

## Investigating the prevalence of anxiety and depression in people living with patellofemoral pain in the UK: the Dep-Pf Study

Wride, James; Bannigan, Katrina

*Published in:*  
Scandinavian Journal of Pain

*DOI:*  
[10.1515/sjpain-2018-0347](https://doi.org/10.1515/sjpain-2018-0347)

*Publication date:*  
2019

*Document Version*  
Peer reviewed version

[Link to publication in ResearchOnline](#)

*Citation for published version (Harvard):*

Wride, J & Bannigan, K 2019, 'Investigating the prevalence of anxiety and depression in people living with patellofemoral pain in the UK: the Dep-Pf Study', *Scandinavian Journal of Pain*, vol. 19, no. 2, pp. 375-382. <https://doi.org/10.1515/sjpain-2018-0347>

### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

### Take down policy

If you believe that this document breaches copyright please view our takedown policy at <https://edshare.gcu.ac.uk/id/eprint/5179> for details of how to contact us.

# Investigating the prevalence of anxiety and depression in people living with patellofemoral pain in the UK: The Dep-Pf Study

## ABSTRACT

1

### 2 **Background and Aims**

3 Patellofemoral pain (PFP) is a common knee condition causing pain around or behind  
4 the kneecap which is exacerbated by certain activities. Traditionally it has been viewed  
5 as a self-limiting condition. Recent research proves this is not the case and the  
6 evidence for poor long-term outcomes is growing. Whilst the evidence base for PFP  
7 treatment and the understanding of its aetiology is improving, it remains a complex and  
8 difficult to treat condition. In many physical conditions, it has been shown that anxiety  
9 and depression negatively affect both their management and duration. It is unclear how  
10 prevalent anxiety and depression are in PFP. This study aimed to identify the  
11 prevalence of anxiety and depression in people living with PFP in the UK.

### 12 **Methods**

13 In order to investigate this, a cross-sectional online survey was undertaken. Four  
14 hundred participants with self-reported symptoms of PFP were recruited through a  
15 tailored social media campaign, using modified snowball sampling. Eligibility criteria  
16 were i) aged between 18 and 44, ii) self-reported symptoms of PFP (using accepted  
17 criteria) iii) resident in the UK. Exclusion criteria were previous history of patella  
18 dislocation or previous surgery to affected knee. The survey recorded demographic  
19 information, previous treatment for both PFP and anxiety and depression, the Hospital

20 Anxiety and Depression Scale and the Anterior Knee Pain Scale. Ethical approval was  
21 gained from a University of Plymouth Ethics Committee.

## 22 **Results**

23 Half (49.5%; n=198) of respondents were classified as experiencing anxiety and 20.8%  
24 (n=83) as experiencing depression. The levels of anxiety and depression identified in  
25 this study are higher than those found in the general population (5.9-7.8% and 3.3-7.8%  
26 respectively). This mirrors results which have been reported in other studies into PFP in  
27 different settings and with other musculoskeletal conditions, such as osteoarthritis and  
28 contracted shoulder.

## 29 **Conclusions**

30 Anxiety and depression are more common in people living with PFP than in the general  
31 population. These findings support the need for greater research into the effects of  
32 psychological factors, such as anxiety and depression, in PFP. A key area of future  
33 research will be to determine whether these psychological factors affect treatment  
34 outcomes in people living with PFP.

## 35 **Implications**

This is the first study to investigate the prevalence of anxiety and depression in people  
living with patellofemoral pain in the UK. This study shows that anxiety and depression  
are very common in people living with patellofemoral pain. The need for further work  
into the effects of psychological factors in patellofemoral pain is indicated.

## 36 **Keywords**

37 **Patellofemoral; Knee; Anxiety; Depression; Prevalence; Mental Health**

38

## **Introduction**

39 Patellofemoral pain (PFP) is a common knee condition (1) generally affecting younger  
40 and more active people (2). It is characterised by pain around or behind the patella  
41 aggravated by weight bearing activity with the knee in a flexed position (3). It has  
42 traditionally been viewed as a self-limiting condition, however more recent research has  
43 shown that over 40% of those receiving treatment for PFP will still have symptoms after  
44 a year (4) with one in four reporting ongoing pain after 20 years (5). The impact of living  
45 with PFP is becoming clear, affecting activity levels (6), social participation (7,8) and  
46 Health related Quality of Life (8). Historically, research has focussed on the anatomical  
47 and biomechanical causes of PFP (9–11), however this is starting to change. Recently  
48 best practice guidelines have been published (12,13) which provide guidance as to the  
49 optimal management of PFP. Despite this PFP remains a complex and challenging  
50 condition to treat (14,15) and many people still continue to experience symptoms even  
51 with optimal management (4).

52 In other musculoskeletal conditions it has been shown that anxiety and depression are  
53 more common in these populations than the general population, with figures ranging  
54 from 16-30% in those living with musculoskeletal conditions (16–18) compared with 3.3-  
55 7.8% in the general UK population (19). This has led to further work to investigate the  
56 effects of psychological changes on the management and treatment of these conditions  
57 (20–22). It has been shown that increased levels of anxiety and depression are  
58 associated with greater persistence of the condition (22), increased acute pain (21),  
59 slower recovery (20) and greater risk of re-occurrence (23). Despite this there has been  
60 little work to investigate anxiety and depression in PFP (24).

61 A recent systematic review of psychological features in PFP (24) identified few studies  
62 investigating the prevalence of anxiety and depression with more extensive literature on  
63 the effects of kinesiophobia and catastrophizing behaviour. Those studies which do  
64 exist reporting anxiety and depression were generally conducted with small sample  
65 sizes and using a variety of disparate outcome measures (24). This limited the ability to  
66 perform any meta-analyses to identify the true picture of anxiety and depression in PFP  
67 with only a single study (25) reporting clear prevalence figures for anxiety and  
68 depression. Domenech et al (25) investigated the prevalence of anxiety and depression  
69 in Spanish tertiary care PFP patients. This study reported the prevalence of anxiety  
70 (30%) and depression (16%) in 97 consecutive patients attending an orthopaedic clinic.  
71 However, this is not representative of the majority of PFP patients in the UK who are  
72 managed in a primary care setting. Attendance at an orthopaedic clinic would suggest  
73 increased severity and chronicity of the condition and, as such, these results cannot be  
74 considered representative of the general PFP population. To the best of our knowledge,  
75 there had been no UK based studies investigating anxiety and depression in people  
76 living with PFP.

