



The quality of life of patients with patellofemoral pain – a systematic review

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The purpose of this study is to perform a systematic review of literature to assess the quality of life of patients with patellofemoral pain syndrome

A systematic review was performed in Pubmed ; Cochrane ; Embase ; Web of science and were searched until January 2018. There was no limit regarding the year of publication. The review was limited to English, Dutch and German articles.

Fifteen articles met the inclusion criteria. Seven articles reported the SF-36 and three articles reported the KOOS. Both the SF-36 and the KOOS showed lower quality of life of patients with patellofemoral pain syndrome.

There are indications that patellofemoral pain syndrome influences the quality of life equal to serious medical conditions and sometimes even osteoarthritis. Because it afflicts mostly young people it may have a huge impact on their lives. More research is needed, in particular which is focus on the quality of life.

Keywords : Patellofemoral pain syndrome ; anterior knee pain ; chondromalacia patellae ; quality of life ; quality adjusted life years.

the USA is estimated at 13.5% (11). About 22 out of 1000 persons per year in the USA will be diagnosed with PFPS, with females being 2.23 times more likely to develop PFPS in comparison to males (4,11). PFPS is characterized by a dull or sharp pain anterior or retropatellar of the knee (19). These symptoms mostly occur with increased pressure on the patella. Examples are : walking stairs, deep squatting and standing up from a chair (19,23). The pain is rarely present when the joint is not loaded (15). Other symptoms which often occur in PFPS are : patellofemoral crepitus, stiffness, difficulty with activities of daily living, restricted physical activity resulting in a poor quality of life (8).

Although much is written about the treatment to improve the quality of life, to our knowledge nothing is written about the actual impact of PFPS on the quality of life. Since most patients with PFPS are adolescents, a deterioration of quality of life directly influences their career possibilities. This systematic review aims to give an answer to the question : Do patients with patellofemoral pain syndrome have a lower quality of life compared to

INTRODUCTION

Patellofemoral pain syndrome (PFPS) is a common knee problem seen by general practitioners and orthopedic surgeons. PFPS is accounting for 11-17% of knee pain presentations in the general practice and 25-40% of all knee problems seen in the sports injury clinic. The prevalence of PFPS in

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the healthy age matched population? It is important to gain more knowledge about the quality of life so we are more able to inform patients properly.

MATERIALS AND METHODS

A systematic review was conducted and reported in accordance with the reporting guidance provided in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.

MEDLINE, EMBASE, Web of Science and Cochrane Library databases were searched (last search performed January 5th 2018). The search strategy was determined in collaboration with an information specialist from the medical library of the Radboud University medical center. Keywords used to develop our search strategy were ‘patellofemoral pain syndrome’ and ‘quality of life’. No Grey literature search was undertaken. The detailed search strategy is provided in Table I. Reference lists of

included studies and relevant reviews were screened for relevant studies.

All articles were screened based on title and abstract by 2 reviewers (LR and SvdG). In this screening stage, studies were excluded if they fulfilled one of the following criteria: 1) Osteoarthritis/ arthritis; 2) Anterior cruciate ligament/ meniscus; 3) Total knee arthroplasty/ knee reconstructions/ nailing/ prostheses; 4) Trauma; 5) Osteotomy; 6) (Patella)maltracking/ -malalignment disorder; 7) conference proceeding; 8) article not in English, Dutch, or German (all languages were screened). In the subsequent full text screening stage, studies were further evaluated for eligibility. In addition, studies were excluded if they contained data also published in another included paper. In case of a sub study being part of the larger, original study, the original study was included. In case of reported preliminary data the most extended paper was included in the analysis. Discrepancies between the two screening

