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Predictors of adherence to home-based physical therapies: a systematic review

Rosie Essery, Adam W A Geraghty, Sarah Kirby, Lucy Yardley

Institutions: University of Southampton

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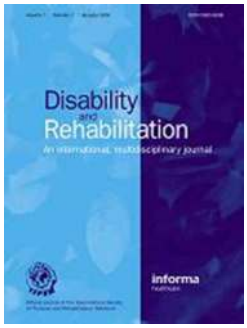

Predictors of adherence to home-based physical rehabilitation therapies: a systematic review

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Running head: Adherence to home-based physical therapies

Implications for Rehabilitation

- Non-adherence to physical rehabilitation therapies is often high – particularly in self-managed, home-based programmes, despite good adherence being important in achieving positive outcomes.

- The findings of this systematic review indicate that greater self-efficacy, self-motivation, social support, intentions and previous adherence to physical therapies predict higher adherence to HBPTs.

- Assessment of these domains before providing individuals with their HBPT regimes may allow identification of 'risk factors' for poor adherence. These can then potentially be addressed or managed prior to, or alongside, the therapy.

- Interventions to support patients' self-managed physical rehabilitation should include elements designed to enhance patients' self-efficacy, self-motivation and social support given the evidence that these factors are good predictors of adherence.

Running head: Adherence to home-based physical therapies

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Authors

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Author note

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*Correspondence concerning this article should be addressed to: (removed for masked review process)

Abstract

Purpose: Self-managed, home-based physical therapy (HBPT) is an increasingly common element of physical therapy rehabilitation programmes but non-adherence can reach 70%. Understanding factors that influence patients' adherence to HBPTs could help practitioners support better adherence. Research to date has focused largely on clinic-based physiotherapy. The objective of this review, therefore, was to identify specific factors which influence adherence to home-based, self-managed physical therapies. **Method:** A systematic review was conducted in which eight online databases were searched using combinations of key terms relating to physical therapies, adherence and predictors. Matching records were screened against eligibility criteria and 30 quantitative articles were quality assessed and included in the final review. Relevant data were extracted and a narrative synthesis approach was taken to aggregating findings across studies. **Results:** There was relatively strong evidence that the following factors predicted adherence to HBPTs: intention to engage in the HBPT, self-motivation, self-efficacy, previous adherence to exercise-related behaviours, and social support. **Conclusions:** This review has identified a range of factors that appear to be related to patients' adherence to their self-managed physical rehabilitation therapies. Awareness of these factors may inform design of interventions to improve adherence.

Key words:

Adherence, physiotherapy, self-management, predictors

Predictors of adherence to home-based physical therapies: a systematic review

Self-managed, home-based physical rehabilitation therapy (HBPT) is an increasingly common element of rehabilitation programmes for various long-term conditions [1-3]; a trend likely to continue given physiotherapists' limited time and resources [4]. Patients' adherence to such programmes is central to the success of the therapy [5] with research demonstrating that adherent patients have better treatment outcomes [6]. The World Health Organisation (WHO) define adherence as "the extent to which a person's behaviour – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider" [7]. Within the field of rehabilitation, the term 'engagement' is also increasingly used in relation to patients' self-management of their health. This term not only encompasses notions of whether a patient's behaviour is adherent, but also of interaction with professionals and identifying relevant information too [8-10]. Whilst important to acknowledge this broader concept of engagement, the focus of this review is primarily upon whether patients' behaviour is adherent to recommendations and, as such, the term 'adherence' will be used throughout.

Despite adherence to physical therapy regimens being recognised as fundamental to positive outcome, there is evidence that non-adherence is often very high [11-13]. The WHO's (2003) evidence for action report on adherence to long-term therapies states that: "the ability of patients to follow treatment plans in an optimal manner is frequently compromised by more than one barrier, usually related to different aspects of the problem." [7]. Self-managed HBPTs in particular, often demonstrate the lowest levels of patient adherence amongst physical therapy modalities [14,15]. Nonetheless, for adherent patients, HBPT can be superior to standard care [16].

It is important to note the variation in how concepts of adherence and non-adherence are operationalised in existing literature [17]. Participants are sometimes considered non-adherent to HBPT regimens if they fail to achieve either a certain proportion, or absolute value, of recommended exercise repetitions [e.g. 18], recommended exercise duration [e.g. 19], recommended exercise frequency [e.g. 20], or sometimes a combination of these. This creates a dichotomy between 'adherent' and 'non-adherent'

participants, although there appears little consensus regarding what proportion of repetitions, duration or frequency should be considered the cut-off between adherence and non-adherence. In another approach, some studies do not make this dichotomy between adherent and non-adherent participants. Although they still measure adherence against the same criteria, they do so on a continuum and so discuss adherence in relative terms such as 'higher' and 'lower'[e.g. 21]. Despite these differences in operationalising the concept there still appears to be consensus that, however measured, poor or non-adherence within physical therapy is an issue. Owing to such heterogeneity in the operationalization of this concept, and in line with a recent review of self-report measures in this field [22], adherence was considered in relatively broad terms for the purposes of this review, as the degree to which individuals' behaviour corresponds with agreed recommendations.

Understanding factors influencing patients' adherence to HBPTs could facilitate the identification of barriers and help practitioners maximise exposure to factors promoting adherence [23]. Although a systematic review has identified a number of barriers to clinic-based treatment adherence in physiotherapy outpatients, it noted that barriers for self-managed physical therapy may well be different and should be further investigated separately [23]. Indeed, studies have noted differences in adherence behaviour between clinic and home-based elements of physical therapy [14] and differential effects of factors such as age on adherence to home and clinic-based physical therapy [24]. Qualitative research exploring patients' perceptions of their reasons for adherence identified distinct phases in terms of reasons given for poor adherence that corresponded to the times when patients were still attending clinic-based sessions and when their programme was fully home-based [11]. Furthermore, HBPT is often characterised by a number of features that make it particularly susceptible to non–adherence [19]. These features include the unsupervised nature of treatment, necessitation of lifestyle modification, not providing immediate symptomatic-relief, doubts and uncertainty about the therapy, and potential provocation of symptoms [17,25].

Whilst two recent systematic reviews in this field have investigated intervention-related factors associated with adherence to HBPTs [26,27], the included studies do not always directly investigate

relationships between adherence and specific potential predictors. One of these reviews did investigate both intervention and specific individual factors [26]. However, this review was specific to home exercise adherence in chronic low back pain and so it is not clear whether these findings may be applicable to HBPTs more generally. Although the other [27] considered a broader range of HBPTs, it focussed predominantly on intervention-related factors. As such, it was not always clear which aspect of the interventions were associated with adherence, or whether any influence on adherence may, for example, have been attributable to non-specific intervention effects [28].

We conducted a systematic review with the aim of identifying specific factors that predict adherence to a broad range of home-based, self-managed physical rehabilitation therapies. The review gave consideration to a wide array of self-managed physical therapies in order to understand whether there are factors predictive of adherence to self-managed physical rehabilitation regardless of the specific focus of the therapy.