77 The aim of this study was to identify the prevalence of anxiety and depression in people  
78 living with PFP in the UK and whether there are any links between the severity of PFP  
79 and anxiety and depression.

80

81

## **METHOD**

82 **Study Design**

83 A cross-sectional online study design was used to gain a snap-shot of the prevalence of  
84 anxiety and depression in people living with PFP in the UK population. An online  
85 approach, using Bristol Online Surveys (now Online Surveys), was used to reach a  
86 wide-ranging and diverse population which may not have been available from a more  
87 traditional outpatient centred recruitment strategy. The study was opened on 01<sup>st</sup> March  
88 2017 and closed on 09<sup>th</sup> May 2017 as the required sample size had been achieved.  
89 Participants were provided with a detailed information sheet and could withdraw at any  
90 time during or up until two weeks after completion of the survey. Ethical approval was  
91 gained from University of Plymouth Faculty of Health & Human Sciences, Schools of  
92 Medicine and Dentistry Research Ethics Committee (Reference 16/17-257)

93

#### 94 **Participants**

95 A sample size of 330 was calculated, using Raosoft Sample Size calculator, based on  
96 an estimated UK population of 675,000 people living with PFP in our age range [based  
97 upon a minimum 3% prevalence (3,26), the UK population aged 15-44 (27)] and a  
98 prevalence of anxiety and depression of 30% based on the figures found by Domenech  
99 in PFP and reported in other conditions (16–18,25). The higher figure of 30% was  
100 chosen based on the figures for anxiety (25) to reduce the risk of underpowering the  
101 study. As there is no pre-existing sampling frame participants were recruited from a variety  
102 of online sources (Facebook, Twitter, Forums, Special Interest groups, such as parkrun)  
103 who identified as having PFP based on accepted criteria (3). Recruitment was capped  
104 at 400 completed surveys. Whilst this allowed for the potential of over recruitment, this  
105 enabled people who had begun completing the survey the opportunity to complete it

106 once the calculated sample size was completed and to allow for any withdrawals  
107 following the closing of recruitment. Eligibility criteria were i) adults aged between 18  
108 and 44, ii) self-reported symptoms of PFP of pain when loading the knee in a flexed  
109 position, such as running, jumping, squatting, hopping (3) iii) resident in the UK.  
110 Exclusion criteria were previous history of patella dislocation or previous surgery to  
111 affected knee (3).

### 112 **Outcome measures**

113 A questionnaire was developed to address our research question. The data collected is  
114 summarised in Table 1.

115

### 116 **Statistical analysis**

117 Data was analysed with IBM SPSS Statistics (version 23.0). The sociodemographic  
118 characteristics of the respondents are reported as percentages and numbers.  
119 Prevalence of anxiety and depression were calculated as percentages of total sample.  
120 Independent samples t-tests were used to compare continuous variables such as age  
121 and HADS and AKPS scores. Chi-squared tests was used to compare categorical  
122 variables such as gender, previous history of anxiety and depression and duration of  
123 symptoms (categorical as grouped) with current HADS and AKPS scores. Correlation  
124 between severity of PFP symptoms (NRS and AKPS) and severity of anxiety and  
125 depression was assessed using Pearsons correlation co-efficient. Tests for normality  
126 were not run as the sample size was in excess of that required for Central Limit

127 Theorem assumptions of normality (28). Levels of statistical significance were set at  
128  $p < 0.05$ .

## 129 **RESULTS**

130 The survey was accessed 2,386 times, with 1,894 not progressing beyond the consent  
131 page and 162 people being excluded as they did not meet the inclusion criteria. The  
132 demographics of the participants are summarised in table 2, as those excluded did not  
133 complete the demographic information this is not available. Scores for the HADS-A,  
134 HADS-D, AKPS and NRS are presented in table 3.

135

### 136 **Prevalence of anxiety and depression**

137 Almost half (49.5%;  $n = 198$ ) of respondents scored  $\geq 8$  on the HADS-A (29) indicating  
138 the presence of anxiety. One in five respondents (20.8%;  $n = 83$ ) scored  $\geq 8$  (29) on the  
139 HADS-D indicating depressive symptoms. When combined this showed that 53% ( $n =$   
140 215) of respondents were living with anxiety and/or depression.

### 141 **Age**

142 Respondents with a HADS-A score suggesting anxiety were shown to be younger than  
143 those who were not (mean age = 33.55 v 35.3) following an independent samples t-test  
144 ( $p = 0.015$ ). In those with scores suggesting depressive symptoms no significant  
145 difference was identified (mean age = 34.55 v 34.4;  $p = 0.86$ ) (Table 4).

146

### 147 **Gender**



148 A chi-squared test for independence (with Yates' Continuity Correction) indicated a  
149 significant association between gender and anxiety ( $p = 0.001$ ). Adjusted residual  
150 scores (4.6) indicated a greater than expected number of females with anxiety. No  
151 significant association was seen between depressive symptoms and gender ( $p = 0.628$ ).

### 152 **History of anxiety and depression**

153 A significant association between a previous diagnosis of anxiety and/or depression and  
154 a current score indicating anxiety or depressive symptoms was found using chi-  
155 squared. This was found to be stronger for anxiety ( $\phi = -0.33$ ;  $p = 0.001$ ) than  
156 depression ( $\phi = -0.22$ ;  $p = 0.001$ ).

### 157 **Association with knee symptoms**

158 A significant association between AKPS score and both anxiety and depressive  
159 symptoms was identified using an independent samples t-test (Table 4). Pearson  
160 product-moment correlations showed a small negative correlation between lower scores  
161 on the AKPS and higher levels of anxiety ( $r = -0.15$ ;  $p < 0.001$ ), and a small to medium  
162 negative correlation between lower AKPS and higher levels of depressive symptoms ( $r$   
163  $= -0.26$ ;  $p < 0.001$ ).

