**Title**: Therapeutic alliance appears to facilitate adherence to physiotherapy-led exercise and physical activity for older adults with knee pain: a longitudinal qualitative study

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**Abbreviated title**: Physiotherapy Led Intervention for Knee Pain

**Key words**: Physiotherapy; therapeutic alliance; osteoarthritis; knee; exercise; physical activity

**Word Count**: 250 words (Abstract)

3745 words with reviewers’ requested additions (Introduction, Method, Results, Discussion)

**References**: 49

**Tables**: 4 in text, 1 in eAddenda

**Figures**: 2

**Footnotes:** nil

**eAddenda:** 3

**Ethics approval:** The North West 1 Research Ethics Committee, Cheshire, UK (REC reference: 10/H1017/45) approved this study. All participants gave written informed consent before data collection began.

**Competing interests**: Nil

**Source(s) of support**: This is independent research funded by the National Institute for Health Research (RP-PG-0407-10386) and the Arthritis Research UK Centre in Primary Care grant (18139). The views expressed are those of the authors and not necessarily those of the NHS, the NIHR or the Department of Health. CJ is part-funded by Collaborations for Leadership in Applied Health Research and Care West Midlands. NF is an NIHR Senior Investigator and was supported through an NIHR Research Professorship (NIHR-RP-011-015)

**Acknowledgements**: We thank all the patients who participated in the interview study. We thank Dr Diane Roberts (DR) for her contribution to the BEEP pilot study interviews and for conducting early interviews for the main qualitative study linked to the BEEP trial. We thank the administrative staff and others who supported the qualitative research study within the BEEP trial from Keele Clinical Trials Unit including research programme support from Liz Mason. We thank Professor Peter Croft who led the NIHR programme grant within which the BEEP trial was funded and all the members of the TSC and DMC including the PPIE members.

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**ABSTRACT**

**Objectives:** To investigate patients’ experiences and impact of physiotherapist (physical therapist) led exercise interventions for knee pain attributable to osteoarthritis, and to explore barriers and facilitators to change in exercise and physical activity behaviour over time.

**Methods**: Face-to-face, semi-structured, longitudinal interviews were undertaken with older adults with knee pain randomised to one of three physiotherapist-led exercise intervention arms in the BEEP trial (Benefits of Effective Exercise for knee Pain); n=30 on intervention completion, n=22 12 months later. A ‘layered approach’ to thematic analysis included open coding (using constant comparison), deductive coding and within-case and cross-case longitudinal analysis of change.

**Results**: Different levels of exercise supervision, progression and individualisation emerged, matching the content of the intervention protocols. Barriers to exercise and general physical activity were similar across intervention arms (lack of motivation, time, physical environment, lack of supervision and/or monitoring). Despite individualising exercise programmes and specifically targeting exercise, some barriers to adherence remained at 12 months. Factors facilitating longer-term exercise adherence included change in or retained knowledge about the role of exercise for knee pain and the presence and quality of a therapeutic alliance which was also reflective of participants’ experience of the intervention regardless of trial arm.

**Conclusions:** Despite a focus on individualisation and exercise adherence, barriers remained in the longer-term. Strong therapeutic alliance during treatment appears to facilitate adherence to exercise and general physical activity. The findings highlight on-going physiotherapy support and therapeutic alliance as targets for future adherence enhancing interventions for exercise in older adults with knee pain.

**Keywords**: Physiotherapy; therapeutic alliance; osteoarthritis; knee; exercise; physical activity

**INTRODUCTION**

Musculoskeletal conditions, after mental health, are the leading cause of disability worldwide.1, 2 Osteoarthritis (OA) is associated with more limitations in activities of daily living among older people than any other disease.3 Exercise, including local muscle strengthening and general physical activity (general aerobic fitness), is recommended as a core treatment.4 Although there is evidence of small to moderate benefits from exercise and physical activity (PA) for knee OA, these decline over time, potentially explained by reduced adherence.5 Previous research has identified a wide array of factors which influence adherence to exercise and physical interventions for knee OA. These include individual’s physical capacity to exercise, previous exercise history, symptom relief and improvement, positive exercise experiences and beliefs, healthcare professionals’ and social support, expectations of improvement.6-12. Lack of motivation, pain and physical limitations, low self-efficacy, depression or anxiety, time constraints, poor social support, non-positive experiences of physical activity and beliefs about OA, exercise and pain also impact on exercise adherence.8-12 External factors include the physical therapists’ professional care and encouragement towards patients, while environmental factors include weather, suitable/ accessible exercise environments7,9,13. Clinical recommendations for promoting exercise adherence include improving the nature of the relationship between patient and provider, and the importance of individually tailoring exercise programmes and while better supervision is recommended to facilitate the prescription of progressive exercise programmes tailored to suit the changing needs of patients.7,11,13

Whether the influence of these factors changes over time in regard to the uptake and maintenance of exercise and physical activity behaviour remains unexplored.12 Understanding whether and how these factors change over-time can potentially provide evidence that will enable the development and optimisation of exercise interventions for OA, to provide maximum benefit for patients over the longer-term. Additionally, the majority of studies have focused on prescribed exercise rather than general physical activity.12

The BEEP trial (Benefits of Effective Exercise for knee Pain) (completed between October 2010 and May 2016; ISRCTN93634563) aimed to test whether enhanced physiotherapist-led exercise interventions could provide larger, longer-lasting benefits for patients with knee OA. It was hypothesised that i) greater individualisation, supervision and progression of a lower limb exercise programme would be superior to usual NHS physiotherapy exercise and ii) a programme that targets exercise adherence in the longer-term, supporting the transition from lower-limb exercise to general PA, would be superior to usual NHS physiotherapy exercise.

