a systematic review, Matthews et al.[23] examined possible prognostic factors for PFP and found longer pain duration (>4 months) as the most common prognostic factor for a poor outcome[23]. In this study, the median duration of symptoms in both groups are longer than 4 months (Table 1), which could be one reason the physiotherapists have difficulty predicting changes in function or treatment success based on the duration of symptoms. The physiotherapists emphasized common prognostic factors such as pain and psychological – and physiological factors in their reasons for prediction in both groups, which corresponds to findings in Matthews et al. as predictors for a poorer outcome[23]. Previous research has shown that physiotherapists can predict function and treatment success based on the initial assessment of patients with neck and lower back pain, TKA, and lumbar spinal fusion[3,15,30]. However, neither of these studies explored the underlying reasons for their predictions. Our results show that physiotherapists use previously validated prognostic factors in their predictions. Despite using validated prognostic factors, we found no association between physiotherapists' prediction and the prognosis. Previous studies have used similar methods for the prediction of the prognosis, but the patient population was very different[3,15,30]. Knee osteoarthritis is a more specific diagnosis with tissue damage, and the surgery is associated with a significant improvement in pain and function[19]. Contrary, there is no identified tissue pathology in PFP[23]. A possible explanation could be in Henriksen et al.[15] the physiotherapists estimated the prognosis based on a full examination, history taking, and medical records, and the physiotherapist estimating the prognosis was not involved in the rehabilitation. In this study, the physiotherapists estimated the prognosis based on the first encounter with the patients, which only consisted of history taking and information provision. Therefore, the physiotherapists had to base their prognosis on their first impression of the factors they considered to be of importance for the prognosis. Tegner et al. predicted the prognosis based on the physiotherapists' first meeting

with the patients[30] which is similar to ours. Tegner et al. found an association between physiotherapists' prognosis and disability, pain, HRQoL (Health outcome and Quality of life), and GPE (Global Perceived Effect), but no association between physiotherapists' prognosis and satisfaction with surgery outcome (SSO). However, the predictive values of the scores were low[30]. A possible explanation for the low predictive ability values could be the very short time spent with the patients before giving a prognosis[30]. This is comparable to our study and may be a contributing factor to the physiotherapists' inability to predict the prognosis. A more comparable diagnosis may be neck and lower back pain in the study by Cook et al.[3]. Neck and lower back pain are often, as with PFP, non-specific diagnoses that are multifactional and with a heterogeneous clinical presentation[2]. In Cook et al.[3] 78% of the participants were acute or subacute patients and in our study, almost all participants are chronic patients. The prognosis for acute and subacute low back pain is good[12] and the long-term prognosis for PFP is poor[22]. Chronic pain can have a negative impact on psychosocial and physiological well-being and quality of life in general, especially for patients with persistent PFP[6,10,11,23], which makes it difficult to predict the prognosis. Another reason could be that in Cook et al.[3] the physiotherapist had a standardized examination process, which potentially influenced the estimation of the prognosis. In this study, there was not a standardized examination process.

Limitations and strengths

This study has some limitations. Firstly, the physiotherapists who made the prognostic estimates were the same individuals who provided the interventions. This could potentially affect the treatment because of a conscious or unconscious strive to achieve a successful/unsuccessful outcome according to their prognosis. Secondly, the prognostic estimates were made after group allocations, and there seems to be a trend towards a better-estimated prognosis in HE (Table 1). This could imply that the physiotherapists have more faith in the hip exercise than in QE. This induces a risk that the physiotherapists subconsciously influenced the outcomes (resulting in a poorer or better outcome) based on the initial assessment of each patient. A strength of this study is the large population included. With 100 participants in each group the probability of committing a type 2 error is low. Moreover, the relatively high number of physiotherapists participating in this study increases the external validity, making the results transferable to other clinical settings. The mean KUJALA score of the participants is comparable with scores found in other studies[17,23], which supports the external validity of the results.

Implications for Clinical Practice and Future Research

One of the questions patients often wants to be answered in clinical practice is how long they should attend physiotherapy[29]. To answer this question, physiotherapists need tools that can help predict the prognosis. There is no tool according to the current literature that can predict the prognosis for patients with PFP[23]. Our study underlines that physiotherapists' do not have a "gut" feeling and they cannot predict the prognosis, however, the patients still improve clinically significant in function in both groups despite the prognosis. Therefore, it will be interesting in future studies to investigate whether the physiotherapist's prognosis is associated with other prognostic variables such as pain or quality of life, and how the duration of symptoms affects the prognosis.

Conclusion

Physiotherapists' prediction of the prognosis is not associated with changes in function or treatment success based on initial assessment after 12 and 26-week follow-up for patients with PFP, despite focusing on validated prognostic factors. This study suggests that physiotherapists' prognoses are not useful as an additional source of information in decision-making and identifying patients with poor projected outcomes.

Key Points:

Findings: No association was found between physiotherapists' prognosis and KUJALA change score for either QE or HE at 12 and 26 weeks. No association was found between physiotherapist prognosis and TransQ for either QE or HE at 12 and 26 weeks. The physiotherapists used previously validated prognostic factors in their reasons for prediction.

Implications: Physiotherapists' prognoses are not useful as an additional source of information in decision-making and identifying patients with poor projected outcomes.

Causes: This study only examined few variables. The results of this study are presented in regression models, including the potential predictor of the outcome, and a sensitivity analysis was not performed.

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