Method

Search strategy

Online databases (MEDLINE, CINAHL, EMBASE, PsychINFO, Psycharticles, PubMed, AMED and The Cochrane Library) were systematically searched for studies investigating factors associated with adherence to HBPTs, published anytime until December 2015. Search terms were customised to the relevant database and comprised: terms relating to home physical therapies (e.g. 'exercise therapy', 'physiotherapy', 'home physiotherapy', 'home exercises', 'rehabilitation exercises'); terms concerning adherence (e.g. 'adherence', 'compliance', 'treatment compliance', ' patient engagement'); and terms referring to predictors (e.g. 'barriers', 'facilitators', 'predictors'). Inclusion of terms such as 'home-based' or 'self-managed' as limiters appeared to restrict returned records too extensively and excluded potentially relevant articles. As such, these terms were not included in the initial database search, but were instead included during the article screening stage. Following the identification of relevant articles, their reference lists were hand-searched for additional relevant literature.

Study selection

Figure 1 illustrates the process of study selection.

Studies of any design were considered for inclusion if they were published in English and reported quantitative measurement of adults' adherence to a HBPT and at least one factor predicted to be associated with adherence. HBPT was defined as any predominantly self-managed, unsupervised treatment regimens involving progressive movement and stretching of affected body parts in order to treat musculoskeletal impairment, or loss of physical function due to injury or disease. Studies were excluded if participants were exclusively under 18 years old or if the physical therapy was performed by another person (due to not being expected to take responsibility for self-managing their physical therapy). Studies were also excluded if they investigated therapeutic regimens comprising recommendations of general aerobic exercise (e.g. for weight management) rather than specific rehabilitation exercises. Finally, studies were excluded if the physical therapy was only clinic-based, or if studies combined clinic and home-based adherence data for analysis (studies were eligible if home-based data were reported separately).

(Insert Figure 1 about here)

Quality assessment and data extraction

A non-scoring quality assessment tool developed from the STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) checklist [29] was utilised to facilitate transparent assessment of study quality [30]. Studies were assessed across three domains: control for bias, including how well defined and representative the sample was, blinding and follow-up rate; appropriate measurement, including measures used and reporting of outcome data; and control for confounding, including whether statistical adjustment was made for confounders. No studies were excluded on the basis of their quality assessment but there was variation in the overall quality. Data extracted from

studies comprised sample characteristics, study design, theoretical approach, intervention details, adherence measures, and findings.

Data synthesis

Due to a lack of homogeneity across studies a meta-analytic approach to synthesis was not possible. Therefore, a narrative synthesis approach was adopted guided by principles outlined by Popay and colleagues [31]. This approach focuses on textual summaries and descriptions of the results with the primary aim of "'tell[ing] the story' of the findings from the included studies" [31]. In this review, the elements of this process comprised: developing a preliminary synthesis to organise the findings from the included studies; exploring relationships within this data to understand and explain patterns or differences; and assessing the robustness of the synthesis through consideration of the strength, quality and generalisability of the included data. Study findings were organised into conceptually-related categories and discussed with reference to how many studies reported significant relationships and the magnitude of these (presented in table 1), as well as considerations regarding the methodological quality of the relevant studies.

Results

Methodological overview of studies

Table 1 presents an overview of the key study characteristics. Studies are referred to by their reference ID as indicated in the table. The majority of the 30 studies were longitudinal prospective designs. Two studies analysed data from the same participants [32,33] . Two sets of studies [24,34,35; 15,32] appear to use sub-sets of participants from the same study.

Sample characteristics across studies were highly varied with some defined by the particular therapy investigated. Five studies' samples were gender specific to females [15,18,36-38], but all others were

mixed. The mean age of samples was also often determined by the condition investigated. Owing to the exclusion of studies with exclusively non-adult samples, all except four studies [1,21,32,33] only included participants over 18. The minimum age of any participant recruited was 14, but all participants conducted their physiotherapy independently. Although the HBPTs studied did vary, several therapies were the subject of multiple studies. Specifically, rehabilitation exercises following ACL-repair surgery was the subject of five studies [24,34,35,39,40]; Pelvic Floor Muscle Exercise (PFME) therapy for symptoms of urinary incontinence was investigated in four studies [15,36-38]; rehabilitation exercises following sports injury was investigated in three studies [32,33,41]; physiotherapy exercises as part of falls prevention interventions were also the subject of three studies [42-44]; dizziness and balance disorders were investigated by two studies [19,45], as were upper limb disorders and injuries [46,47], non-specific neck or low back pain [20,48], and osteoarthritis of the hip or knee [49,50]. Other HBPTs investigated were for stroke rehabilitation [51]; osteoporosis [18]; rheumatoid arthritis [52], and ankle sprains [53]. Three studies [1,21,54] investigated participants engaged in home physical rehabilitation for a variety of musculoskeletal conditions.

All measures of adherence included participant self-report. In some instances, physiotherapist estimates of adherence were also included. For analysis, the adherence outcomes tended to be dichotomised into 'adherent' and 'non-adherent' participants or expressed as proportions of the recommended exercise completed.

(Insert table 1 about here)

General quality assessment of findings

Although issues of study quality are discussed where relevant to specific findings, the quality assessment also highlighted issues that apply more universally relating to: study design and methods, measures and possible sources of bias.

Study design and methods

Studies frequently used sample sizes of 70 or less [24,32,33,40,41,44,46,47,51]. Although there are no universal rules regarding appropriate sample size for multivariate analyses, smaller studies with many predictor variables allow less confidence in findings [55]. Variation in studies' sample sizes (and therefore power) potentially account for inconsistencies in significant findings for a given factor. Levy and colleagues' non-significant finding regarding self-efficacy [32], for example, may be due to the study not being sufficiently powered to detect a small association with adherence. This is supported by other studies demonstrating that the association between self-efficacy and adherence was indeed small [20,46]. Additionally, nearly a third of studies either did not conduct multivariate analyses [1,45,47,48,50-52,54] or did not fully report the results [33] meaning that it was not always possible to interpret the nature of certain relationships identified or to know whether other factors acted as confounders. Finally, studies generally utilised correlational methods to assess associations between adherence and other investigated factors and so could, at best, only indicate an independent predictive association.

Measures

Non-validated measures of various constructs were often employed [1,20,35,42,44,46,51-54] and the reliability of scales for the given sample were sometimes not conducted [51], reported [1,42,46,48,52,54] or did not always demonstrate acceptable reliability [44,47,53]. This is consistent with findings of a recent systematic review of self-report measures of adherence to unsupervised, home-based rehabilitation programmes. This review concluded that almost all of 61 measures identified lacked any psychometric validation [22]. Within the current review, use of such non-validated measures may account for inconsistencies in findings for certain factors, with non-validated measures potentially less likely to accurately measure target concepts. Some studies did attempt to overcome these issues by

creating new measures modelled on existing scales or theory in the scientific literature [1,20,51,53] or through pre-testing and piloting of the scales [44,52,54].