Within the trial participants were randomised to Usual Physiotherapy Care (UC control: Up to 4 treatment sessions of advice and exercise over 12 weeks) (n=176 participants), Individually Tailored Exercise (ITE: individualised, supervised and progressed lower limb exercises, 6-8 sessions over 12 weeks) (n=178 participants), or Targeted Exercise Adherence (TEA: transitioning from lower limb exercise to general PA, 8-10 contacts over 6 months) (n=172 participants). The interventions are described in full elsewhere.14, 15 The trial results showed that participants receiving UC, ITE and TEA, on average, experienced moderate improvement in pain and function, as measured by the Western Ontario and McMaster Universities Arthritis Index (WOMAC).16 However, there were no significant differences between arms at 6 months (primary outcome), or at other time-points (3,6,9,18-months) and adherence declined over time in all arms.17

This paper reports findings from a programme evaluation utilising qualitative interviews alongside the trial to understand the experience of trial participants. Qualitative methods are important in trials as they help to explain how complex interventions are implemented within a particular social context, facilitate interpretation of trial outcomes and can save money by highlighting to researchers of future trials interventions most likely to be effective.18-22 Furthermore, we used a longitudinal qualitative approach to understand adherence to exercise and physical activity across the course of the trial. 23,24 We aimed to investigate: 1) participants’ experiences of treatment 2) barriers and facilitators to exercise and general PA behaviour in the longer-term.

**PATIENTS AND METHODS**

BEEP trial participants were adults aged 45-years and over with knee pain and/or stiffness in one or both knees who met criteria for a clinical diagnosis of OA.4 Face-to-face, semi-structured interviews with a subsample of participants from each intervention arm were undertaken at two time-points: post-intervention interviews shortly following BEEP treatment completion; and follow-up interviews approximately 12-months after their intervention had finished. Interviews were undertaken by AM, MH and DR, all of whom are experienced in qualitative research methods. None of the participants were previously known to the interviewers. Purposive sampling was undertaken (using trial questionnaire data) to ensure a diverse range of characteristics including age, gender, trial intervention arm, baseline pain severity and changes in knee pain and function according to WOMAC scores after intervention.16The post-intervention interview topic guide included open questions to explore participants’ views on what happened during physiotherapy sessions, impact of treatment on exercise and general PA behaviour, and beliefs about changes in knee symptoms and exercise behaviour over the course of treatment. Follow-up interviews explored participants’ experiences of exercise; treatment over the longer-term; perceptions of adherence to the prescribed exercises and changes in PA behaviour over time and impact on their knee (see eAddenda for topic guides). All interviews were conducted in the participant’s homes. Field notes were written up as soon as possible after the interviews to record the interviewer’s immediate impressions. Interviews were audio-recorded (with participant’s consent), transcribed by an independent university approved transcription company, and anonymised. NVivo (QSR International) was used for data management. 25

A ‘layered approach’ to thematic analysis was undertaken.26 Open coding of all transcripts identified experiences of interventions, views on BEEP exercises and general PA and barriers and facilitators to exercise. Adopting constant comparison transcripts were read and re-read, an initial coding framework devised and codes grouped into themes by AM.27,28 CJ, MH and NF independently coded a sample of transcripts. Codes and initial themes were discussed, agreed, and then applied to the dataset with ongoing refinement. Data collection and analysis were carried out iteratively so that emerging themes (post-intervention) could be explored during follow-up interviews. Sampling continued until no new themes emerged indicating data saturation.29 Next, deductive coding included pre-determined codes of individualisation, supervision and progression (core characteristics of BEEP interventions).14

Finally, we used longitudinal qualitative analysis, which is particularly useful when studying changes in health behaviour and within programme evaluations to further an understanding of not just whether an intervention is perceived to work, but why it works and if it is feasible and acceptable over time.24,30 We used a within-case and cross-case longitudinal analyses using descriptive and interpretive questions to determine elements of behaviour change within the data.23 Summaries of each participant’s data were used to identify perceptions of changes in BEEP exercises and general PA, and influences of change during the period from post-intervention to follow-up (within case) and in each intervention arm (cross-case).23,26 Ethical approval was received (REC reference:10/H1017/45).