164 No significant association was identified between the NRS scores and either anxiety  
165 and depressive symptoms.

### 166 **Duration of Symptoms**

167 A chi-squared test identified no significant association between the duration of PFP and  
168 the presence of anxiety ( $p = 0.73$ ) or depressive symptoms ( $p = 0.39$ ).

169

170

## **DISCUSSION**

171 Until recently the role of psychological factors in PFP has received little attention. The  
172 recent publication of a systematic review (24), has emphasised the paucity of evidence  
173 in this area. The current study has suggested that over half of people living with PFP  
174 are experiencing anxiety and/or depressive symptoms. There seems to be a small  
175 correlation between increased severity of PFP symptoms (AKPS) and increased levels  
176 of anxiety and depressive symptoms. This is more marked with depressive symptoms.  
177 To the best of our knowledge this is the first study to investigate the prevalence of  
178 anxiety and depression in people living with PFP in the UK population.

179

### *Anxiety and depression prevalence in PFP*

181 The levels of anxiety and depressive symptoms shown in this study are much higher  
182 than those found in the general population (anxiety: 49.5% v 5.9-7.8%; depressive  
183 symptoms 20.8 v 3.3-7.8% (19)). Whilst some caution must be exercised with these  
184 figures due to the potential for the HADS to overestimate anxiety and depression (30),  
185 and the broad inclusion criteria of the study, this suggests a significant proportion of the  
186 study population are experiencing anxiety and depression in addition to the known  
187 physical effects of PFP.

188 Despite these concerns, the results echo those reported in other studies. Domenech et  
189 al (25) identified similar rates of anxiety (30%) and depression (16%) in people with

190 PFP (n=97) in a tertiary setting. They also reported similar mean scores for HADS-A  
191 (7.9) and HADS-D (5.3). Direct comparisons with this study should be made with  
192 caution as it is not clear as to the threshold used to identify anxiety and depression.  
193 Axford et al. (18) suggested a rate of depression in excess of 40% in osteoarthritis,  
194 however this has recently been superseded by the systematic review by Stubbs et al.  
195 (16), which suggested figures of around 20% may be more accurate for both anxiety  
196 and depression in osteoarthritis. Similar figures have also been reported in contracted  
197 shoulder (17) and low back pain (31). This suggests that the findings in this study are  
198 realistic, despite concerns regarding the accuracy of the HADS as a measurement tool.  
199 The growing evidence from these studies suggest that higher levels of anxiety and  
200 depression are found across a number of MSK conditions.

201 The figures for anxiety in this study suggest a high prevalence in people living with PFP.  
202 However, this must be viewed in the context of the study population. The study  
203 population was predominately female (67.6%) and relatively young (mean age 34.4).  
204 Previous studies have shown that anxiety is more common in younger women than in  
205 the general population (32). It must be considered whether the results found reflect the  
206 demographics of the study. Whilst there was a significant difference in the prevalence of  
207 anxiety between men and women, this alone does not explain the prevalence of anxiety  
208 in this study.

#### 209 *Relationship between symptom severity and anxiety and depression*

210 The results of this study identified a correlation between greater severity of PFP  
211 symptoms (as measured on the AKPS) and higher scores recorded on the two elements

212 of the HADS. The magnitude of correlation was small for anxiety ( $r = -0.15$ ;  $p < 0.001$ )  
213 and small to medium for depressive symptoms ( $r = -0.26$ ;  $p < 0.001$ ). However the large  
214 numbers involved in this study suggest that this statistical significance may be due to  
215 the sample size (33). When we consider the strength of the relationship between the  
216 two sets of variables ( $-0.15$  and  $-0.26$ ), and the co-efficient of determination (2.25% and  
217 6.76% respectively), the low levels of these figures suggest that there is only a weak  
218 influence of the level of PFP symptoms on the level of anxiety and depressive  
219 symptoms (33). When the figures are examined the mean difference in AKPS between  
220 those with and without anxiety and depressive symptoms (Table 4), whilst statistically  
221 significant, fall well below the minimal clinically important difference for the AKPS (34).

222 Domenech et al. (25) reported correlations of  $-0.61$  and  $0.57$  for depression and anxiety  
223 (measured with the HADS) with the Lysholm score. Piva et al (35) reported a correlation  
224 of  $-0.45$  between the KOS-ADLS and Beck Anxiety Index. This reinforces the concerns  
225 raised by Maclachlan et al. (24) regarding the heterogeneity of outcome measures used  
226 in PFP research. It could be argued that had the current study taken a different  
227 approach to data analysis, such as a binary approach to anxiety and depression, then a  
228 stronger relationship may have been found between these factors, as suggested by  
229 previous studies.

230 Irrespective of the magnitude of the relationships identified by Piva et al. (36),  
231 Domenech et al. (25) and the current study, all agree that there is a relationship  
232 between severity of PFP symptoms and anxiety and depression. A previous meta-  
233 analysis investigating chronic pain has suggested that increased levels of depression  
234 are associated with the duration of symptoms, severity of symptoms and number of

235 joints affected (37). Interestingly this current study has suggested that neither the  
236 duration of symptoms nor level of pain (measured by NRS) affect the levels of anxiety  
237 and depression in PFP. This may reflect the nature of the population targeted in this  
238 study. Previous studies have concentrated on people attending a variety of secondary  
239 and tertiary healthcare settings, whereas this study has recruited people whether they  
240 were receiving formal treatment or not. PFP is not considered to be a degenerative  
241 condition, with many people having symptoms over a long time period (4,5). This may  
242 suggest that some of the respondents included in this study with long term symptoms  
243 have been managing their condition well, with pain at a low level.

#### 244 **Future Research**

245 Further research would be beneficial to identify the effects, if any, of anxiety and  
246 depression on treatment outcomes in PFP. Should this show that anxiety and  
247 depression does have a negative impact on treatment outcomes then further studies  
248 investigating the treatment of anxiety and depression in PFP would be warranted.