Table I. — Searches

Pubmed	(“patello femoral pain”[Title/Abstract] OR “patello-femoral pain”[Title/Abstract] OR “patellofemoral syndrome”[Title/Abstract] OR “patello-femoral syndrome”[Title/Abstract] OR “patellar-femoral pain”[Title/Abstract] OR “patella femoral pain syndrome”[Title/Abstract] OR “knee pain syndrome”[Title/Abstract] OR “patellofemoral pain”[Title/Abstract] OR “patellofemoral pain syndrome”[MeSH Terms] OR “anterior-knee pain”[Title/Abstract] OR “anterior knee pain”[Title/Abstract] OR “chondromalacia patella”[Title/Abstract] OR “chondromalacia patellae”[Title/Abstract] OR “patella chondromalacia”[Title/Abstract] OR “patellar chondromalacia”[Title/Abstract] OR “chondromalacia patellae”[MeSH Terms]) AND (VAS[Title/Abstract] OR qaly[Title/Abstract] OR qol[Title/Abstract] OR sf-36[Title/Abstract] OR sf-12[Title/Abstract] OR EQ-5D[Title/Abstract] OR EQ-VAS[Title/Abstract] OR KOOS[Title/Abstract] OR KOS-ADLS[Title/Abstract] OR “visual analogue scale”[Title/Abstract] OR “quality adjusted life year”[Title/Abstract] OR “quality of life”[Title/Abstract] OR “knee injury osteoarthritis outcome score”[Title/Abstract] OR “quality-adjusted life years”[MeSH Terms] OR “quality of life”[MeSH Terms] OR “knee injury osteoarthritis outcome score”[MeSH Terms])
Embase	((patello femoral pain or patello femoral pain syndrome or patello-femoral pain or patellofemoral syndrome or patello-femoral pain syndrome or patello-femoral syndrome or patellar-femoral pain or patella femoral pain syndrome or knee pain syndrome or patellofemoral pain or patellofemoral pain syndrome or anterior-knee pain or anterior-knee pain syndrome or anterior knee pain or anterior knee pain syndrome or chondromalacia patella or chondromalacia patellae or patella chondromalacia or patellar chondromalacia).ti,ab,kw. or patellofemoral pain syndrome/ or patella chondromalacia/) and ((VAS or qaly or qol or sf-36 or sf-12 or EQ-5D or EQ-VAS or koos or KOS-ADLS or visual analogue scale or quality adjusted life years or quality adjusted life year or quality of life or knee injury osteoarthritis outcome score).ti,ab,kw. or quality of life/ or quality adjusted life year/ or short form 36/ or visual analog scale/ or knee injury osteoarthritis outcome score/)
Cochrane	(“patello femoral pain” OR “patello femoral pain syndrome” OR “patello-femoral pain” OR “patellofemoral syndrome” OR “patello-femoral pain syndrome” OR “patello-femoral syndrome” OR “patellar-femoral pain” OR “patella femoral pain syndrome” OR “knee pain syndrome” OR “patellofemoral pain” OR “patellofemoral pain syndrome” OR “anterior-knee pain” OR “anterior-knee pain syndrome” OR “anterior knee pain” OR “anterior knee pain syndrome” OR “chondromalacia patella” OR “chondromalacia patellae” OR “patella chondromalacia” OR “patellar chondromalacia” OR “chondromalacia patellae”) AND (VAS OR qaly OR qol OR sf-36 OR sf-12 OR EQ-5D OR EQ-VAS OR KOOS OR KOS-ADLS OR visual analogue scale OR quality adjusted life years OR quality adjusted life year OR quality-adjusted life years OR quality of life OR knee injury osteoarthritis outcome score)
Web of Science	(“patello femoral pain” OR “patello femoral pain syndrome” OR “patello-femoral pain” OR “patellofemoral syndrome” OR “patello-femoral pain syndrome” OR “patello-femoral syndrome” OR “patellar-femoral pain” OR “patella femoral pain syndrome” OR “knee pain syndrome” OR “patellofemoral pain” OR “patellofemoral pain syndrome” OR “anterior-knee pain” OR “anterior-knee pain syndrome” OR “anterior knee pain” OR “anterior knee pain syndrome” OR “chondromalacia patella” OR “chondromalacia patellae” OR “patella chondromalacia” OR “patellar chondromalacia” OR “chondromalacia patellae”) AND (VAS OR qaly OR qol OR sf-36 OR sf-12 OR EQ-5D OR EQ-VAS OR KOOS OR KOS-ADLS OR visual analogue scale OR quality adjusted life years OR quality adjusted life year OR quality-adjusted life years OR quality of life OR knee injury osteoarthritis outcome score)

authors were resolved by discussion and consensus between these authors.

Our primary outcome was the quality of life defined as SF-36 ; SF-12 ; KOOS ; VAS ; KOS-ADLS ; EQ-5D ; EQ-VAS. Articles only reporting on VAS pain scores were excluded.

Data was extracted from the included articles by two authors and included : study ID, number of knees, type of study, age of patients, sex and the primary outcomes as previously mentioned. All outcomes were noted as a mean. If there was enough data available of the subscales we noted these as a mean range. From this range we made a calculation to calculate the mean out of all the

articles. The means were compared with mean data of the subscale of the average population.

Eventually the SF-36 and KOOS gave enough available data to compare them to the available literature.

The SF-36 consists of 8 subscales : physical function, role limitations due to physical health, role limitations due to emotional problems, energy, emotional well-being, social functioning, pain and general health. These 8 subscales can be calculated to 2 summary scales : the mental and physical component summary (13).

The KOOS consists of 5 subscales : Pain, other Symptoms, Function in daily living (ADL), Function in sport and recreation (Sport/Rec) and knee related Quality of life (QOL). Standardized answer options are given (5 Likert boxes) and each question is assigned a score from 0 to 4. The patient has to answer the questions with his experiences of his knee in the previous week. A normalized score is calculated for each subscale ranging from 0 to 100. 0 is the most extreme problem and 100 is no problem at all (32).

The quality of the studies was assessed by LR using the Cochrane Risk of Bias Tool (14). The first (random sequence generation) and second (allocation concealment) item of the bias tool were most important for this review because we were not interested in the results of the articles but at the baseline characteristics.