More generally, self-report measures utilised by all these studies, rely on participants accurately remembering and reporting their exercising. As such, they are susceptible to social desirability and memory biases, potentially resulting in overestimations of adherence. However, many studies employed methods to minimise social desirability reporting and inaccuracies resulting from memory biases such as collecting daily diary data [35], by asking about difficulties encountered with adhering to the HBPT [19], or by asking participants to also record other incidental data to remove their focus from adherence [44]. Furthermore, although self-report measures are subject to these potential biases, the unsupervised, home-based nature of the exercises provide little alternative for measuring adherence without creating much greater participant burden (e.g. asking them to provide video evidence of exercise completion). Alternatives to self-report are also associated with their own limitations. For example, in-clinic assessments are not necessarily an accurate reflection of unsupervised home practice [22]. Furthermore, devices for objective measurement of exercise adherence such as accelerometers may not capture the movements required in therapeutic regimes, and also depend on individuals wearing them appropriately [22]. In addition, these objective measures may remove participants' sense of autonomy over their decision to adhere and, accordingly, may provide an unrealistic view of adherence [56].

Sources of bias

Response bias was a potential issue for a number of included studies which reported that their dropout rates were very high (45%; [39]), and sometimes that the characteristics of their continuing compared to non-continuing participants were significantly different in outcome-relevant dimensions such as severity and frequency of symptoms [36,37]. Both could exacerbate the risk of outcome data being skewed towards those more likely to adhere and potentially mask significant associations with

other factors. Additionally, a small number of studies [39,41,45,50,51] provided little information regarding recruitment methods or eligibility criteria, or those that are detailed suggest that the sample selection procedures could potentially have introduced bias towards likely high-adherers which, in turn, risks a lack of variance in adherence outcomes.

Factors associated with adherence to home-based physical therapies

Results relating to factors associated with adherence were grouped into eight conceptually-related categories: perceptions of illness, condition or injury; characteristics of and perceptions about therapy; perceptions of ability to complete therapy; motivation and intention; behaviours related to home physical therapy; stress and coping; negative cognitions or emotional experiences and social support. Table 2 summarises the relative strength of evidence for each factor.

Study-specific factors, for example, level of fluid intake in relation to PFME adherence [15], will not be discussed as little can be strongly concluded or generalised from these to HBPT more generally. The findings of one study [44], although eligible for inclusion, will not be discussed as they are unclear. Whilst the study reported significant correlations between home adherence and two variables, it also stated that these variables were not predictive of adherence. Attempts to contact two authors of the paper to clarify were unsuccessful.

(Insert table 2 about here)

Perceptions of illness, condition or injury

Perceived severity

There was limited evidence of perceived severity as predictive of HBPT. Despite one study [32], investigating adherence to HBPT for sports injury, demonstrating a large positive relationship, no multivariate analysis was conducted to control for the effect of other variables and three further studies

[1,33,46] investigating musculoskeletal injury, upper-extremity injury and tendonitis-related injuries respectively, provided no evidence of association. One further study [41] demonstrated that physiotherapists' but not patients' estimates of adherence were positively associated with perceptions of severity in multivariate analyses. However, only the overall regression model was reported which does not provide information about the size of the association with perceived severity [41]. Amongst studies investigating predictors of adherence to home-based PFME therapy, potentially more objective symptom severity, in terms of frequency and severity of urine loss, were shown to be associated with adherence in three studies [15,36,38] but not in another [37]. However, it is not clear whether this more objective consideration of severity in terms of counting occurrences of symptoms is predictive of adherence amongst other patient populations.

Perceived susceptibility

Four studies investigated perceived susceptibility as a potential predictor of HBPT adherence. Two studies examining HBPT following tendonitis found positive associations ranging from small-moderate [33] to large [32]. A study examining sports-related injury [41] demonstrated mixed findings; physiotherapists estimates of adherence (but not patients') were positively associated with perceived susceptibility, and completion of time-based recommendations (but not patient or physiotherapist adherence estimates) were independently predicted by perceived susceptibility in multivariate analyses. One large study (n = 293) of tailored exercises in older adults at risk from falls [42] found no association. The differences in findings between the previous studies and this latter one may relate to differences in participant age and the target of the intervention. Indeed, it has been suggested that older adults acknowledge their susceptibility to falling yet still view it as something that 'just happens' or is out of their control [57].

Perceptions of physical health status

Patients' perceptions relating to their health status and functional ability were investigated by eight studies [1,18,37,42,43,45,48,50]. Four [18,43,45,50] provided evidence supporting an association with HBPT adherence. Greater perceived physical function [18] and physical health status [43] predicted better adherence to HBPT amongst post-menopausal women at high risk of osteoporosis [18], and older adults at risk of falls [43]. Both studies utilised validated measures of perceived quality of life and health status [SF-12 and SF-36: 58,59]. Negative perceptions of health status (including being in poor health, lack of strength, shortness of breath and having an existing illness or limitation) were negatively associated with adherence [45] or were self-reported as reasons for non-adherence [43]. Conversely, amongst older adults with osteoarthritis, higher levels of pain were positively associated with home exercise adherence [50] suggesting that pain acted as a motivator. Additionally, desires to improve health and functional ability were expressed by 82% and 75% of adults recovering from stroke, as motivators to adhere to home exercises [51]. However, 57% of these participants also reported undefined 'musculoskeletal' issues as a barrier to adhering. It is not clear, however, exactly what 'musculoskeletal issues' refer to; whilst this is likely to include pain, it seems a broader concept that may encapsulate other difficulties too.

Four studies found no evidence that overall health status [37], general physical function [1], limitations of daily living, self-perceived health [42]or perceived disability [48] were associated with adherence, amongst: females with urinary incontinence; older adults engaged in falls prevention interventions; adults with chronic low back pain; and adults engaged in various HBPTs for musculoskeletal injury.

Characteristics of, and perceptions about, therapy

Number of exercises

The number of exercises prescribed by a HBPT was investigated by three studies [1,20,35]. Two found that amongst patients undergoing HBPT post-ACL repair surgery [35] and those with chronic back pain [20], the more exercises prescribed, the less likely patients were to adhere to recommendations. Both studies controlled for other factors, and the similar association demonstrated across two different patient populations supports the generalisability of the findings. However, one [20] analysed only completed data which, as recognised by the authors, could potentially bias conclusions towards greater adherence as it is likely that many of those who did not complete the study were non-adherent. One study [1] found no evidence that the number of exercises was associated with patient's adherence to HBPTs for various musculoskeletal impairments

Whilst there is some evidence that individuals prescribed a greater number of exercises tend to complete a lesser proportion of them, it does not necessarily follow that they are completing fewer exercises. For example, completing half of a set of ten exercises would involve completing more exercises than being fully adherent to four exercises. Therefore, although the number of exercises may negatively influence adherence, this may not necessarily have a detrimental effect on therapy outcomes. The number of exercises completed, rather than the proportion of prescribed exercise completed is more significant for outcome.