249 Whilst this study has shown that there are high levels of anxiety and depression evident  
250 in people living with PFP we are unable to draw any inferences as to why this is. Further  
251 qualitative work could identify any common themes about what contributes to the  
252 development of anxiety and depression. This could then be progressed to investigate  
253 whether there is a causative relationship between PFP and anxiety and depression and  
254 in which direction it exists.

#### 255 **Strengths and Limitations**

256 This study benefits from the fact we were able to over-recruit (target 330, actual 400)  
257 ensuring that we were able to adequately power all the calculations for the statistical  
258 analysis. Underpowered studies are more prone to both type I and type II errors (38)  
259 with the risk of both false positive results and 'true' results not reaching statistical  
260 significance. This is a weakness seen in many studies across all fields (39). The  
261 number of respondents in this study was larger than any previous study looking at  
262 mental health in PFP (24,25).

263 The study also benefitted from using robust outcome measures (AKPS, HADS and  
264 NRS) to determine our primary outcomes (PFP severity and anxiety and depression)  
265 with good reliability and validity. These measures have been identified as the most  
266 commonly used outcome tools in PFP (24), meaning that the results of this study can be  
267 easily incorporated into any future meta-analyses.

268 There were a number of clear limitations identified within this study. Foremost among  
269 these was the lack of clinical diagnosis for PFP amongst the respondents. Clinical  
270 assessment by an experienced clinician is considered the gold standard for diagnosis of  
271 PFP (3,12). This was not a practical option for this study due to its online nature.  
272 Instead, the criteria developed by Crossley et al. (2016) were used to classify someone  
273 as living with PFP. This raises the likelihood that other knee conditions were included in  
274 this study. The use of established inclusion and exclusion criteria should have mitigated  
275 this risk.

276 The online nature of the study also contributed to another significant weakness within  
277 the study design. Anxiety and depression are complex, multifactorial conditions unlikely  
278 to be directly attributable to a single cause (40,41). Recent studies have also shown that

279 PFP is highly associated with multi-site musculoskeletal pain (42). As we were unable to  
280 collect extensive medical history for each participant we are unable to account for the  
281 effects of other musculoskeletal or chronic health conditions in this study. This limits our  
282 ability to truly say that PFP is associated with higher levels of anxiety and depression.  
283 This is shown by the high number of respondents identifying as having a history of  
284 anxiety or depression.

285 Another limitation identified in this study is the risk of self-selection bias. Since our  
286 respondents were able to choose whether to participate in the study, it is not possible to  
287 say that this was a representative sample of the population as a whole (43). It is well  
288 established that ethnic minorities are generally under-represented in research  
289 participation (44) and that educated white females are disproportionately represented in  
290 research studies (45). This is shown in this study with an over-representation of those  
291 identifying as white (94.8%; n= 379) compared with that expected from the latest Office  
292 for National Statistics figures (86%) (46). Whilst this is a common finding across many  
293 fields of research, it raises the question about what information may be being missed in  
294 these groups. This is an area which would benefit from greater attention in future  
295 research in order to ensure a wider, and more representative, study population.

## 296 **CONCLUSION**

297 Anxiety and depression in people living with PFP is more common than in the general  
298 UK population. In this study almost half of people meeting the inclusion criteria for PFP  
299 had a score on the HADS-A indicating anxiety and one in five were identified as  
300 experiencing depressive symptoms on the HADS-D. To the best of our knowledge this

301 is the first study to investigate the prevalence of anxiety and depression of people living  
302 with PFP in the general population rather than those who are engaged in healthcare  
303 services. This study cannot draw any causal links between anxiety and depression and  
304 PFP, but it does highlight the strong association between the two conditions. The results  
305 of this study add further strength to the need for additional work into the effects of  
306 mental well-being in PFP. This is an area which has previously received little attention.

307



308 **Research Funding:** This research did not receive any specific grant from funding  
309 agencies in the public, commercial, or not-for-profit sectors. JW is funded by the NIHR  
310 as part of the NIHR Clinical Academic Pathway.

311 **Conflict of Interest declaration:** None declared

312 **Informed Consent:** Informed consent has been obtained from all individuals included in  
313 this study.

314 **Ethical Approval:** Ethical approval was gained from University of Plymouth Faculty of  
315 Health & Human Sciences, Schools of Medicine and Dentistry Research Ethics  
316 Committee (Reference 16/17-257)

317

<i>Demographics</i>	<ul style="list-style-type: none"> <li>• Age</li> <li>• Gender</li> <li>• Educational level,</li> <li>• Employment status</li> <li>• Ethnicity.</li> </ul>
<i>History</i>	<ul style="list-style-type: none"> <li>• Duration of knee pain symptoms.</li> <li>• Any previous treatment for this.</li> <li>• Previous diagnosis of either anxiety and/or depression</li> <li>• Any current treatment for anxiety and/or depression</li> </ul>
<i>Anxiety and Depression</i>	<ul style="list-style-type: none"> <li>• Hospital Anxiety and Depression Scale (HADS) (47)</li> <li>• This scale gives scores for both anxiety (HADS-A) and depression (HADS-D) with a maximum score of 21 on each scale.</li> <li>• A cut-off point of <math>\geq 8</math> was chosen for each scale (29) .</li> <li>• Shown to have the greatest sensitivity for case detection (48).</li> <li>• The HADS has been shown to be valid and reliable for use in primary care, community and musculoskeletal populations (29,30,49,50).</li> </ul>
<i>Knee symptoms</i>	<ul style="list-style-type: none"> <li>• Two measures used to assess severity of PFP symptoms.</li> <li>• A numerical rating scale (NRS) for pain over the previous 24 hours was used to assess current pain.</li> <li>• Shown to be valid and reliable in both general musculoskeletal conditions (51) and PFP (34).</li> <li>• Anterior Knee Pain Scale (AKPS) (52) was used to assess level of function.</li> <li>• Shown to be both valid and reliable in PFP patients (53) and requires little guidance in completion (54).</li> </ul>