RESULTS

The search strategy retrieved 1200 unique records. Subsequent selection procedure resulted in 22 eligible articles of which 15 studies could be included in this systematic review (Fig. 1).

Table 2 summarizes the quality assessment of the studies included in the systematic review. Six out of 15 studies were single arm studies and thus the first and second item of the quality assessment were not applicable. Eight out of 15 studies were of low risk of bias. One out of 15 articles was of high risk of bias.

The demographic characteristics of the articles reviewed are presented in Table 3. In total, 1179 patients with PFPS were included. About 64% of

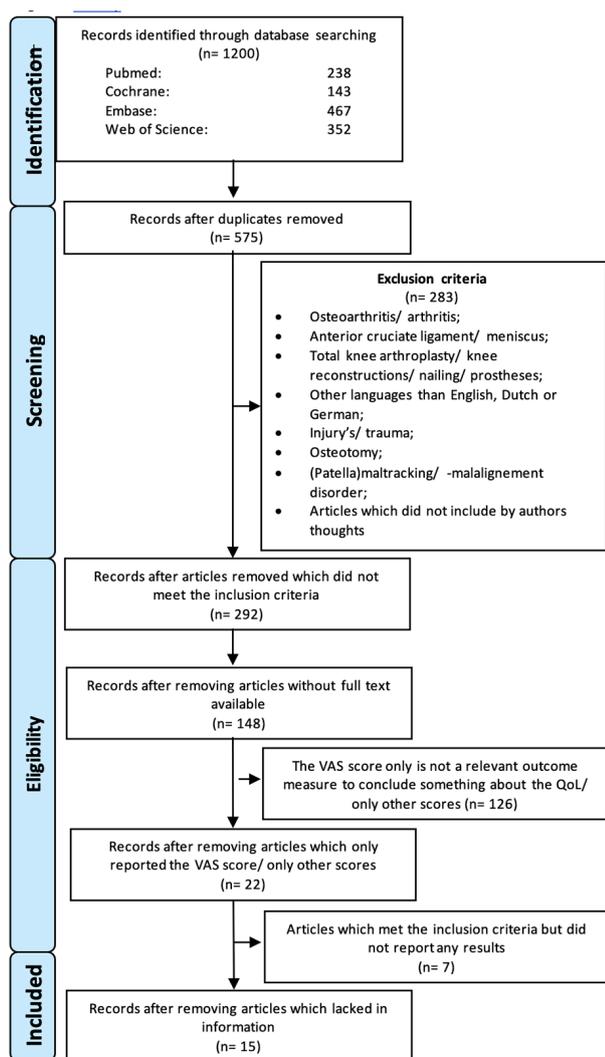


Figure 1. — Study selection flow chart.

Table II. — Risk of bias assessment

	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting
T. Assa (2013)	-	-	-	?	+	+
M. Banan (2016)	n.a.	n.a.	-	-	+	+
R. Cheung (2013)	+	+	-	-	+	+
C. Eapen (2011)	n.a.	n.a.	-	-	+	-
G. Espí-López (2017)	+	+	-	+	+	+
A. Haim (2013)	n.a.	n.a.	-	+	+	+
T. Kuru (2012)	+	+	-	+	+	+
S. Patil (2010)	+	?	-	-	-	-
S. Piva (2009)	n.a.	n.a.	-	+	+	+
C. Rathleff (2013)	+	+	-	-	-	+
M. Rathleff (2013)	+	+	-	-	+	+
M. Rathleff (2013)	n.a.	n.a.	-	-	?	?
G. Syme (2009)	+	+	+	+	+	-
S. Tan (2010)	+	+	-	-	-	+
L. Tsai (2015)	n.a.	n.a.	-	?	+	+

+ : low risk of bias. - : high risk of bias. ? : unclear risk of bias. n.a. : not applicable due to only one intervention group without a control group

which were female (one study did not report gender). The average age of the patients was 23.4 years. All results of the outcome measures are presented in Table 4.

Seven articles reported the SF-36 (1,6,9,12,18,26,31). From those articles the mean age ranged from 17.0 to 40.9 years. Some articles did not report the subscales of the SF-36. The mean of the different subscale scores between the studies which did note the subscales ranged (mean) from : physical function : 39.26-88.16 (63.85), role limitations due to physical health : 33.79-77.63 (42.58), role limitations due to emotional problems : 39.36-66.67 (62.44), energy : 43.70-63.16 (52.88), emotional well-being : 39.52-73.47 (65.70), social functioning : 42.31-82.89(73.36), pain : 39.98-62.47 (50.71) and general health : 40.29-65.68 (61.70). In comparison to the population referenced data from Obidoa et al. (24) the patients with PFPS scored worse on almost

all the SF-36 subscales, except physical functioning and energy as shown in Table 5.