**RESULTS**

Thirty participants were interviewed post-intervention (PI). Of those, 22 agreed to be interviewed at follow-up (FU) 12 months later. There was a spread of participants across the three intervention arms and according to age, gender, baseline and 18-month FU PA levels and adherence to exercise at 3, 6 and 18-months (measured in trial questionnaires). (See Table 1).

(Table 1 here)

Results are presented in four parts. Part one outlines patient perceptions of what happened during BEEP interventions. Parts two and three focus on perceptions of change over time and barriers and facilitators to exercise and PA in the longer-term. Part four focuses on participants’ suggested improvements to physiotherapy interventions. Illustrative data excerpts are available in Table 2 (see eAddenda for Table 2).

1. Patient perception of BEEP trial interventions

Physiotherapy-led exercises were described by participants across all arms of the trial, and the core exercise characteristics of supervision, progression and individualisation were experienced at different levels (basic and higher) and varied across each arm.

*Supervision*

A basic level of supervision was evident in patients’ narratives as they described how the treating physiotherapist demonstrated and explained the purpose of the exercises, before observing and assessing the patients as they did them, and monitoring for any symptom response to the exercise programme.

Some physiotherapists did the exercises *with* the patient, creating a sense of partnership. Some participants noted particularly high levels of attentiveness from the physiotherapist, suggesting a higher level of supervision. Participants across the arms reported being motivated when performing the exercises under the supervision of the physiotherapist, however, their motivation faded over time without supervision.

*Progression*

A basic level of exercise progression was evident in all arms and included increasing the number of repetitions of exercises, introducing new exercises and maintaining improvements in exercise. Higher levels of progression were described by participants in the ITE and TEA arms such as moving beyond specific lower limb exercises to more general PA, often linked to their own individual exercise goals, and valued activities (e.g. cycling, attending a gym).

*Individualisation*

Patient interviews revealed evidence of a basic level of exercise individualisation in all three intervention arms. Exercises were adapted based on the individual’s ability to perform them, reducing or increasing exercise difficulty, or providing alternatives if individuals found them too difficult (e.g. due to pain).

Individualisation in the UC arm did not extend beyond this basic level. However, a higher level of individualisation was evident in both the ITE and TEA arms as participants reported the physiotherapist adjusted their exercise programme to suit their individual needs (e.g. co-morbidities) and personal exercise goals. Providing explanations for adjustments and exercise replacements, monitoring patients’ progress and moving beyond specific lower limb BEEP exercises characterised a higher level of individualisation.

Overall, in this sample, we found that the core intervention constructs (supervision, progression and individualisation) were delivered as expected. Therefore, the null findings of the BEEP trial may not be down to poor delivery of these key intervention components. The trial paper reports on other aspects of fidelity (e.g. delivery of cognitive behavioural and educational strategies) and so our findings are complementary in helping to interpret the trial results.

2. Longer term barriers to exercise and general physical activity

A wide range of factors emerged as barriers or facilitators to exercise and general PA (Tables 3 and 4) and were common across arms.

(Tables 3 and 4)

Patient factors (existence of pain or other physical symptoms, low exercise self-efficacy, lack of motivation, or incentive to exercise during pain-free periods), time and place, weather, lack of supervision and monitoring remained as barriers to exercise or uptake of general PA in the longer term. The excerpts in Table 2 are illustrative of these themes (See eAddenda for Table 2)

Barriers relating to a lack of motivation, unsuitable physical environment, and a lack of support or incentives during pain-free periods remained at follow-up. Patients also had ongoing concerns about exercising when in pain and a lack of exercise self-efficacy. At follow-up continuing knee pain, instability, fear of falling or “doing the wrong thing” also deterred some participants from continuing with exercise in the longer term.

Whilst articulated as barriers to exercise in post-intervention interviews, the burden of exercises and physiotherapist related factors (e.g. perceptions the physiotherapist was disinterested) did not appear to be barriers in the longer-term. New barriers at 12 months were lack of support to exercise and receipt of conflicting advice from health care practitioners.

Figure 1 presents a model explaining longer-term barriers to exercise and PA. The arrows illustrate how barriers are linked and how there is often multiple influences on adherence to an exercise and PA intervention.

3. Longer term facilitators to exercise and general physical activity

The most prominent facilitating factors remaining at 12 months were *patient related* factors, specifically an individual’s ‘naturally active’ identity, prevention motivations (avoiding the return of pain or future surgery), observing and feeling benefits, and knowledge (change in knowledge or retained knowledge) about the role of exercise for pain. Participants who felt they were ‘naturally active’ and exercised regularly prior to the BEEP trial generally maintained their PA behaviour into the longer term, regardless of intervention arm. A strong therapeutic alliance between physiotherapist and patient was also a powerful facilitator to exercise and PA.

*Change in Knowledge*

Knowledge about exercise specific to individual needs facilitated exercise and PA in the longer-term and was linked to patient and physiotherapist characteristics. In general participants reported learning about the benefits of exercising for joint pain from the physiotherapist and information booklets, and experientially during supervision of their exercise programme in BEEP intervention sessions. Physiotherapists’ explanations of the value and rationale of exercise for knee pain, how to do the exercises and what should feel right and wrong, changed patients’ perceptions of exercise. A participant in the ITE intervention arm retained knowledge about the role of exercise for pain and how this was supported by reassurance from the physiotherapist, increasing the participant’s exercise self-efficacy and ability to exercise despite pain.