			n
Age, mean (SD)	34.4	(7.18)	400
Gender - female, n (%)	268	(67.3)	397
Ethnicity, n (%)			
White	379	(94.8)	
Asian or Asian British	9	(2.3)	
Black or Black British	3	(0.8)	398
Mixed / Multiple ethnic groups	5	(1.3)	
Other ethnic background	2	(0.5)	
Education, n (%)			
GCSE / O Level	26	(6.5)	
AS Level	5	(1.3)	
A Level	36	(9.0)	
NVQ or other vocational	39	(9.8)	398
First Degree (including foundation degree)	177	(44.3)	
University Higher Degree (Msc or PhD)	111	(27.8)	
None of the above	4	(1.0)	
Employment Status, n (%)			
Employed / Self employed	352	(88.0)	
Unemployed	7	(1.8)	
Looking after home/ family	13	(3.3)	399
Student / Full time education	25	(6.3)	
Unable to work	2	(0.5)	
Pain Duration, n (%)			
<3 Months	55	(13.8)	
3-6 months	54	(13.5)	
6-12 months	42	(10.5)	
12-18 months	40	(10)	400
18-24 months	27	(6.8)	
2-5 years	84	(21.0)	
>5 years	98	(24.5)	
Affected Knee, n (%)			
Right	111	(27.8)	
Left	126	(31.5)	400
Both	163	(40.8)	
Previous treatment for PFP - Yes, n (%)	187	(46.8)	400
Previous Diagnosis of anxiety or depression - Yes, n (%)	136	(34.8)	400
Receiving Treatment for anxiety or depression - Yes, n (%)	45	(11.3)	400

321 *Table 3: Mean values of key outcome measure for study participants. (SD = Standard deviation)*

Outcome Measure	Mean	SD
Numerical Rating Scale - Pain 0-10,	3.45	(2.2)
Hospital Anxiety and Depression Scale – Anxiety 0-21,	7.75	(4.2)
Hospital Anxiety and Depression Scale - Depression 0-21,)	4.65	(3.5)
Anterior Knee Pain Scale 0-100,	76.7	(10.4)

322

323

324 Table 4: Associations between anxiety and depression and key outcome measures. (NRS = Numerical Rating Scale;  
 325 AKPS = Anterior Knee Pain Scale)

Variable	Depression			Anxiety		
	<8	≥8		<8	≥8	
	(n=317)	(n = 83)	<i>p</i>	(n= 202)	(n = 198)	<i>p</i>
<b>Age</b>	34.40 (7.15)	34.55 (7.35)	0.86	35.30 (7.13)	33.55 (7.14)	0.015
<b>NRS</b>	3.45 (2.18)	3.45 (2.35)	0.994	3.32 (2.23)	3.58 (2.19)	0.25
<b>AKPS</b>	77.61 (10.23)	73.24 (10.15)	0.001	78.37 (9.96)	75 (10.49)	0.001

326

327 **References**

328

- 329 1. van Middelkoop M, van Linschoten R, Berger MY, Koes BW, Bierma-  
330 Zeinstra SM. Knee complaints seen in general practice: active sport  
331 participants versus non-sport participants. *BMC Musculoskelet Disord*  
332 [Internet]. 2008 Dec 19;9(1):36. Available from:  
333 [http://bmcmusculoskeletdisord.biomedcentral.com/articles/10.1186/14](http://bmcmusculoskeletdisord.biomedcentral.com/articles/10.1186/1471-2474-9-36)  
334 [71-2474-9-36](http://bmcmusculoskeletdisord.biomedcentral.com/articles/10.1186/1471-2474-9-36)
- 335 2. Rathleff MS, Roos EM, Olesen JL, Rasmussen S. Early intervention  
336 for adolescents with patellofemoral pain syndrome--a pragmatic  
337 cluster randomised controlled trial. *BMC Musculoskelet Disord*.  
338 2012;13:9.
- 339 3. Crossley KM, Stefanik JJ, Selfe J, Collins NJ, Davis IS, Powers CM,  
340 McConnell J, Vicenzino B, Bazett-Jones DM, Esculier J-F, Morrissey  
341 D, Callaghan MJ. 2016 Patellofemoral pain consensus statement from  
342 the 4th International Patellofemoral Pain Research Retreat,  
343 Manchester. Part 1: Terminology, definitions, clinical examination,  
344 natural history, patellofemoral osteoarthritis and patient-reported  
345 outcome. *Br J Sports Med* [Internet]. 2016 Jul;50(14):839–43.  
346 Available from: [http://bjsm.bmj.com/lookup/doi/10.1136/bjsports-2016-](http://bjsm.bmj.com/lookup/doi/10.1136/bjsports-2016-096384)  
347 [096384](http://bjsm.bmj.com/lookup/doi/10.1136/bjsports-2016-096384)
- 348 4. Collins NJ, Bierma-Zeinstra SMA, Crossley KM, van Linschoten RL,  
349 Vicenzino B, van Middelkoop M. Prognostic factors for patellofemoral  
350 pain: a multicentre observational analysis. *Br J Sports Med* [Internet].  
351 2013 Mar;47(4):227–33. Available from:

- 352 <http://bjsm.bmj.com/lookup/doi/10.1136/bjsports-2012-091696>
- 353 5. Nimon G, Murray D, Sandow M, Goodfellow J. Natural history of  
354 anterior knee pain: a 14- to 20-year follow-up of nonoperative  
355 management. *J Pediatr Orthop* [Internet]. 1998 Jan 1;18(1):118–22.  
356 Available from:  
357 [http://content.wkhealth.com/linkback/openurl?sid=WKPTLP:landingpa  
358 ge&an=00004694-199801000-00021](http://content.wkhealth.com/linkback/openurl?sid=WKPTLP:landingpage&an=00004694-199801000-00021)
- 359 6. Glaviano NR, Baellow A, Saliba S, Al. E, Tatman M, Olesen JL.  
360 Physical activity levels in individuals with and without patellofemoral  
361 pain. *Phys Ther Sport* [Internet]. 2017;25(0):2432–9. Available from:  
362 <http://linkinghub.elsevier.com/retrieve/pii/S1466853X17301530>
- 363 7. Smith BE, Moffatt F, Hendrick P, Bateman M, Rathleff MS, Selfe J,  
364 Smith TO, Logan P. The experience of living with patellofemoral  
365 pain—loss, confusion and fear-avoidance: a UK qualitative study. *BMJ  
366 Open* [Internet]. 2018;8(1):e018624. Available from:  
367 <http://bmjopen.bmj.com/lookup/doi/10.1136/bmjopen-2017-018624>
- 368 8. Coburn SL, Barton CJ, Filbay SR, Hart HF, Rathleff MS, Crossley KM.  
369 Quality of life in individuals with patellofemoral pain: A systematic  
370 review including meta-analysis. *Phys Ther Sport* [Internet].  
371 2018;33(2018):96–108. Available from:  
372 <https://doi.org/10.1016/j.ptsp.2018.06.006>
- 373 9. Myer GD, Ford KR, Barber Foss KD, Goodman A, Ceasar A, Rauh  
374 MJ, Divine JG, Hewett TE. The incidence and potential  
375 pathomechanics of patellofemoral pain in female athletes. *Clin  
376 Biomech*. 2010;25(7):700–7.

- 377 10. Powers CM, Bolgia L a, Callaghan MJ, Collins N, Sheehan FT.  
378 Patellofemoral pain: proximal, distal, and local factors, 2nd  
379 International Research Retreat. J Orthop Sports Phys Ther [Internet].  
380 2012;42(6):A1-54. Available from:  
381 <http://www.ncbi.nlm.nih.gov/pubmed/22660660>
- 382 11. Noehren B, Scholz J, Davis I. The effect of real-time gait retraining on  
383 hip kinematics, pain and function in subjects with patellofemoral pain  
384 syndrome. Br J Sports Med [Internet]. 2011 Jul 1;45(9):691–6.  
385 Available from: <http://www.ncbi.nlm.nih.gov/pubmed/20584755>
- 386 12. Barton CJ, Lack S, Hemmings S, Tufail S, Morrissey D. The ‘Best  
387 Practice Guide to Conservative Management of Patellofemoral Pain’:  
388 incorporating level 1 evidence with expert clinical reasoning. Br J  
389 Sports Med [Internet]. 2015 Jul;49(14):923–34. Available from:  
390 <http://bjsm.bmj.com/lookup/doi/10.1136/bjsports-2014-093637>
- 391 13. Lack S, Neal B, De Oliveira Silva D, Barton CJ. How to manage  
392 patellofemoral pain – Understanding the multifactorial nature and  
393 treatment options. Phys Ther Sport [Internet]. 2018;32:155–66.  
394 Available from: <https://doi.org/10.1016/j.ptsp.2018.04.010>
- 395 14. Smith BE, Hendrick P, Bateman M, Moffatt F, Rathleff MS, Selfe J,  
396 Smith TO, Logan P. Current management strategies for patellofemoral  
397 pain: an online survey of 99 practising UK physiotherapists. BMC  
398 Musculoskelet Disord [Internet]. 2017 Dec 8;18(1):181. Available from:  
399 [http://bmcmusculoskeletdisord.biomedcentral.com/articles/10.1186/s1](http://bmcmusculoskeletdisord.biomedcentral.com/articles/10.1186/s12891-017-1539-8)  
400 [2891-017-1539-8](http://bmcmusculoskeletdisord.biomedcentral.com/articles/10.1186/s12891-017-1539-8)
- 401 15. Papadopoulos KD, Noyes J, Barnes M, Jones JG, Thom JM. How do



- 402 physiotherapists assess and treat patellofemoral pain syndrome in  
403 North Wales? A mixed method study. *Int J Ther Rehabil*.  
404 2012;19(5):261–72.
- 405 16. Stubbs B, Aluko Y, Myint PK, Smith TO. Prevalence of depressive  
406 symptoms and anxiety in osteoarthritis: A systematic review and  
407 meta-analysis. *Age Ageing*. 2016;45(2):228–35.
- 408 17. Ding H, Tang Y, Xue Y, Yang Z, Li Z, He D, Zhao Y, Zong Y. A report  
409 on the prevalence of depression and anxiety in patients with frozen  
410 shoulder and their relations to disease status. *Psychol Health Med*.  
411 2014;19(6):730–7.
- 412 18. Axford J, Butt A, Heron C, Hammond J, Morgan J, Alavi A, Bolton J,  
413 Bland M. Prevalence of anxiety and depression in osteoarthritis: use  
414 of the Hospital Anxiety and Depression Scale as a screening tool. *Clin*  
415 *Rheumatol*. 2010;29(11):1277–83.
- 416 19. McManus S, P B, Jenkins R, Brugha T. Mental health and well-being  
417 in England: Adult Psychiatric Morbidity Survey 2014. Leeds; 2016.
- 418 20. Melloh M, Elfering A, Käser A, Salathé CR, Barz T, Aghayev E, Röder  
419 C, Theis J-C. Depression Impacts the Course of Recovery in Patients  
420 with Acute Low-Back Pain. *Behav Med [Internet]*. 2013 Jul;39(3):80–9.  
421 Available from: <http://www.ncbi.nlm.nih.gov/pubmed/23930900>
- 422 21. Elfering A, Käser A, Melloh M. Relationship between depressive  
423 symptoms and acute low back pain at first medical consultation, three  
424 and six weeks of primary care. *Psychol Health Med [Internet]*. 2014  
425 Mar 4;19(2):235–46. Available from:  
426 <http://www.tandfonline.com/doi/abs/10.1080/13548506.2013.780131>