Four articles reported the KOOS (2,11,30,36). From those articles the mean age ranged from 17.3 to 38.8 years. The mean of the different subscale scores between the studies ranged (mean) from : pain :22.97-72.3 (61.83), other symptoms : 20.14-78.6 (67.77), activities of daily living : 53.43-80.6 (74.89), sports function : 14.33-63.4 (51.40) and knee related QoL : 11.16-62.7 (49.20). In comparison to the population referenced data from Paradowski et al. (25) the population scored worse on all the KOOS subscales as shown in Table 6.

DISCUSSION

The goal of this systematic review was to assess as much information as possible about the quality of life of patients with PFPS in relation to healthy

Table III. — Demographic characteristics of the articles reviewed

Author (year)	Journal	Type of study	Sex (M/F)	Age (mean (±SD))
T. Assa (2013) ¹	Elsevier	Retrospective	91/66	30.3 (5.0)
M. Banan (2016) ²	J Babol Univ Med Sci	Cross-sectional	5/20	35.25 (10.29)
R. Cheung (2013) ⁶ *	Elsevier	Cross-sectional	Group 1:? Group 2: 7/12	22.7 (1.41) 21.0 (2.04)
C. Eapen (2011) ⁹	Asian Journal of Sports Medicine	Pilot	8/12	27.50 (6.60)
G. Espí-López (2017) ¹¹ *	Journal of orthopaedic & sports physical therapy	Randomized controlled trial	Group 1: 15/15 Group 2: 16/14	29.7 (9.5) 29.2 (10.5)
A. Haim (2013) ¹²	Elsevier	Retrospective analyze	27/21	31.2 (8.7)
T. Kuru (2012) ¹⁸ *	Acta orthop traumatol turc	Experimental	Group 1: 3/12 Group 2: 1/14	32.93 (12.17) 40.93 (10.57)
S. Patil (2010) ²⁶	Acta orthopedica Belgium	Prospective controlled trial	14/20	17
S. Piva (2009) ²⁸	Arch phys med rehabil	Cross-sectional	35/39	29 (9)
C. Rathleff (2013) ²⁹	Danisch medical journal	Prospective cohort	34/46	14
M. Rathleff (2013) ³⁰	Journal of orthopaedic & sports physical therapy	Cross-sectional	0/57	17.3 (1.1)
M. Rathleff (2013) ³¹ *	BMC musculoskeletal disorders	Cohort	Group 1:0/253 Group 2: 91/0	17 17
G. Syme (2009) ³⁴ *	Elsevier	Single blind randomized controlled trial	Group 1:10/13 Group 2: 10/13 Group 3: 8/15	28.8 (8.0) 27.3 (7.9) 28.5 (6.4)
S.Tan (2010) ³⁵ *	Scandinavian journal of medicine & science in sports	Randomized clinical trial	Group 1: 23/42 Group 2: 23/43	24.7 (8.6) 23.4 (7.8)
L.Tsai (2015) ³⁶	Clin J Sport med	Controlled laboratory test	2/9	38.8 (17.5)

* These articles divided the patients in groups because of different treatments. The groups will not be specified because we only looked at the baseline characteristics.

individuals. This study brought together and summarized the results of fifteen articles reporting on the quality of life in PFPS. Two outcome measures were mostly used to describe the patients' status, being the SF-36 and the KOOS. The most important finding of the present study is that there is some information about the quality of life of patients with PFPS, but nothing has been written specifically on the quality of life. The main purpose of all articles was to show if treatment for PFPS was beneficial to no treatment. Based on the review of the fifteen studies it would be reasonable to conclude that the quality of life is worse in patients with PFPS compared to those of healthy individuals as showed in the SF-36 and KOOS. The SF-36 showed, in comparison with the average population, that patients with PFPS are experiencing more limitations due to physical aspect as well as the emotional aspect. They are also experiencing more problems in their social life and they experience more pain than the average

population. Due to limitations in their physical functioning, more emotional problems, limitations in their social functioning and more experiencing of pain, the patients with PFPS indicating a worse general health than the average population. The KOOS showed, in comparison with the average population, that patients with PFPS are experiencing more pain and they indicate more other symptoms. The patients with PFPS are experiencing more problems during sports and their activities of daily living and indicating a worse QoL than the average population.