*Therapeutic alliance*

Therapeutic alliance - defined as a sense of collaboration, warmth and support between physiotherapists and patients emerged as a core facilitator to exercise in the short and longer-term regardless of intervention arm.31-34 A therapeutic alliance facilitated agreement on the exercise intervention and generated an affective bond. Table 5 outlines features of a therapeutic alliance between the participants and physiotherapists in all three intervention arms alongside information about adherence to exercise and PA. Participants spoke positively about physiotherapists who took time to get to know them and valued the physiotherapist’s ability to understand and empathise. Participants appreciated physiotherapists taking time to explain exercises, and show how and why they worked, and positively encouraging and empowering them to contribute to their own treatment and to ask questions in return. Continuity over treatment sessions with the same physiotherapist helped to build a sense of collaboration, and participants spoke about developing rapport, openness and trusting relationships where they felt valued, respected and supported.

(Table 5 here)

Figure 2 illustrates a model of facilitating factors to explain the interplay between patient and physiotherapy characteristics, therapeutic alliance, knowledge and longer-term exercise or PA. Participants from all intervention arms reported anxiety about exercising with pain but physiotherapists’ reassurance during supervision (linked to therapeutic alliance above) helped them to understand when pain was an indication to stop and when it was safe to work through pain. Participants described how changes in their knowledge and confidence to exercise (fostered during interactions in treatment sessions) impacted on exercise and PA over 12 months later.

*Time and place*

Time and place remained as an exercise facilitator 12 months after BEEP treatment completion, as the nature of the exercises meant that participants could fit them into their daily lives at home and work (e.g. sitting at work, waiting for the kettle to boil).

*Support and supervision*

Regular contact and support from others (family and friends) also emerged as a factor that facilitated exercise and PA in the longer term. For those who had moved on to more general PA, staff at the local gym were an important source of motivation especially when they took an interest in the patient’s knee problem and their progress. Participants also reported wanting supervision from staff at local gyms, like that they had experienced in the BEEP trial with physiotherapists.

4. Suggested improvements to physiotherapy interventions

Participants from all intervention arms talked of a need for more regular physiotherapist reviews (e.g. 6, 12 or 24 months after the end of the initial intervention) to enable changes in exercises to be made appropriately and remind patients of the importance of continuing with exercise and PA. Participants in the UC and ITE arms felt that regular reviews with physiotherapists rather than GPs (primary care physicians) or hospital consultants (specialists) were more appropriate as they provided the ‘right kind of advice’ and support and were ‘easier to talk to’. Other suggestions included more treatment sessions, treatment spread over a longer period and different modes of delivery (e.g. email or telephone sessions and reminders, physiotherapist home visits and community-based activities).

**DISCUSSION**

This qualitative study embedded within the BEEP trial aimed to investigate participants’ experiences and perceptions of treatment, particularly supervision, individualisation, progression and barriers and facilitators to exercise and general PA behaviour in the longer-term. This helps to shed light on the quantitative clinical results of the trial and provides novel understanding regarding change in barriers and facilitators to exercise and PA over time. This understanding can inform how to optimise future exercise interventions for OA to provide maximum benefit for patients over the longer-term.

The qualitative findings show that participants experienced different levels of supervision, individualisation and progression within each arm. This provides context for the other qualitative findings and for the interpretation of the quantitative clinical results as the physiotherapists overall appeared to deliver core intervention components well. The lack of significant differences in clinical outcomes between the intervention arms may therefore be attributed to other factors. For example, regardless of intervention arm barriers and facilitators to exercise and PA were common and similar, both after completion of BEEP interventions and at longer-term follow-up. We have added to previous research on barriers and facilitators to exercise by identifying the longer-term barriers as predominantly patient factors, but which also include time and place, the weather and ongoing supervision and monitoring.7, 9, 12,35,36 All three interventions appeared to facilitate those who saw themselves as ‘naturally active’ to maintain levels of PA despite their knee pain.