Attitudes towards therapy

Three studies investigated factors relating to attitudes towards exercise therapy as predictors of adherence to HBPT amongst: women with urinary incontinence [38], individuals with tendonitis-related injuries[33] and adults undergoing osteopathic treatment [54]. Two [33,54] provided evidence of small to moderate associations with adherence, whereas one [38] suggested there to be no association. However, the two studies evidencing an association both used a single item measure, one of which [54]

asked about attitudes more generally towards health, sports and exercise. The study which did not find an association utilised a validated 13-item measure of attitudes towards PFME therapy.

Expectations of therapy outcome

Of seven studies [1,32,33,38,41,46,52] investigating whether participants' perceived efficacy and benefits of their HBPT were associated with their adherence, only two [41,52] found limited evidence. Athletes with lower perceptions of the efficacy of their sports injury rehabilitation were less likely to spend the required amount of time completing their exercises as demonstrated by multivariate analyses. Physiotherapist estimates of adherence were associated with perceived efficacy but this did not remain significant in multivariate analyses. However, patient estimates of adherence were not associated with perceived efficacy in this same study. In a further study, a greater belief in benefits of home exercises for rheumatoid arthritis was positively associated with adherence [52]. However, this study relied on a very brief non-validated measure utilising single items to measure these constructs. Nevertheless, in support of outcome expectations predicting adherence, Forkan and colleagues [45] found that older adults endorsing an item suggesting they had low expectations of their home balance exercises were less likely to adhere. The item used to assess outcome expectation in this sample was from a pre-existing validated measure [Expected Outcomes for Habitual Exercise scale: 60].

Conversely, five studies reported no associations with adherence, when investigating perceived benefits of HBPT for musculoskeletal injury [1], upper extremity impairment [46] and urinary incontinence [38], and perceived efficacy of HBPT for tendonitis-related injury [32,33].

Practicalities of conducting therapy

Four studies provided evidence that certain practical barriers are associated with reduced levels of adherence to various HBPTs. Difficulties fitting the exercises in were independently predictive of

poorer adherence amongst women engaged in PFME therapy [15]; and associated with poorer adherence in adults with chronic neck and back pain [20] (but no longer significant in multivariate analyses). Furthermore, 15% of non-adherers to HBPT to reduce risk of falls [43], and 36% of all participants undergoing stroke rehabilitation [51] cited lack of time a barrier to adherence. Two studies [15,37] found that women reporting difficulties remembering to do their PFMEs were less likely to be adherent. One provided evidence of an independent predictive association [37], but whilst the other also demonstrated a negative relationship [15], this was no longer significant in multivariate analyses.

There is some evidence that finding the time to fit exercises in and remembering to do them is associated with how successful patients' are in completing them. However, social-desirability responding could potentially mask genuine reasons for non-adherence in favour of those considered more 'socially-acceptable'. Rather than divulge real reasons, non-adherent participants may report those they feel are more socially acceptable barriers such as those described above. This may lead to an overestimation of those factors' associations with adherence.

Perceptions of ability to complete therapy

Two aspects of participants' perceptions regarding their ability to complete their HBPTs were investigated by twelve studies: perceptions of self-efficacy [20,21,32,33,36-38,41,46,47], perceived behavioural control (PBC) [19,39]. The similarity between these constructs has previously been acknowledged [61] and as such, the findings pertaining to these factors are considered together. Ten of these studies [19-21,32,36-38,41,46,47] provided evidence of an association with adherence. Three [20,38,46] found that patients reporting higher self-efficacy were more likely to be adherent to HBPTs for chronic neck and back pain [20], upper limb impairments [46], and urinary incontinence [38] suggesting that the importance of self-efficacy for adherence is not limited to a specific patient population. Amongst individuals with sports injuries physiotherapist (but not patient) estimates of adherence were predicted by participants' self-efficacy [41]. Once again, only the overall regression

model was reported in this study which does not provide us with information about the size of the association with self-efficacy. In the other cases, these effects ranged from small [20,46] to large [38] but all remained significant in multivariate analyses.

A further five studies provided evidence of an association between patients' perceptions of their ability and their adherence to HBPTs for: urinary incontinence [36,37]; tendonitis-related injury [33]; musculoskeletal injury [21]; and dizziness [19]. However, these associations did not remain significant in multivariate analyses suggesting that the other factors taken into account, including intention [19,36], previous adherence behaviour [36], difficulty remembering to do exercises [37], and practitioner-client relationship factors [21] were at least partially responsible for these effects.

However, one study demonstrated that, amongst individuals with a soft-tissue shoulder injury, whilst maintenance self-efficacy (confidence to continue with exercises over the period) was strongly associated with adherence, recovery self-efficacy (confidence in recovery from an adherence relapse) was not [47]. Two studies [32,39] found no association between perceptions of ability and adherence to HBPT amongst patients' taking part in home rehabilitation post ACL-repair surgery.

Motivation and Intention

Intention to adhere

Participants' intentions to complete their HBPT exercises were investigated by six studies [19,33,36,39,47,53]. All except one [36] found that those reporting higher intention were more likely to adhere across four patient groups; patients undergoing HBPT following ACL-repair surgery [33,39], patients with ankle sprains [53], patients with a soft-tissue shoulder injury [47] and patients carrying out HBPT to reduce dizziness [19]. The size of these effects varied; two [19,39] demonstrated large independent associations with intention; whereas three [33,47,53] demonstrated a small to moderate effects which did not remain significant in multivariate analyses.

One study [36] found that women's intention to conduct their exercises was not associated with adherence to home-based PFME therapy. However, the authors note that the intention data were very positively skewed with small standard deviations which could potentially hinder statistical identification of a relationship between intention and adherence.

Self-motivation

Self-motivation refers to individuals' tendency to persevere with a behaviour in the absence of external drives [62]. Patients' self-motivation to engage in their HBPT was investigated by four studies. Two demonstrated that higher self-motivation independently predicted greater adherence to HBPT for rehabilitation from ACL-repair surgery, accounting for between 23% [24] and 26% [34] of the variance in adherence behaviour. One [24] demonstrated that further predictive ability could be achieved by considering self-motivation's interaction with age; self-motivation was predictive of adherence only amongst older participants.

Two additional studies found small-moderate positive associations between self-motivation and home adherence amongst patients with musculoskeletal impairments [1] and those undergoing rehabilitation following ACL-repair surgery [33]. However, neither provided evidence of a multivariate association. All four studies employed the same validated and reliable measure of self-motivation. Consistent with this evidence, another study [18] reported that, amongst women engaged in home exercises to reduce their risk of osteoporosis, 61% of those who withdrew cited lack of motivation as a reason for doing so. Similarly, 57% of stroke rehabilitation patients cited lack of motivation as a barrier to their home exercise adherence [51].