To put the results in perspective we have compared the results with those of knee osteoarthritis (KOA). Table 7 shows the results of both the SF-36 and KOOS of those with PFPS in comparison with those KOA. The patients with KOA impressed to score worse on all SF-36 subscales (10,16,17) and KOOS subscales (17,33) than the patients with PFPS, but the ranges fall right within those of

Table IV. — Results of individual studies

Author	Outcome measures (mean(\pm SD))*
T. Assa	SF-36 - Physical function: 65.1 (20.3) - Pain: 50.4 (21.7) - Limitation due to physical problems: 39.5 (37.5) - Limitation due to emotional problems: 64.8 (42.1) - Energy; 53.9 (18.1) - Social functioning: 76.5 (24.0) - Emotional well being: 69.1 (16.8) - General health: 65.1 (17.6) - Physical score: 54.8 (16.3) - Mental score: 65.9 (17.4)
M. Banan	VAS - 5.013(2.160) KOOS - Other symptoms: 20.14(12.64) - Pain: 22.97(11.11) - Activities of daily living: 53.43(25.92) - Recreational and sport function: 14.33(10.21) - Knee-related quality of life: 11.16(8.79)
R. Cheung	SF-36 group 1 - Physical function: 88.16(16.68) - Role physical: 77.63(38.06) - Pain: 62.47(18.69) - Energy: 63.16(17.89) - Social functioning: 82.89(21.73) - General health: 65.68(20.52) - Role emotional: 66.67(44.44) - Mental health: 73.47(15.21) SF-36 group 2 - Physical function: 74.74(15.32) - Role physical: 42.11(40.10) - Pain: 51.42(21.85) - Energy; 54.47(20.94) - Social functioning: 78.29(15.50) - General health: 64.79(18.89) - Role emotional: (57.89(44.22) - Mental health: 64.63(13.94)
C. Eapen	SF-36 - Physical component: 36.69(4.34) - Mental component: 41.63(6.50) - Pain: 45.40(13.23)
G. Espi-López	KOOS group 1 - Pain: 72.3(10.9) - Symptoms: 78.6(9.7) - ADL: 80.6(11.4) - Sports: 63.4(19.6) - Qol: 61.4(18.2) KOOS group 2 - Pain: 71.4(12.9) - Symptoms: 77.5(16.0) - ADL: 79.8(15.1) - Sports: 61.2(18.2) - Qol: 62.7(18.6)
A. Haim	SF-36 - Physical function: 60.6(19.9) - Pain: 50.5(22.6) - Limitation due to physical health: 41.7(39.7) - Energy: 50.0(21.0)
A. Haim	- Emotional well being: 68.3(15.9) - Limitation due to emotional health: 69.4(41.7) - Social functioning: 76.3(24.4) - General health: 60.2(19.7) - Physical score: 52.6(18.5) - Mental score: 64.9(19.2)
T. Kuru	VAS group 1 - 6.00(1.60) SF-36 - Physical function: 41.10(7.80) - Role physical: 33.79(8.96) - Pain: 39.98(6.42) - Energy; 45.59(6.91) - Social functioning: 42.31(8.06) - General health: 40.29(7.52) - Role emotional: 39.36(13.40) - Mental health: 39.52(8.92) VAS group 2 - 6.73(1.53) SF-360Role physical: 42.56(12.91) - Pain: 43.22(10.37) - Energy; 43.70(10.29) - Social functioning: 43.75(9.13) - General health: 43.34(10.95) - Role emotional: 42.66(15.00) - Mental health: 39.54(11.93)
S. Patil	SF-36 - Physical component: 36.9 - Mental component: 52.7
S. Piva	KOS-ADLS - 66(17)
C. Rathleff	VAS (mean(IQR)) - 80(68-89) EQ-5D - 0.82(0.77-0.84)
M. Rathleff	VAS (median(IQR)) - 1.3(0.3-2.7) EQ-VAS - 63.3(20.3) KOOS - Pain: 66.9(11.9) - Symptoms: 77.3(11.3) - ADL: 78.0(10.5) - Sports: 53.6(18.5) - Qol: 52.4(14.5)
M. Rathleff	EQ-VAS (median(IQR)) group 1 - 72(54-85) EQ-5D (median(IQR)) - 0.78(0.72-0.82) EQ-VAS (median(IQR)) group 2 - 79(68-88) EQ-5D (median(IQR)) - 0.78(0.78-0.82)
G. Syme	SF-36 group 1 - Physical component: 44.96(7.69) - Mental component: 44.96(7.69)

G. Syme	SF-36 group 2 - Physical component: 46.67(7.85) - Mental component: 46.67(7.85) SF-36 group 3 - Physical component: 46.67(7.85) - Mental component: 46.67(7.85)
S.Tan	EQ-VAS group 1 - Health state: 78.62 - Pain: 4.14 EQ-5D - 0.8191(0.1422) EQ-VAS group 2 - Health state: 79.65 - Pain: 4.03 EQ-5D - 0.8073(0.1706)
L.Tsai	KOOS - Pain: 69.2(10.5) - Symptoms: 70.5(13.2) - ADL: 78.6(11.4) - Function in sport: 52.1(18.0) - Knee-related QoL: 49.0(21.0)

*Not all outcome measures were noted as mean(\pm SD). If not it is mentioned.