The importance of a therapeutic alliance during treatment in facilitating both short and longer-term adherence to exercise and general PA behaviour has also been highlighted within this study, suggesting it may be an important target in future exercise interventions for knee OA. Previous studies have recognised the importance of therapeutic alliance (or patient-provider relationship) as a central component of the therapeutic process and a determinant of treatment outcome in psychotherapy, but impact on musculoskeletal outcomes has been less studied.37-39 Ferreira et al reported that positive therapeutic alliance ratings between physiotherapists and patients were associated with improved outcomes in low back pain.40 A need for further exploration of the role of therapeutic alliance in relation to rehabilitation outcomes has been recognised.39,41 A systematic review by Hall et al reported significant positive associations between therapeutic alliance and global perceived effect of treatment as well as changes in pain, physical function, patient satisfaction with treatment, depression and general health status.34 Our study adds to previous research in two ways. First, we suggest that therapeutic alliance during the treatment phase may have a longer-term influence on patients’ exercise and general PA behaviour. This supports recent evidence suggesting that therapeutic alliance may be the best predictor of adherence to exercise.42 Second, we have identified key features of therapeutic alliance that appear to be facilitators to exercise adherence which include mutual investment, the quality of personal interactions and communication, and an affective bond. Various conceptual frameworks have been used to explain therapeutic alliance in relation to physiotherapy, but the heterogeneity of these models limits their application in the musculoskeletal pain context.39 Identifying an optimal framework for use in musculoskeletal pain rehabilitation settings may be informed by our analysis. Quantitative measures of therapeutic alliance are available. Babatunde et al identified 26 measures; the Working Alliance Inventory (WAI) being the most used.39 However, Hall et al found that measures developed from psychotherapy exhibit a ceiling effect and require re-contextualisation for a musculoskeletal pain context.43 Despite specifically targeting exercise adherence in the longer-term in the TEA intervention in the BEEP trial, similar barriers to exercise were identified in participants in each of the three intervention arms and remained over time.

When asked about potential improvements to the BEEP interventions, participants suggested regular reviews (with a physiotherapist or GP) over a longer period of time and different modes of delivery. The best method for providing ongoing support for exercise to this patient population remains unclear. The addition of two 30-minute booster sessions to a 12-week supervised physiotherapy exercise programme did not increase adherence or improve pain or function in a trial by Bennell et al.44 Although regular reviews are a component of a chronic disease management model, barriers to the use of OA chronic disease service management models exist.45 It is possible that harnessing the potential of eHealth to provide ongoing reminders and monitoring may help to maintain adherence over time.46,47

A strength of this work is that the analysis was not constrained to the core constructs of the exercise interventions and did not attempt to either confirm or reject the clinical trial results but to explain them.26 The qualitative data analysis was conducted while the authors were unaware of the quantitative clinical trial results in order to maintain an interpretive approach. By sampling for a diverse range of characteristics and applying a within-case and cross-case longitudinal approach we went beyond a cross-sectional analysis of the qualitative data set, ensuring that data saturation was achieved in accordance with the aims of the study. The use of descriptive and analytical questions about change in behaviour also provide insights into longitudinal data analysis which is seldom reported.23 A limitation is that we did not also interview physiotherapists to explore their experiences of delivering the BEEP trial interventions or to gain understanding of their perceptions of therapeutic alliance. Future research is required to establish if it is possible to harness the potential of a greater therapeutic alliance between patients and physiotherapists, and whether regular reviews and ongoing support of patients lead to sustained changes in exercise and PA behaviour in the longer-term. There were also eight participants who declined to a follow-up interview. Our purposive sampling framework ensured a good range of patient characteristics and we reached a state of thematic saturation within the analysis and are confident in the themes identified. However, we cannot be sure that the addition of data from the eight participants who declined a follow-up interview would change the results, and we accept this as a limitation of longitudinal qualitative studies.

Interview participants experienced different levels of supervision, individualisation and progression yet similar barriers and facilitators to exercise and PA were found irrespective of which of the three BEEP trial intervention arms participants were allocated to. Despite a focus on supervision, individualisation, and progression to improve exercise adherence, barriers remained 12 months after contact with the physiotherapist ended including lack of support and regular reviews, continuing knee pain, fear of “doing the wrong thing” and the weather. However, the presence and quality of a therapeutic alliance during treatment appeared to facilitate adherence to exercise and general PA. These findings help to explain the quantitative trial results.17 They also highlight that models of ongoing support and enhanced therapeutic alliance should be targets for future trials of exercise in older adults with knee pain.