- 427 22. Rathbun AM, Stuart EA, Shardell M, Yau MS, Baumgarten M,  
428 Hochberg MC. Dynamic Effects of Depressive Symptoms on  
429 Osteoarthritis Knee Pain. *Arthritis Care Res (Hoboken)* [Internet].  
430 2017 Mar;11(5):475–6. Available from:  
431 <http://doi.wiley.com/10.1002/acr.23239>
- 432 23. Pinheiro MB, Ferreira ML, Refshauge K, Ordoñana JR, Machado GC,  
433 Prado LR, Maher CG, Ferreira PH. Symptoms of Depression and Risk  
434 of New Episodes of Low Back Pain: A Systematic Review and Meta-  
435 Analysis. *Arthritis Care Res (Hoboken)* [Internet]. 2015;67(11):1591–  
436 603. Available from: <http://doi.wiley.com/10.1002/acr.22619>
- 437 24. Maclachlan LR, Collins NJ, Matthews MLG, Hodges PW, Vicenzino B.  
438 The psychological features of patellofemoral pain: a systematic  
439 review. *Br J Sports Med* [Internet]. 2017;51(9):732–42. Available from:  
440 <http://bjsm.bmj.com/lookup/doi/10.1136/bjsports-2016-096705>
- 441 25. Domenech J, Sanchis-Alfonso V, López L, Espejo B. Influence of  
442 kinesiophobia and catastrophizing on pain and disability in anterior  
443 knee pain patients. *Knee Surgery, Sport Traumatol Arthrosc* [Internet].  
444 2013 Jul 19;21(7):1562–8. Available from:  
445 <http://link.springer.com/10.1007/s00167-012-2238-5>
- 446 26. Lack S, Barton CJ, Sohan O, Crossley K, Morrissey D. Proximal  
447 muscle rehabilitation is effective for patellofemoral pain: a systematic  
448 review with meta-analysis. *Br J Sports Med* [Internet]. 2015  
449 Nov;49(21):1365–76. Available from: <http://dx.doi.org/10.1136/>
- 450 27. Office for National Statistics. Population Estimates for UK, England  
451 and Wales, Scotland and Northern Ireland, Mid 2015 [Internet]. 2016

- 452 [cited 2016 Oct 10]. p. 1–9. Available from:  
453 [http://www.ons.gov.uk/ons/rel/pop-estimate/population-estimates-for-](http://www.ons.gov.uk/ons/rel/pop-estimate/population-estimates-for-uk--england-and-wales--scotland-and-northern-ireland/mid-2014/index.html)  
454 [uk--england-and-wales--scotland-and-northern-ireland/mid-](http://www.ons.gov.uk/ons/rel/pop-estimate/population-estimates-for-uk--england-and-wales--scotland-and-northern-ireland/mid-2014/index.html)  
455 [2014/index.html](http://www.ons.gov.uk/ons/rel/pop-estimate/population-estimates-for-uk--england-and-wales--scotland-and-northern-ireland/mid-2014/index.html)
- 456 28. Daniel WW, Cross CL. Biostatistics. Basic Concepts and Methodology  
457 for the Health Sciences. 10th ed. John Wiley & Sons; 2013. 960 p.
- 458 29. Covic T, Cumming SR, Pallant JF, Manolios N, Emery P, Conaghan  
459 PG, Tennant A. Depression and anxiety in patients with rheumatoid  
460 arthritis: prevalence rates based on a comparison of the Depression,  
461 Anxiety and Stress Scale (DASS) and the hospital, Anxiety and  
462 Depression Scale (HADS). BMC Psychiatry [Internet]. 2012;12(1):6.  
463 Available from:  
464 [http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3285517&](http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3285517&tool=pmcentrez&rendertype=abstract)  
465 [ool=pmcentrez&rendertype=abstract](http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3285517&tool=pmcentrez&rendertype=abstract)
- 466 30. Cameron IM, Cardy A, Crawford JR, du Toit SW, Hay S, Lawton K,  
467 Mitchell K, Sharma S, Shivaprasad S, Winning S, Reid IC. Measuring  
468 depression severity in general practice: discriminatory performance of  
469 the PHQ-9, HADS-D, and BDI-II. Br J Gen Pract [Internet]. 2011 Jul  
470 1;61(588):419–26. Available from:  
471 <http://bjgp.org/cgi/doi/10.3399/bjgp11X583209>
- 472 31. Currie SR, Wang J. Chronic back pain and major depression in the  
473 general Canadian population. Pain. 2004;107(1–2):54–60.
- 474 32. Remes O, Brayne C, van der Linde R, Lafortune L. A systematic  
475 review of reviews on the prevalence of anxiety disorders in adult  
476 populations. Brain Behav. 2016;6(7).

- 477 33. Pallant J. SPSS survival manual: a step by step guide to data analysis  
478 using SPSS. 6th ed. Step by step guide to data analysis using the  
479 SPSS program. Maidenhead: Open University Press; 2016.
- 480 34. Crossley KM, Bennell KL, Cowan SM, Green S. Analysis of outcome  
481 measures for persons with patellofemoral pain: Which are reliable and  
482 valid? Arch Phys Med Rehabil. 2004;85(5):815–22.
- 483 35. Piva SR, Fitzgerald GK, Irrgang JJ, Fritz JM, Wisniewski S, McGinty  
484 GT, Childs JD, Domenec MA, Jones S, Delitto A. Associates of  
485 Physical Function and Pain in Patients with Patellofemoral Pain  
486 Syndrome. Arch Phys Med Rehabil [Internet]. 2009 Feb 1 [cited 2016  
487 Oct 5];90(2):285–95. Available from:  
488 <http://linkinghub.elsevier.com/retrieve/pii/S0003999308016328>
- 489 36. Piva S, Fitzgerald G, Wisniewski S, Delitto A. Predictors of pain and  
490 function outcome after rehabilitation in patients with patellofemoral  
491 pain syndrome. J Rehabil Med. 2009;41(8):604–12.
- 492 37. Gandhi R, Zywił MG, Mahomed NN, Perruccio A V. Depression and  
493 the Overall Burden of Painful Joints: An Examination among  
494 Individuals Undergoing Hip and Knee Replacement for Osteoarthritis.  
495 Arthritis [Internet]. 2015;2015:1–6. Available from:  
496 <http://www.hindawi.com/journals/arthritis/2015/327161/>
- 497 38. Christley RM. Power and Error: Increased Risk of False Positive  
498 Results in Underpowered Studies. Open Epidemiol J [Internet]. 2010  
499 Feb 1;3(1):16–9. Available from:  
500 <http://benthamopen.com/ABSTRACT/TOEPIJ-3-16>
- 501 39. Turner RM, Bird SM, Higgins JPT. The Impact of Study Size on Meta-