PFPS with the exception of the ADL in de KOOS. With the comparison of the results we have to keep in mind that the population with KOA is on average older than the population with PFPS. The elder population scores in average worse on quality of life scorecards (24,25). In comparison with the medical outcome study of A. McHorney et al. (22),

Table V. — Results SF-36

	Results (calculated mean (range))	Average healthy population (mean)
Physical functioning	63.85 (39.26-88.16)	84.2
Role limitations due to physical health	42.58 (33.79-77.63)	80.9
Role limitations due to emotional health	62.64 (39.36-66.67)	81.3
Energy	52.88 (43.70-63.16)	60.9
Emotional well-being	65.70 (39.52-73.47)	74.7
Social functioning	73.36 (42.31-82.89)	83.3
Pain	50.71 (39.98-62.47)	75.2
General health	61.70 (40.29-65.68)	71.9

Table VI. — Results KOOS

	Results (calculated mean (range))	average healthy population (mean range)
Pain	61.83 (22.97-72.30)	87.4-92.2
Other symptoms	67.77 (20.14-78.60)	86.5-89.5
ADL	74.89 (53.43-80.60)	88.6-95.2
Sports functioning	51.40 (14.33-63.40)	68.4-76.0
Knee related QoL	49.20 (11.16-62.70)	77.7-85.3

in which they used the SF-36 for a large group of people, PFPS is comparable with serious medical conditions (described as : patients with advanced or

Table VII. — Comparison PFPS with KOA

	Results (calculated mean (range))	Outcome in Knee Osteoarthritis (range) ^{10, 16, 17, 33}	Outcome in serious medical conditions(mean(SD)) ²²
SF-36			
Physical functioning	63.85 (39.26-88.16)	23.28-39.98	57.35(2.34)
Role limitations due to physical health	42.58 (33.79-77.63)	14.00-44.96	43.92(3.31)
Role limitations due to emotional health	62.64 (39.36-66.67)	39.50-63.54	76.16(3.11)
Energy	52.88 (43.70-63.16)	43.31-51.70	47.79(1.82)
Emotional well-being	65.70 (39.52-73.47)	47.56-59.32	77.59(1.32)
Social functioning	73.36 (42.31-82.89)	43.70-56.00	80.03(2.03)
Pain	50.71 (39.98-62.47)	34.65-45.48	65.10(2.06)
General health	61.70 (40.29-65.68)	43.23-57.84	49.13(1.80)
KOOS			
Pain	61.83 (22.97-72.30)	37.35-39.90	
Other symptoms	67.77 (20.14-78.60)	46.40-49.39	
ADL	74.89 (53.43-80.60)	37.21-48.60	
Sports functioning	51.40 (14.33-63.40)	14.44-26.5	
Knee related QoL	49.20 (11.16-62.70)	22.30-26.50	

complicated chronic medical conditions) as shown in table 7. This indicates that PFPS is a serious condition which is of huge impact on the societal well being.

The present review has some limitations. First of all, despite the use of several databases with different keywords, it is still possible that some articles may not have been included in our search. Secondly, we did use anterior knee pain as a keyword. Most of the time they refer to PFPS with anterior knee pain, but sometimes there are other definitions to which they refer to with anterior knee pain (3). Also, the SF-36 is a good scale to describe the quality of life. However, The problem with the articles which used the SF-36, is that the outcomes were described in different manners. It was impossible to calculate the subscales to a mental component summary (MCS) and physical component summary (PCS), because the SF-36 can be calculated in two different ways : the orthogonal factor rotation and the oblique factor rotation (27,37). The studies which made a summary of the subscales did not report if they used the orthogonal factor rotation or the oblique factor rotation. Due to the lack of information on the calculations we could not calculate the MCS and PCS ourselves. Neither did those articles report if they used the SF-36 V1 or SF-36 V2. There is not much of a difference between those versions, but the V2 has slight improvements in range and precision for the Role-Physical and Role-Emotional scales (20,21). Furthermore, we could not calculate the SF-36 completely because some articles did not report the subscales of the SF-36. Therefore, the calculation we made does not include all data. The range in the outcome measures of both the SF-36 and KOOS was very broad. Maybe due to the different calculations in the SF-36 or the different populations in all of those studies. The broad ranges may be affected by uncontrollable variations these heterogenic populations take with them. We also keep in mind that the sample sizes of all the involved studies are quiet small and may influence the outcomes.

Although there are some limitations in this present study, we should not take these results lightly. There are indications that PFPS influences the quality of life equal to serious medical conditions and in some

subscales even osteoarthritis and because PFPS afflicts mostly the younger populations these results assume PFPS may have a huge impact on the lifes of those people. It is conceivable that the influence of PFPS on the quality of life may cause the patients to take different choices in life and limiting their future. Even though there is some information, more research about the quality of life of patients with PFPS is needed. In particular research which is focused on the quality of life and which influence it has on the patient's life and not the treatment options.