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**Table 1: Characteristics of BEEP trial interview participants**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Trial ID** | **Gender** | **Age** | **WOMAC Pain^** | **WOMAC Function^** | **PASE″ (mean score)** | | **I have been doing my exercises as often as advised≈….** | | | |
|  |  |  |  |  | **Baseline** | **18-months** | **3-months** | **6-months** | | **18-months** |
| **UC** |  |  |  |  |  |  |  |  | |  |
| 1135 | F | 55-64 | Missing | Got worse‡ | 205 | 188 | Strongly agree | Agree | Strongly agree | |
| 11702 | M | 45-54 | Got worse | Got worse | 31 | Missing | Agree | Disagree | Strongly agree | |
| 364 | F | 75+ | Got worse | Got worse | 32 | 64 | Not sure | Strongly disagree | Strongly disagree | |
| 42 | M | 55-64 | Got worse | Got worse | 149 | 170 | Disagree | Disagree | Strongly disagree | |
| 6153 | M | 75+ | Improved‡ | Improved | 69 | Missing | Agree | Agree | Missing | |
| 6937 | M | 55-64 | Improved | Improved | 212 | 518 | Disagree | Disagree | Disagree | |
| 7058 | M | 65-74 | Improved | Improved | Missing | 117 | Disagree | Disagree | Disagree | |
| 7082 | F | 65-74 | No change | Improved | 160 | 152 | Agree | Not sure | Not sure | |
| 7283 | F | 65-74 | Improved | Improved | 200 | 188 | Agree | Agree | Disagree | |
| 8460 | F | 75+ | Got worse | Got worse | 187 | 157 | Strongly agree | Disagree | Disagree | |
| **ITE** |  |  |  |  |  |  |  |  |  | |
| 6878 | F | 55-64 | Improved | Improved | 299 | 189 | Strongly agree | Strongly agree | Agree | |
| 6517 | F | 45-54 | Got worse | Got worse | 295 | 261 | Strongly agree | Agree | Strongly disagree | |
| 61 | F | 75+ | Improved | Improved | 97 | 178 | Strongly agree | Agree | Not sure | |
| 36 | M | 65-74 | Improved | Improved | 266 | Missing | Strongly agree | Not sure | Disagree | |
| 26 | F | 55-64 | Improved | Improved | 157 | 193 | Agree | Agree | Disagree | |
| 1481 | M | 45-54 | Got worse | Got worse | 292 | 219 | Agree | Agree | Strongly disagree | |
| 1171 | M | 75+ | Improved | Improved | Missing | 243 | Not sure | Agree | Strongly agree | |
| 11 | M | 55-64 | No change | no change | 207 | 245 | Strongly agree | Strongly agree | Strongly agree | |
| **TEA** |  |  |  |  |  |  |  |  |  | |
| 8141 | F | 65-74 | Improved | Improved | 30 | 43 | Strongly agree | Agree | Strongly agree | |
| 7880 | M | 45-54 | Missing | Got worse | 116 | 168 | Strongly disagree | Agree | Disagree | |
| 6544 | F | 45-54 | Improved | Improved | 143 | 209 | Agree | Disagree | Not sure | |
| 6436 | F | 55-64 | Improved | Got worse | 124 | Missing | Agree | Strongly agree | Disagree | |
| 5210 | F | 75+ | Got worse | Got worse | 226 | 65 | Strongly agree | Agree | Missing | |
| 4876 | M | 75+ | Improved | Improved | 139 | 55 | Agree | Agree | Missing | |
| 4677 | M | 65-74 | Improved | Improved | 312 | 167 | Agree | Agree | Agree | |
| 3657 | M | 65-74 | Improved | Improved | 147 | 196 | Agree | Disagree | Disagree | |
| 30 | M | 65-74 | Improved | Improved | 175 | 129 | Agree | Agree | Agree | |
| 3 | F | 55-64 | Improved | Improved | 25 | 90 | Strongly agree | Strongly agree | Agree | |
| 181 | F | 75+ | No change | Got worse | 136 | Missing | Agree | Missing | Missing | |
| 1736 | M | 55-64 | Got worse | Improved | 196 | 110 | Disagree | Disagree | Disagree | |

^The Western Ontario and McMaster Universities Arthritis Index (WOMAC) consists of 24 items divided into 3 sub-scales; pain, physical function and stiffness. The pain subscale ranges from 0 (no pain) to 20 (maximum pain) and the function subscale ranges from 0 (no disability) to 68 (maximum disability). The psychometric properties of the WOMAC16 have been extensively studied in knee pain populations in clinical trials of different interventions including exercise.48 WOMAC Pain and Physical Function Scores were taken from self-completed questionnaires returned at 3 months follow-up. ‡Improved - any reduction in pain or disability subscale scores from baseline to 3-month questionnaire. ‡Got Worse - any increase in pain or disability subscale score from baseline to 3-month questionnaire. ″The Physical Activity Scale for the Elderly (PASE) assesses physical activity levels over a 1-week period combining physical activity from several domains including household, occupational and leisure.49 Scores range from 0 to 793, with higher scores indicating greater physical activity. ≈Single item adherence question

**Table 3: Barriers to physiotherapy-led exercises and general physical activity in the BEEP trial.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Usual Care | | Individually Targeted Exercise | | Targeted Exercise Adherence | |
|  | Post Intervention | Follow-up | Post Intervention | Follow-up | Post Intervention | Follow-up |
| BEEP Prescribed Exercise | * Patient factors (Ongoing pain, attitudes to exercise & pain, physical status) * No change in knowledge * Severity of exercise * Time and place limitations * Lack of supervision * Physiotherapist (poor communication, negative attitude) | * Patient factors (pain free, negative attitudes towards exercise & pain) * Replaced with other activities | * Patient factors (lack of enjoyment, reduced self-efficacy) * Replaced with other activities * Time & place limitations * Burden of exercise | * Patient factors (pain worsening, reduced exercise self-efficacy, fear of falling, concerned about ‘doing the wrong thing’, lack of enjoyment) * Lack of monitoring * Replaced with other activity * Conflicting advice from HCPs * Time and place limitations * Weather | * Patient factors (pain, injury, lack of motivation, no change in knowledge, comorbidity, injury, negative beliefs about exercise for pain) * Time and place limitations (No time, poor access to facilities) * Physiotherapist (poor explanation and delivery of intervention) | * Patient factors (no more pain so not motivated) |
| General Physical Activity |  |  | * Patient factors (lack of motivation or enjoyment) * Time limitations * Replaced exercises with other activities * Weather | * Patient factors (ongoing pain) | * Patient factors (lack of motivation and self-efficacy, comorbidities, already active so no perceived need) * Weather | * Patient factors (pain free, worsening pain, lack of motivation & exercise self-efficacy) * Time and place limitations * Lack of support * Weather * Financial cost of facilities |