Behaviours related to physical exercise therapy

Previous adherence behaviour

Three studies [20,36,49] provided evidence that patients who had previously demonstrated good adherence to HBPTs [36,49], or who had not demonstrated poor adherence [20] were more likely to be adherent at the current time point. The generalisability of this finding is strengthened by the fact that the three studies involved different patient populations; older adults with osteoarthritis of the hip or knee [49]; women engaged in PFME therapy for urinary incontinence [36]; and patients undergoing HBPT for neck and low back pain [20]. All three demonstrated that previous adherence behaviour remained associated with adherence after other factors were accounted for, suggesting this to be an independent predictive association. Relatedly, an additional study [33] reported that habit (measured by participants' frequency of engagement in clinic-based activities across the whole rehabilitation period) significantly predicted adherence to home exercises amongst athletes with a tendonitis-related injury. A further study also reported that previous positive experiences relating to health, sport and exercise were associated with greater adherence to home rehabilitation exercises amongst those undergoing osteopathy treatment [54].

Current Physical Activity Level

Four studies [1,21,43,49] investigated whether participants' involvement in physical activity was associated with adherence, but only one [49] supported this. Amongst older adults with osteoarthritis, those reporting the highest levels of concurrent physical activity were much more likely to be adherent to their home exercises in weeks five to eight than those reporting the lowest levels [49]. Those who perceived themselves as physically inactive were also far less likely to be adherent. The authors acknowledge that this was not the case for weeks one to four suggesting that these factors may only be predictive of longer-term adherence. These large effects were from multivariate analyses suggesting

that patients' perceptions of their physical activity levels were independently predictive of home exercise adherence.

However, three studies [1,21,43] found no evidence amongst patients' undertaking HBPT for various musculoskeletal impairments [1,21], nor older adults engaged in home-exercises for falls prevention [43], that current activity level was associated with adherence. Variations in follow-up durations between studies may account for some differences in findings.

Stress and coping

Two studies [15,35] provided evidence that stress may act as a barrier to HBPT adherence. One [35] found that adults engaged in HBPT following ACL-repair surgery adhered less on days when they reported elevated stress. Furthermore, there was an interaction between daily stress and participants' athletic identity; on days when participants experienced low stress, level of athletic identity did not influence adherence rates, whereas on high-stress days, those strongly identifying as athletes were more likely to be adherent. Relatedly, Borello-France and colleagues [15] found a significant association between 'other barriers' and reduced levels of adherence amongst women engaged in home-based PFME therapy for urinary incontinence, with 'life stress' reported as one of these.

One study [33] found that both distraction coping and palliative coping were independently predictive of home adherence. Patients who avoided thinking excessively about their ACL injury (distraction coping) were more likely to be adherent to rehabilitation exercises. Conversely, those focused on alleviating the negative *consequences* of their injury (palliative coping) were less likely to be adherent. This study also found an association between instrumental coping and home exercise adherence, but multivariate analyses revealed that this was accounted for by other factors.

Negative cognitions and emotional experiences

Two studies provide evidence that negative cognitions and emotional experiences may act as barriers to HBPT adherence for rehabilitation from ACL-repair surgery [35] and impaired balance [45], On days when participants reported negative mood, they completed a lower proportion of their home exercises [35]. Additionally, more pessimistic patients performed a smaller proportion of their exercises on days they experienced greater pain [35]. Both factors remained significant after other factors were accounted for suggesting an independent predictive association.

Feelings of depression interfering with exercise were also shown to be associated with reduced HBPT adherence [45]. Individuals reporting this were less likely to complete their exercises as those who did not report having trouble with their exercises whilst depressed. However, as this study did not conduct multivariate analyses, it is not possible to understand the nature of this relationship further. Conversely, a further study suggests that higher baseline distress was associated with a longer total training time at both four and 12 month follow-up amongst low back pain patients [48]. However, this was also not investigated using multivariate analyses.

Social support and guidance

Guidance and advice from physiotherapist

Five studies investigated the relationship between support from a physiotherapist and adherence to HBPTs for: rheumatoid arthritis [52]; musculoskeletal injury [1,21]; tendonitis-related injuries [33]; and neck and low back pain [20]. They provided evidence that participants were more likely to adhere to HBPT exercises when they were satisfied with their physiotherapist [1,20,21], received clarification of doubts and had questions answered [1,20], felt 'stimulated' or encouraged by the physiotherapist [52], had at least one instance of supervised exercises [1,20], and perceived that the physiotherapist appreciated what was required of them as a patient [33]. Evidence from multivariate analysis was mixed but demonstrated some support for all factors except 'stimulation from

physiotherapist' which was only investigated in univariate analyses. The generalisability of these findings is supported by the range of therapies studied.

It should be considered though, whether participants truthfully report any negative experiences of their physiotherapists if they perceive that the therapist might see this. In two studies [1,33], the relevant questionnaires were completed during clinic and so were potentially vulnerable to socially-desirable responding which could bias the results in favour of more positive physiotherapist evaluations. One study did attempt to mitigate this effect by offering participants the opportunity to complete the questionnaire at home [1] and another two either sent the questionnaires by post a month later [20] or only contacted participants after discharge [52]. However, participants may still have had concerns about who would see the returned questionnaire that may have influenced their responding.

Support from friends and family

Four studies investigating HBPTs for: rehabilitation following ACL-repair surgery [24,34]; tendonitis-related injuries [33]; and neck and low back pain [20] demonstrated that emotional support [20,33,34] and listening support from teammates and personal assistance from family [33] were associated with greater home-exercise adherence. One study demonstrated an interaction between age and general social support such that higher levels of social support predicted greater adherence only amongst the oldest third of participants [24]. With the exception of emotional support from family and friends for which analyses provided mixed results, all other factors remained significant in multivariate analyses. 50% of stroke rehabilitation patients also reported social support to be a motivating factor in adhering to their home rehabilitation therapy [51].

Conversely, one study suggested that encouragement from relatives was not associated with adherence to HBPT for rheumatoid arthritis [52]. However, this study relied on a very brief non-validated measure that only used a single item to measure this construct, and asked participants to recall information retrospectively.

Discussion

Summary of key findings

There was relatively strong evidence that the following factors predicted adherence to HBPTs: intention to engage in the HBPT, self-motivation, self-efficacy, previous adherence to exercise-related behaviours, and social support. However, making robust conclusions about the predictive ability of these factors has been significantly challenged by the limited number of studies investigating many factors, studies' methodological limitations, variations in concept definition and operationalization, and discrepancies between findings. Of particular note is the problematic measurement of home exercise adherence. The lack of validated and standardised methods [22] pose a real methodological limitation within this field of research and make it very challenging to compare across findings of studies.

Predicting adherence to home-based physical therapies

Self-efficacy emerged from the review as a strong predictor of adherence to HBPTs. Given that self-efficacy refers to individuals' confidence in their ability to complete a given task [63], in a situation that is reliant predominantly upon their own skills and knowledge, it is perhaps not surprising that patients' self-efficacy is predictive of the extent to which they continue with their HBPT. Greater self-efficacy allows individuals to overcome challenges with greater ease [64] which, again, seems especially important whilst individuals are engaged in such therapies without professional supervision. Several reviews have similarly reported that individuals with greater self-efficacy tend to be more adherent to outpatient physical therapy [23], cardiac rehabilitation and general exercise recommendations [65,66].