REFERENCES

1. **Assa T, Elbaz A, Mor A, Chechik O, Morag G, Salai M, Haim A.** Gait metric profile of 157 patients suffering from anterior knee pain. A controlled study. *Knee*. 2013, 20 : 40-44.
2. **Banan M, Talebi GA, Taghipour DM.** A Study on the Effects of Patellar Taping on Pain, Quality of Life, and Radiographic Findings in Patients with Patellofemoral Pain Syndrome. *Journal of Babol University of Medical Sciences*. 2016, 18(1) : 18-24.
3. **van den Berg I, Daane K, Gereke K, den Hartog B, Hilgersom H, Westerhof A, Lankhorst K.** Behandelprotocol voor het patello-femoraal pijnsyndroom. (internet). Available from : <https://www.researchgate.net/>
4. **Boling M, Padua D, Marshall S, Guskiewicz K, Pyne S, Beutler A.** Gender differences in the incidence and prevalence of patellofemoral pain syndrome. *Scand. J. Med. Sci. Sports*. 2010 Oct, 20(5) : 725-730.
5. **Chang WD, Chen FC, Lee CL, Lin HY, Lai PT.** Effects of Kinesio taping versus McConnell taping for patellofemoral pain syndrome : a systematic review and meta-analysis. *Evidence-Based Complementary and Alternative Medicine*. 2015 Jun, Article ID 471208.
6. **Cheung RT, Zhang Z, Ngai SP.** Different relationships between the level of patellofemoral pain and quality of life in professional and amateur athletes. *PM&R*. 2013 Jul, 5(7) : 568-572.
7. **Collins NJ, Misra D, Felson DT, Crossley KM, Roos EM.** Measures of knee function : International Knee Documentation Committee (IKDC) Subjective Knee Evaluation Form, Knee Injury and Osteoarthritis Outcome Score (KOOS), Knee Injury and Osteoarthritis Outcome Score Physical Function Short Form (KOOS-PS), Knee Outcome Survey Activities of Daily Living Scale (KOS-ADL), Lysholm Knee Scoring Scale, Oxford Knee Score (OKS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Activity Rating Scale (ARS), and Tegner Activity Score (TAS). *Arthritis Care Res*. 2011 Nov, 63(S11) : 208-228.