**Table 4: Facilitators to physiotherapy-led exercises and general physical activity in the BEEP trial.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Usual Care | | Individually Targeted Exercise | | Targeted Exercise Adherence | |
|  | Post Intervention | Follow-up | Post Intervention | Follow-up | Post Intervention | Follow-up |
| BEEP Prescribed Exercise | * Patient factors (Enjoyment, increased self-efficacy, feeling benefit) * Time and place (can fit in to daily life or work) * Physiotherapist factors (positive, instilled confidence, reassuring) | * Patient factors (pain free, attitudes towards exercise & pain, feeling the benefit) * Prevention (avoiding future surgery) * Change in knowledge * Replaced with other activities | * Patient factors (Feeling benefit, naturally active, increased self-efficacy, enjoyment) * Time & place (can fit into daily life and work) * Change in knowledge * Physiotherapist (Reassuring, respectful, open, trusting) * Supervision * Prevention (avoiding surgery) | * Time & place (can fit into daily life and work) | * Patient factors (Self-efficacy, naturally active) * Change in knowledge * Time and place (fit into daily life and work) * Physiotherapist (instilled confidence, reassuring, respectful, listened) * Supervision * Prevention (avoiding surgery) | * Patient factors (Naturally active, feeling the benefit) * Change in knowledge * Supported by family |
| General Physical Activity |  | * Change in knowledge | * Patient factors (Self-efficacy, naturally active) * Change in knowledge * Physiotherapist (inspiring, realistic) * Time and place (fit into daily life and work) | * Patient factors (naturally active) * Change in knowledge | * Patient factors (Feeling the benefit, naturally active, enjoyment) * Change in knowledge * Time and place (Fits into daily life and work) * Physiotherapist (Encouragement) * Prevention (avoiding surgery) | * Patient factors (naturally active) * Support from others * Change in knowledge |

**Table 5: Characteristics of a therapeutic alliance across the three BEEP trial interventions and participants’ perceptions of adherence**