Higher self-motivation and greater intention to complete HBPT exercises also emerged as strong predictors of greater adherence to HBPTs. Given the self-managed nature of physical therapy programmes considered, it is perhaps to be expected that greater intention and self-motivation were predictive of adherent behaviour. Self-Determination Theory [SDT: 67,68] postulates that intrinsic motivation, stemming from internal perceptions of the importance, value and interest in the target

behaviour, is more likely to result in persistent performance than extrinsic motivation, resulting from external sources of coercion and feelings of obligation [67]. In a self-managed therapy programme, relatively free of external motivators, individuals reporting higher intentions and self-motivation are likely to have comparatively high intrinsic motivation and, therefore, should be most likely to adhere. These findings are also concordant with theoretical models and empirical findings in related areas of study. Certain theoretical models propose that intentions are the most immediate determinant of behaviour [e.g. Theory of Planned Behaviour (TPB): 61] and empirical findings have also demonstrated intentions to be predictive of treatment-related exercise adherence [69]. Self-motivation has also been shown to be independently predictive of adherence to sports rehabilitation therapies [70-72] and cardiac rehabilitation therapies [66,73].

Previous adherence behaviour emerged as a further strong predictor of adherence to HBPT exercises. If an individual has successfully completed similar behaviours before, this is likely to increase their perceptions of competence [74], and therefore their likelihood of conducting the behaviour again. Furthermore, increased perceptions of exercise competence are likely to enhance interest in the behaviour [74] which in turn, may increase intrinsic motivation and the likelihood of persistence. In support of these findings regarding previous adherence behaviour, a systematic review of adherence to outpatient physical therapies [23] similarly revealed that greater past adherence behaviour is predictive of higher current adherence. Other empirical findings have revealed similar results amongst chronic back pain sufferers [75] and individuals with Rheumatoid Arthritis [76]. Rejeski and colleagues [77] also concluded that a patient's history of adherence to home exercises may be indicative of future performance.

A final factor emerging from this review as a strong predictor of adherence to HBPTs was that of social support. Social support is believed to facilitate adherence via encouraging optimism and self-esteem, buffering stresses of illness, reducing depression and giving practical assistance [78,79]. The review's findings in this regard are in line with previous reviews of adherence to medical treatments in

general [80] and, more specifically, outpatient physiotherapy [23], which also demonstrated greater levels of support to be associated with greater adherence.

Limitations

Only published full-text English language articles were included which may have introduced a publication bias given that unpublished studies may be more likely to have reported null-findings. It might be also considered that the review did not give sufficient consideration to variations in adherence measures between studies. Given that the review considered a broad range of different HBPTs with differing patient-population characteristics, making full consideration of different adherence measures would have added further complexity to the synthesis and may have limited conclusions further. The fact that some predictors are differentially associated with adherence depending on whether frequency, intensity, duration or proportion of recommendations completed is measured, suggests that this need to be considered in future [81].

The heterogeneity of the HBPTs included within the review, and the associated variations in both therapy and patient characteristics may also be considered a limitation of the synthesis and interpretation of findings across studies. However, the focus of this review intended to take a broad overview of self-managed rehabilitation therapies in order to understand whether there are factors predictive of adherence to self-managed physical rehabilitation regardless of the specific focus of the therapy. As such, it seemed important to consider a broad range of self-managed therapies. The nature and duration of HBPTs, as well as characteristics of specific patient populations are likely to be influential in adherence. Additional reviews with narrower, perhaps condition-specific, focus could potentially investigate whether predictors of adherence are specific to particular therapy types or patient subgroups. Similar reviews investigating intervention-related factors for adherence in musculoskeletal pain [82] and, more specifically, chronic low back pain [26] have already been conducted.

Implications for research and practice

Further research could look to clarify the nature of the relationships between HBPT adherence and each of the five factors identified as consistent predictors; i.e. whether there are certain groups of people, or circumstances for which these predictors are especially strong and whether other factors mediate or moderate the relationship. In conjunction with the growing behaviour change technique literature e.g. [83], these findings could help to inform the most effective ways to increase adherence to new HBPT interventions. Having provided evidence regarding the most important determinants of adherence behaviour to target in this context, this could guide the appropriate choice of behaviour change techniques for implementation in these interventions. Finally, future research should aim to address the discussed methodological limitations – particularly issues relating to the measurement of home based exercise adherence - to provide more robust support for predictors of adherence to HBPTs.

The findings of this review have implications for practitioners instigating HBPT regimes with patients. Given that greater self-efficacy, self-motivation, social support, intentions and previous adherence to physical therapies appear to predict higher adherence to HBPTs, prior assessment of these domains may identify any 'risk factors' for poor adherence. With regards to social-support and self-motivation, these assessments may be especially important amongst older adults given the findings that their adherence is more likely to be influenced by these factors. Furthermore, HBPT interventions could include elements designed to target self-efficacy and self-motivation to improve adherence to HBPTs. It has previously been suggested that strategies such as agreeing realistic expectations [84], setting treatment goals [85],action planning [64], and positive reinforcement [86] may help increase patient self-efficacy. Interventions to increase self-efficacy can effectively reduce non-adherence to exercise programmes [87].

Conclusions

This systematic review has found that intention to engage in HBPTs, self-motivation, self-efficacy, previous adherence behaviour, and social support appear to be strong predictors of HBPT adherence. Understanding these predictors provides greater scope for researchers and practitioners to improve adherence through intervention design and implementation targeted at enhancing facilitators and minimising barriers to adherence. The review also identified predictors of adherence behaviour in a self-managed context that are still not fully understood; in noting the contradictory findings and methodological limitations, the review has highlighted areas for further research.