8. Crossley KM. Patellofemoral pain. *BMJ*. 2015 Nov, 11 : 351
9. Eapen C, Nayak CD, Zulfequer CP. Effect of eccentric isotonic quadriceps muscle exercises on patellofemoral pain syndrome : an exploratory pilot study. *Asian J. Sports Med*. 2011 Dec, 2(4) : 227-234.
10. Escobar A, Quintana JM, Bilbao A, Aróstegui I, Lafuente I, Vidaurreta I. Responsiveness and clinically important differences for the WOMAC and SF-36 after total knee replacement. *Osteoarthritis and cartilage*. 2006 Oct, 15(3) : 273-280.
11. Espí-López GV, Serra-Añó P, Vicent-Ferrando J, Sánchez-Moreno-Giner M, Arias-Buría JL, Cleland J, Fernández-de-Las-Peñas C. Effectiveness of Inclusion of Dry Needling Into a Multimodal Therapy Program for Patellofemoral Pain : A Randomized Parallel-Group Trial. *J. Orthop. Sports Phys. Therapy*. 2017 Jun, 47(6) : 392-401.
12. Haim A, Segal G, Elbaz A, Mor A, Agar G, Bar-Ziv Y, Atoun, E. The outcome of a novel biomechanical therapy for patients suffering from anterior knee pain. *Knee*. 2013 Dec, 20(6) : 595-599.
13. Hays RD, Shapiro MF. An overview of generic health-related quality of life measures for HIV research. *Qual. Life Res*. 1992, 1(2) : 91-97.
14. Higgins JPT, Green S. Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0. *The Cochrane Collaboration*. 2011. (internet). Available from <http://handbook.cochrane.org>
15. Hott A, Liavaag S, Juel NG, Brox JI. Study protocol : a randomised controlled trial comparing the long term effects of isolated hip strengthening, quadriceps-based training and free physical activity for patellofemoral pain syndrome (anterior knee pain). *BMC Musculoskelet Disord*. 2015 Feb, 16 : 40.
16. Tae-Hun K, Kun Hyung K, Jung Won K, MinHee L, Kyung-Won K, Jung Eun K, et al. Moxibustion treatment for knee osteoarthritis : a multi-centre, non-blinded, randomised controlled trial on the effectiveness and safety of the moxibustion treatment versus usual care in knee osteoarthritis patients. *PLoS one*. 2014 Jul, 9(7) : e101973.
17. Elizaveta K, Engebretsen L, Verdonk P, Nehrer S, Filardo G. Clinical Outcomes of Knee Osteoarthritis Treated With an Autologous Protein Solution Injection : A 1-Year Pilot Double-Blinded Randomized Controlled Trial. *Am. J. Sports Med*. 2018 Jan, 46(1) : 171-180.
18. Kuru T, Yalman A, Dereli EE. Comparison of efficiency of Kinesio® taping and electrical stimulation in patients with patellofemoral pain syndrome. *Acta Orthop. Trauma Turc*. 2012, 46(5) : 385-392.
19. Lantz JM, Emerson-Kavchak AJ, Mischke JJ, Courtney CA. Tibiofemoral joint mobilization in the successful management of patellofemoral pain syndrome : a case report. *Int J Sports Phys Ther*. 2016 Jun, 11(3) : 450-461.
20. Laucis NC, Hays RD, Bhattacharyya T. Scoring the SF-36 in orthopaedics : a brief guide. *J. Bone Joint Surg. Am*. 2015 Oct, 97(19) : 1628-1634.
21. Maruish, ME. User's manual for the SF-36v2 Health Survey. *Quality Metric Incorporated*. 2011. (internet). Available from : <https://www.scienceopen.com/>
22. McHorney CA, John E, Ware Jr JE, Raczek AE. The MOS 36-Item Short-Form Health Survey (SF-36) : II. Psychometric and clinical tests of validity in measuring physical and mental health constructs. *Medical care*. 1993 Mar, 31(3) : 247-263.
23. Ng GY, Cheng JM. The effects of patellar taping on pain and neuromuscular performance in subjects with patellofemoral pain syndrome. *Clin. Rehab*. 2002 Dec, 16(8) : 821-827.
24. Obidoa CA, Reisine SL, Cherniack M. How Does the SF-36 Perform in Healthy Populations? A Structured Review of Longitudinal Studies. *J. Soc. Behav. Health Sci*. 2010 Jan, 4(1) : 30-48.
25. Paradowski PT, Bergman S, Sundén-Lundius A, Lohmander LS, Roos EM. Knee complaints vary with age and gender in the adult population. Population-based reference data for the Knee injury and Osteoarthritis Outcome Score (KOOS). *BMC Musculoskelet Disord*. 2006 May, 7 : 38.
26. Patil S, White L, Jones A, Hui AC. Idiopathic anterior knee pain in the young A prospective controlled trial. *Acta Orthop. Belg*. 2010 Jun, 76(3) : 356-359.
27. Pelle AJ, Kupper N, Mols F, de Jonge P. What is the use? Application of the short form (SF) questionnaires for the evaluation of treatment effects. *Qual. Life Res*. 2013 Aug, 22 : 1225-1230.
28. Piva SR, Fitzgerald GK, Irrgang JJ, Fritz JM, Wisniewski S, McGinty GT, et al. Associates of physical function and pain in patients with patellofemoral pain syndrome. *Archives of physical medicine and rehabilitation*. 2009 Feb, 90(2) : 285-295.
29. Rathleff CR, Olesen JL, Roos EM, Rasmussen S, Rathleff MS. Half of 12-15-year-olds with knee pain still have pain after one year. *Dan. Med. J*. 2013 Nov, 60(11) : A4725.
30. Rathleff MS, Roos EM, Olesen JL, Rasmussen S, Arendt-Nielsen L. Lower mechanical pressure pain thresholds in female adolescents with patellofemoral pain syndrome. *J. Orthop. Sports Phys. Ther*. 2013 Jun, 43(6) : 414-421.
31. Rathleff MS, Skuldbøl SK, Rasch MN, Roos EM, Rasmussen S, Olesen JL. Care-seeking behaviour of adolescents with knee pain : a population-based study among 504 adolescents. *BMC Musculoskelet Disord*. 2013 Jul, 14 : 225.
32. Rathleff MS, Vicenzino B, Middelkoop M, et al. Patellofemoral pain in adolescence and adulthood : same same, but different? *Sports Med*. 2015 Nov, 45(11) : 1489-1495.
33. Feride S, Paker N, Bugdayci D. The relationship between knee injury and osteoarthritis outcome score (KOOS) and timed up and go test in patients with symptomatic knee osteoarthritis. *Rheumatol. Int*. 2013 Oct, 33(10) : 2691-2694.

34. **Syme G, Rowe P, Martin D, Daly G.** Disability in patients with chronic patellofemoral pain syndrome : a randomised controlled trial of VMO selective training versus general quadriceps strengthening. *Man. Ther.* 2009 Jun, 14(3) : 252-263.
35. **Tan SS, Van Linschoten RL, Van Middelkoop M, Koes BW, Bierma-Zeinstra SM, Koopmanschap MA.** Cost-utility of exercise therapy in adolescents and young adults suffering from the patellofemoral pain syndrome. *Scandinavian journal of medicine & science in sports.* 2010 Aug, 20(4) : 568-579.
36. **Tsai LC, Lee SJ, Yang AJ, Ren Y, Press JM, Zhang LQ.** Effects of off-axis elliptical training on reducing pain and improving knee function in individuals with patellofemoral pain. *Clin. J. Sport Med.* 2015 Nov, 25(6) : 487-493.
37. **Wilson D, Parsons J, Tucker G.** The SF-36 summary scales : problems and solutions. *Soz. Präventivmed.* 2000, 45(6) : 239-246.