|  |  |  |  |
| --- | --- | --- | --- |
| **Therapeutic alliance characteristic** | **Example** | **Illustrative Quotation** | **Perceptions of adherence‡ to exercise and physical activity levels at end of treatment and 12-month follow-up** |
| Mutual Investment | Equity in the work/  Reciprocity | “The thing is you do the exercise cos you feel that you don’t want to let the other person down. You know you do them cos in the first instance you think ‘oh that’s going to do me good, it’s going to yeah’, but also there’s a secondary thing there you think oh he’s gone out of his way to explain these things to me and shown me what to do it’s only fair that I do them so at least I can tell him what sort of effect its having the next time I meet him you know.” (7058, UC FU). | At end of treatment was partially adherent to exercises and was an active hill walker. At follow-up no longer did BEEP exercises but active hill walker and joined gym. (7058, UC). |
|  | Appreciative of other | “So I, I think, and I think it’s because of [physiotherapist] in a way, I didn’t, don’t feel as though I wanted to let him down ‘cause he’d been so good, got me so far.” (3657, TEA PI). | At end of treatment was adherent to exercise and joined a gym. At follow-up was partially adherent, joined different gym and cycled. (3657, TEA). |
|  |  | “I also think that because they see you trying, it motivates them as well.” (1481, ITE FU) | At end of treatment was adherent to exercises, used exercise bike. At follow-up was not adherent to BEEP exercises but did other sitting exercises, cycled and walked. (1481, ITE). |
|  | Joint motivations  Negotiation/  agreement | “Watched me doing all the exercise, then she’d write on the list how many times she wanted me to do, you know. But I said to her, I said ‘Well I’m doing them once, once a day.’ She said ‘Well as long as you do thoroughly, but do the ten times of each exercise, you know.” (6153, UC PI) | At end of treatment was adherent to exercises, withdrawn from study at follow-up (6153, UC). |
| Personal interactions / Affective bond | Feeling at ease/relaxed/valued | “I mean, he always had time to talk to you, and say, you know, ‘Any questions or anything?’ He didn’t rush you in and rush you out or, like, you know, it does happen sometimes but, with people, but, no, he was very good.” (61, ITE FU) | At end of treatment adherent to BEEP exercises and active through dancing. At follow-up continued to dance but not doing BEEP as knee worsened and awaiting knee replacement (61, ITE). |
|  | Perception of therapist (e.g. “good” “nice”) | “She was a nice young lass, you know, bedside manner, the fact that she straightaway sort of suspected what it was, do you know what I mean?” (30, TEA FU) | At end of treatment was partially adherent to BEEP exercises, cycled, walked dog and did morning stretches. At follow-up continued to cycle, and walk and did BEEP 2 or 3 times a week (30, TEA). |
|  | Getting to know each other / Making connections | “We were talking about gardening whatever as I was doing my exercises as well. And she sort of mentioned things about her life and what she could do with various bits and pieces and it just made it a much more enjoyable experience I think. […] I think it made a difference. It made me feel I wanted to do the exercises more.” (26, ITE FU) | At end of treatment partially adherent to BEEP exercises. At follow-up partially adherent as tried to do some exercises but others were too painful (due to Baker’s cyst) (26, ITE). |
|  |  | “She’d had a car crash. She herself, her leg’s badly damaged. So she had got an insight into sort of what it was all about, you know.” (30, TEA, FU) | At end of treatment partially adherent to BEEP exercises, cycled, walked dog and did morning stretches. At follow-up continued to cycle, and walk and did BEEP 2 or 3 times a week (30, TEA). |
|  | Attentiveness to other | “I think she was far more realistic and she seemed more interested in me as a person and what I did. I know the other girl talked about it but it was more as a matter of course, not out of … made you feel particularly valuable I suppose.” (26, ITE PI) | At end of treatment partially adherent to BEEP exercises. At follow-up partially adherent as tried to do some exercises but others were too painful (due to Baker’s cyst) (26, ITE). |
| Communication | Openness, honesty and trust | “I do think it was probably seeing that (BEEP) physio that really made me open up and think this is a shared thing, he is trying to help me. I wanted to be helped. But he was on such a level that I could share things that I’d maybe found in the past difficult to share.” (1135, UC, FU) | Adherent both at end of BEEP treatment and at follow-up. Continued with the exercises because felt left knee was deteriorating (1135, UC). |
|  |  | “Of course she said ‘Three times a day’ and I’d look at her. ‘How many times you do that?’ I said ‘Once.’ […. ] oh yes, I was honest with her, yes. I said ‘Once but very thorough’ [yes], you know.” (6153, UC PI) | At end of treatment was adherent to exercises, withdrawn from study at follow-up (6153, UC). |
|  |  | “And then you start asking more...you develop a bit of a rapport and I think that from the study I'm sure the physio gets a little bit more out of it because you start expanding on, on what you're saying.” (1481, ITE, PI). | At end of treatment was adherent to exercises, used exercise bike. At follow-up was not adherent to BEEP exercises but did other sitting exercises, cycled and walked (1481, ITE). |
|  | Listening | “So I think, I, I was quite impressed with the physio in that she listened and understood what I was saying with regard to both the pain in the knee and my mental health problems and the hernia.” (7880, TEA PI) | At end of treatment partially adherent and did mountain biking and walking. At follow-up partially adherent, did BEEP exercises but irregularly (7880, TEA). |
|  | Explanations offered and understood (exercise self-efficacy) | “She explained even though the exercises might cause pain, as said, she sort of suggested that the, the problem amongst other things was the lack of strength in the muscle. So she said by building the muscles up that will support the knee better [yeah] in the long run.” (7880, TEA PI) | At end of treatment partially adherent and did mountain biking and walking. At follow-up partially adherent, did BEEP exercises but irregularly (7880, TEA). |
|  |  | “By going seeing someone every week for a period of time, I think you, you develop some trust, some openness comes from the... from my part, comes from that as well, some understanding.” (1481, ITE PI) | At end of treatment was adherent to exercises, used exercise bike. At follow-up was not adherent to BEEP exercises but did other sitting exercises, cycled and walked (1481, ITE). |
|  | Reassurance/confidence (exercise self-efficacy) | “Reassure me. Reassure me. Give me the right exercises to do, if it wasn't going to do any further damage, if it was arthritis. I think the cartilage problem is caused by, or could have been caused by the arthritis. I needed reassurance that it was okay to actually do the exercises and I wasn't going to cause further damage. Confidence I think because sometimes trying to do these things on your own is a bit scary if you get stuck, because my leg does lock. And I think probably him encouraging me to do the right exercises, and do them every day, which I did do.” (1135, UC PI) | Adherent both at end of BEEP treatment and at follow-up. Continued with the exercises because felt left knee was deteriorating (1135, UC). |
|  |  | “I’ll be a lot more confident, I think I’ll be a bit, say, worried, but at the moment, I’ve got sort of motivation that I’m being seen sort of every month. Um, just reassurance really I suppose isn’t it. Um, I’m doing my exercises and I’m going and um, the physio’s going through the exercises with me and telling me this is – well I know it’s improved, but it’s just a bit of reassurance and – and motivation to keep going a bit longer [mmm] with them.” (6878, ITE PI) | At end of treatment was adherent to BEEP exercises, declined interview at follow-up (6878, ITE). |

‡Adherent – participants described still doing BEEP exercises at both time points. Partially adherent – participants described doing some BEEP exercises or general physical activity or started replacement or new types of physical activity. Non-adherent – participants described not doing BEEP exercises at either time point