- 502 analyses: Examination of Underpowered Studies in Cochrane  
503 Reviews. PLoS One [Internet]. 2013 Mar 27;8(3):e59202. Available  
504 from: <http://dx.plos.org/10.1371/journal.pone.0059202>
- 505 40. National Institute for Health and Clinical Excellence. Generalised  
506 anxiety disorder and panic disorder in adults: Management. Natl Inst  
507 Heal Clin Excell. 2011;(January):1–53.
- 508 41. National Institute for Health and Clinical Excellence. Depression in  
509 Adults: Recognition and Management Clinical Guideline: NICE  
510 Guideline [CG90]. Natl Collab Cent Ment Heal [Internet]. 2009;(April).  
511 Available from:  
512 [https://www.nice.org.uk/guidance/cg90/resources/depression-in-](https://www.nice.org.uk/guidance/cg90/resources/depression-in-adults-recognition-and-management-975742636741)  
513 [adults-recognition-and-management-975742636741](https://www.nice.org.uk/guidance/cg90/resources/depression-in-adults-recognition-and-management-975742636741)
- 514 42. Holden S, Rathleff MS, Roos EM, Jensen MB, Pourbordbari N,  
515 Graven-Nielsen T. Pain patterns during adolescence can be grouped  
516 into four pain classes with distinct profiles: A study on a population  
517 based cohort of 2953 adolescents. Eur J Pain [Internet]. 2017 Dec 27;  
518 Available from: <http://doi.wiley.com/10.1002/ejp.1165>
- 519 43. Bethlehem J. Selection Bias in Web Surveys. Int Stat Rev [Internet].  
520 2010 Jun 18;78(2):161–88. Available from:  
521 <http://dx.doi.org/10.1111/j.1751-5823.2010.00112.x>
- 522 44. Hood GA, Chowdhury TA, Griffiths CJ, Hood RKE, Mathews C,  
523 Hitman GA. The Mela Study: exploring barriers to diabetes research in  
524 black and minority ethnic groups. Prim Health Care Res Dev  
525 [Internet]. 2015;16(01):53–60. Available from:  
526 [http://www.journals.cambridge.org/abstract\\_S1463423614000061](http://www.journals.cambridge.org/abstract_S1463423614000061)

- 527 45. Van Lange PAM, Schippers M, Balliet D. Who volunteers in  
528 psychology experiments? An empirical review of prosocial motivation  
529 in volunteering. *Pers Individ Dif* [Internet]. 2011 Aug;51(3):279–84.  
530 Available from:  
531 <http://linkinghub.elsevier.com/retrieve/pii/S0191886910002850>
- 532 46. Office for National Statistics. Ethnicity and National Identity in England  
533 and Wales [Internet]. 2012 [cited 2016 Nov 14]. Available from:  
534 [http://www.ons.gov.uk/peoplepopulationandcommunity/culturalidentity/  
535 ethnicity/articles/ethnicityandnationalidentityinenglandandwales/2012-  
536 12-11](http://www.ons.gov.uk/peoplepopulationandcommunity/culturalidentity/ethnicity/articles/ethnicityandnationalidentityinenglandandwales/2012-12-11)
- 537 47. Zigmond AS, Snaith RP. The Hospital Anxiety and Depression Scale.  
538 *Acta Psychiatr Scand*. 1983 Jun;67(6):361–70.
- 539 48. Brennan C, Worrall-Davies A, McMillan D, Gilbody S, House A. The  
540 Hospital Anxiety and Depression Scale: A diagnostic meta-analysis of  
541 case-finding ability. *J Psychosom Res* [Internet]. 2010 Oct;69(4):371–  
542 8. Available from: <http://dx.doi.org/10.1016/j.jpsychores.2010.04.006>
- 543 49. Turk DC, Dworkin RH, Trudeau JJ, Benson C, Biondi DM, Katz NP,  
544 Kim M. Validation of the Hospital Anxiety and Depression Scale in  
545 Patients With Acute Low Back Pain. *J Pain*. 2015;16(10):1012–21.
- 546 50. Cameron IM, Crawford JR, Lawton K, Reid IC. Psychometric  
547 comparison of PHQ-9 and HADS for measuring depression severity in  
548 primary care. *Br J Gen Pract* [Internet]. 2008 Jan 1;58(546):32–6.  
549 Available from: <http://bjgp.org/cgi/doi/10.3399/bjgp08X263794>
- 550 51. Hawker GA, Mian S, Kendzerska T, French M. Measures of adult  
551 pain: Visual Analog Scale for Pain (VAS Pain), Numeric Rating Scale

552 for Pain (NRS Pain), McGill Pain Questionnaire (MPQ), Short-Form  
553 McGill Pain Questionnaire (SF-MPQ), Chronic Pain Grade Scale  
554 (CPGS), Short Form-36 Bodily Pain Scale (SF. Arthritis Care Res  
555 (Hoboken) [Internet]. 2011 Nov;63(S11):S240–52. Available from:  
556 <http://doi.wiley.com/10.1002/acr.20543>

557 52. Kujala UM, Jaakkola LH, Koskinen SK, Taimela S, Hurme M,  
558 Nelimarkka O. Scoring of patellofemoral disorders. *Arthrosc J*  
559 *Arthrosc Relat Surg* [Internet]. 1993;9(2):159–63. Available from:  
560 <http://linkinghub.elsevier.com/retrieve/pii/S0749806305803664>

561 53. Singer B, Singer K. Anterior Knee Pain Scale. *Aust J Physiother*  
562 [Internet]. 2009;55(2):140. Available from:  
563 <http://linkinghub.elsevier.com/retrieve/pii/S0004951409700480>

564 54. Bennell K, Bartam S, Crossley K, Green S. Outcome measures in  
565 patellofemoral pain syndrome: test retest reliability and inter-  
566 relationships. *Phys Ther Sport*. 2000 May;1(2):32–41.

567