Declarations of Interest

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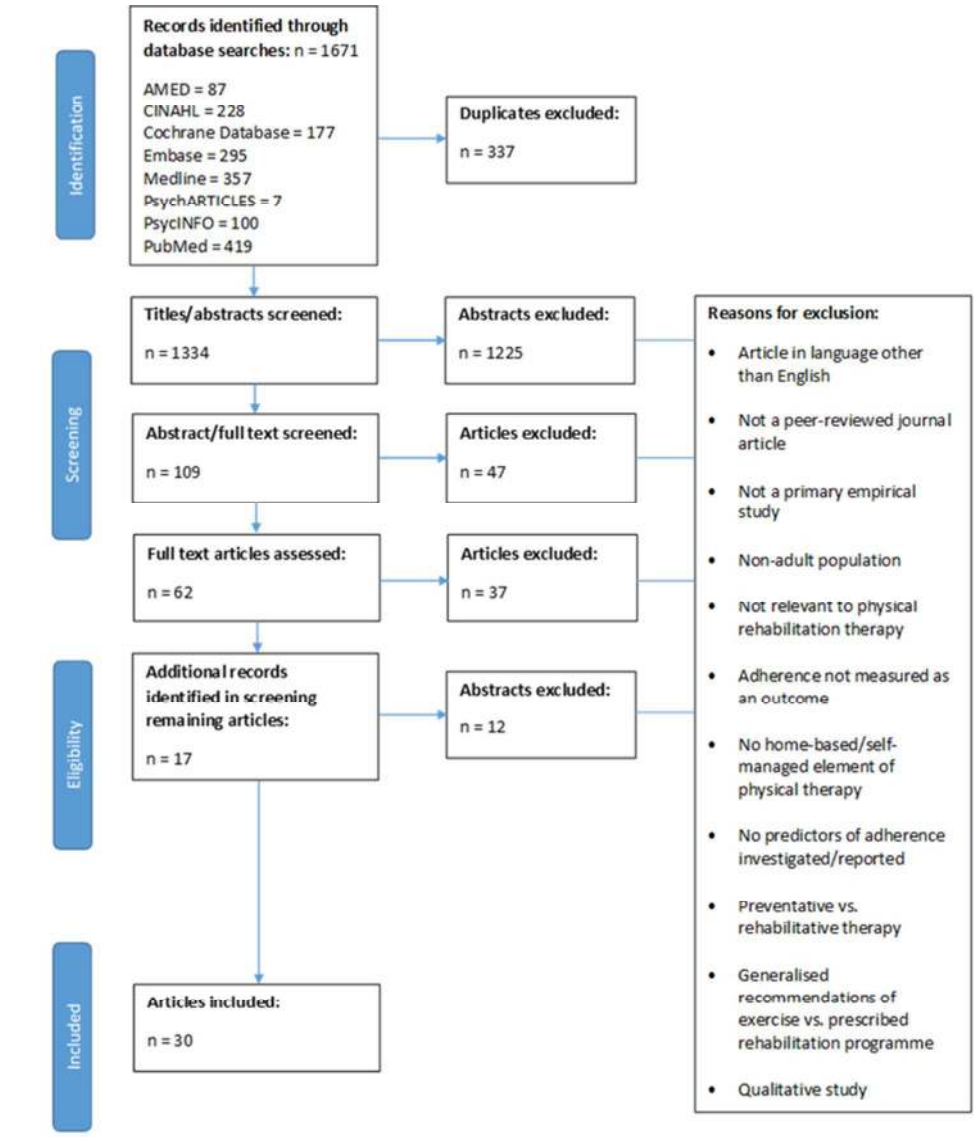

Figure 1 Process of Study Selection

Figure 1. Process of study selection
208x248mm (96 x 96 DPI)

Table 1. Summary of study characteristics

ID	Study and Design	Sample Details	Home-based Physical Therapy Intervention	Adherence Outcome Measure(s)	Significant predictors (effect sizes presented where available)	
					Uni/bivariate	Multivariate
[36]	Alewijnse, et al. (2003) Longitudinal prospective study	129 females, mean age 55.6 years (SD 10.9 years), stress, urge or mixed UI (non-medicated), Netherlands.	Pelvic floor muscle exercises (PFME) at home in follow up period	Participant diary and self - report adherence questionnaire at one year follow-up	**Self-efficacy**, β=0.27, p<0.018	**Final model:** R^2=0.50, R^2 change = 0.133, p<0.001, **previous good adherence**, β=0.43, p=0.000; **weekly wet episodes,** β=0.28, p=0.010
[53]	Bassett & Prapavessis (2011) Secondary data analysis from RCT	69 adults (29 males, 40 females), mean age 35.2 years (SD 12.9 years), with a sustained ankle sprain, New Zealand	Strengthening and balancing activities post discharge from physiotherapy to maintain integrity of ankle	Participant self-report scale measuring extent of adherence to all modalities of treatment from 1 = none to 5 = all	**Intention,** r = 0.25, p<0.05	
[15]	Borello-France, et al. (2010) Prospective secondary data analysis from RCT	144 females, mean age 55.8 years (SD 14.2 years), urge-predominant UI, USA.	PFME in 12 months following 10-week behavioural intervention for urinary incontinence	Self-report exercise questionnaire.	**'Other barriers' including life stress**, B=-3.6, p=0.02 **difficulty remembering to do exercises**, B = -2.6, p=0.03, **baseline symptom severity,** p <0.05	**Difficulties finding time for exercises**, B = -2.5, p=0.03
[37]	Borello-France, et al. (2013) Prospective secondary data analysis from RCT	296 females, mean age 49.6 years (SD 13.0years), stress predominant UI, USA.	PFME in 12 months following 10-week behavioural intervention for stress incontinence	Self-administered questionnaires at clinic attendance.	**Unsure whether doing exercise correctly**, p=0.046	**Difficulty remembering to do exercises**, OR=0.20, p=0.01
[34]	Brewer, et al. (2000) Prospective study	95 athletes (28 female, 67 male), mean age 26.92 years (S.D. 8.23 years) undergoing Anterior Cruciate Ligament (ACL) repair operation, USA	Post-surgery home exercises to promote strength and flexibility in lower limb	Six month post-surgery visits: reported on a scale of 1 (none) to 10 (all) (extent to which they had completed therapy since last visit).	**Social support**, r=0.22, p<0.05	**Self-motivation**, R^2=0.26, β=0.39, p<0.05
[24]	Brewer, et al. (2003) Longitudinal prospective study	61 athletes (21 female, 40 male), mean age 26.03 years (SD 7.99 years) undergoing ACL repair operation, USA	Post-surgery home rehabilitation exercises to promote strength and flexibility in lower limb.	Reported at each subsequent clinic appointment on a scale of 1 (none) to 10 (all) (extent to which they had completed therapy since last visit).		**Self-motivation**, R^2=0.23, β=0.37, p<0.05; **Interactions:** R^2=0.24, **self-motivation x age**, β=0.31, p<0.05; **social support x age**, R^2=0.24, β=0.25, p<0.05

[35]	Brewer, et al. (2013) Prospective daily process study	91 athletes (33 female, 58 male), mean age 29.73 years (S.D. 10.24 years) undergoing ACL reconstruction surgery, USA	Six weeks of post-surgery home rehabilitation exercises to promote strength and flexibility in lower limb.	Self-reported number of sets of home exercises completed per day divided by number of sets of exercises they had been advised to for each of those days. Home exercise ratio calculated.		**Number of exercises**, R^2=0.44, B=-0.251, p<0.001; **daily-stress**, R^2=0.025, B=-0.049, p<0.05; **negative mood**,R^2=0.025, B=-0.011, p<0.05; **Interactions: daily stress x athletic identity,** B= 0.005, p<0.05**; pessimism x pain,** B = -0.020, p<0.05
[1]	Chan & Can (2010) Cross-sectional study	82 patients (58 female, 24 male) age range 16 – 75 years (mean not reported), completing physiotherapy for various conditions, Turkey	Various home physiotherapy exercise regimes (of at least one week duration at recruitment) for musculoskeletal injury	Two item self-report measure of adherence on 5-point Likert scale: 1) times exercises performed per week; 2) number of exercises per session.	**Self-motivation**, r=0.24, p=0.035; **satisfaction with physiotherapist**, r=0.31, p=0.004; **explanation from physiotherapist**, r=0.34, p=0.002; **reassessment of exercises**, r=0.31, p=0.005	
[38]	Chen & Tzeng (2009) Cross-sectional study	106 women, mean age 48.6 years (S.D. 11.39 years), being treated for urinary incontinence, Taiwan	Daily exercise repetitions of PFMEs carried out at home for 12 week period	Three item scale rating average daily time spent on PFMEs and number of daily exercise repetitions.		**Final model:** r^2 = 0.40: **Self-efficacy** r=0.59, p<0.001; **severity of urine loss** r=0.18, p<0.05
[46]	Chen, et al. (1999) Cross-sectional study	62 patients (23 male, 39 female), mean age 47.8 years (SD 13.8 years), upper extremity impairment, USA	Home exercises involving mobilisation of upper extremity as part of physiotherapy programme (of at least one week duration at recruitment)	Self-report questionnaire - for each exercise: number of reps per session & number of sessions per day recommended and actually performed during typical day in previous week.		**Self-efficacy**, r^2=0.08, β=0.33, p<0.05
[47]	Clark & Bassett (2014) One group prospective design	24 adults (14 male, 10 female) mean age 44.2 years (SD 20.4 years) with soft tissue injury of the shoulder, New Zealand	Prescribed home exercise programme for treatment of shoulder injury	Home exercise diary required participant to answer 'yes' or 'no' to two questions regarding whether they completed the required number of exercises prescribed by physio.	**Behavioural intentions,** r= 0.24, no p value reported; **maintenance self-efficacy** r= 0.67, p <0.05	

[45]	Forkan, et al. (2009) Cross-sectional study	175 over 65 year-olds, (156 female, 19 male) mean age 81.04 years (SD 7.08 years), impaired balance , USA	Life-long home exercise plan of balance and flexibility exercises upon discharge from physiotherapy (4-6 week programme).	Self-report survey - measured frequency, duration and combination of mode of exercise	**Negative perceptions of health status**, OR=0.23, p=0.004; **low expectations of therapy**, OR = 0.40, p=0.05; **feelings of depression as barrier**, OR=0.28, p=0.032
[48]	Friedrich, et al. (1998) Double-blind prospect randomised controlled trial	93 adults (46 male, 47 female) mean age 44,1 years (SD 10.7 years) with chronic and recurrent low back pain	Home physical therapy sessions to improve spinal mobility, muscle strength and coordination post-inpatient treatment for back pain.	Daily exercise diary indicating whether, and for how many minutes, exercises performed. Also asked to confirm at 4 and 12 month follow up how long after end of treatment they continued exercising.	**Level of distress,** r=0.18, p=0.036 (4 months,) r = 0.19, p=0.045 (12 months)
[44]	Hardage, et al. (2007) Cross-sectional study	50 older adults (14 male, 36 female) mean age 79. 9 years (SD 7.1 years) recently discharged from home health physiotherapy, USA	Home exercise programme including resistance exercises to improve strength and balance to avoid recurrent falls/injury	Daily home exercise log – monthly calendar on which they marked 'e' on dates they performed exercises. (also asked to record days they had falls as a distractor variable)	**Self-efficacy expectations,** r_{pb}= 0.370, p =0.014; **outcome expectations,** r_{pb}= 0.434, p=0.003 (However, text describes as negative correlations and also states that both factors **did not** predict exercise adherence)
[54]	Howard & Gosling (2008) Cross-sectional study	146 adults (no demographic data reported) prescribed an exercise rehabilitation prescription following attendance at Osteopathy Clinic, Australia	Exercise rehabilitation prescription to be conducted outside formal treatment setting including stretching, strengthening, proprioception and functional rehabilitation	Single item measure in scale: "Did you complete all of the exercises prescribed to you as directed?" Yes/No dichotomous response	**Attitude to health, sport and exercise,** t_{144}=10.16, p<0.001; **past experience of health, sport and exercise,** Mann-Whitney U = 192, corrected z = -9.70, p<0.001
[51]	Jurkiewicz, et al. (2011)	14 adults (7 male, 7 female), mean age 62.9 year, (SD 13 years) post stroke engaged in home-based exercise rehabilitation programme	Resistance training programme conducted at home 2-3 times per week: emphasis on retraining of balance, coordination, weight shifting	As part of questionnaire administered asked to report number of workouts per week.	No significant correlations but participant reported motivators: **desire to improve overall health** (82%)**; desire to improve functional ability** (75%)**; social support** (50%); and barriers: **lack of motivation** (57%); **musculoskeletal issues** (57%); **not enough time** (36%)

[32]	Levy, et al.(2006) Longitudinal prospective study	70 athletes (44 male, 26 female) mean age 32.5 years (SD 10.2 years), tendonitis related injury, UK	Daily home exercises for tendonitis related injury as part of 8-10 week physical therapy rehabilitation programme.	Self-report 5 point Likert scale re. extent to which they had completed recommended exercises.	**Perceived severity**, r= 0.60, p<0.01; **perceived susceptibility**, r=0.72, p<0.05	
[33]	Levy, et al. (2008) Longitudinal prospective study	70 athletes (44 male, 26 female) mean age 32.5 years (SD 10.2 years), tendonitis related injury, UK	Daily home rehabilitation exercises for tendonitis related injury as part of 8-10 week physical therapy rehabilitation programme.	Self-report 5 point Likert scale re. extent to which they had completed recommended exercises.	**Perceived susceptibility**, r=0.26, p<0.05; **self-efficacy** r=0.36, p<0.01; **intention**, r=0.27, p<0.05; **self-motivation**, r=0.24, p<0.05;**attitude**, r =0.31, p< 0.05; **instrumental coping**, r=0.34, p<0.01; **listening support from teammates**, r=0.87, p<0.01; **personal assistance from family**, r=0.26, p<0.05	**Final model** R^2= 0.60: **Habit**, β=0.202, p<0.05; **distraction coping**, β=0.223, p<0.05; **palliative coping**, β=-0.453, p<0.001; **task-appreciation by physiotherapist**, β=0.370, p<0.01; **emotional support from friends**, β=0.292, p<0.05
[18]	Mayoux-Benhamou et al. (2005) Longitudinal prospective study	135 post-menopausal females, mean ages 59.6 years (SD 6.2 years) (all < 70 years), risk factors for osteoporosis, France	Daily programme of four strengthening and flexibility exercises focusing on hips and back to be carried out at home following one-off session	18-month follow up: proportion of prescribed exercise reps per week compared to number self-reported as completed.		**General physical function**, OR=1.26, no p value reported
[20]	Medina-Mirapeix, et al. (2009) Prospective cohort study	184 adults (148 female, 36 male)aged 18-70 years (mean age not reported), chronic non-specific neck or low back pain, Spain	Stretching and strength exercises to be completed at home after four-week physiotherapy intervention in clinic - individual recommendations of frequency per week and duration per session	One month post-intervention: adherence to frequency per week and duration per session: self-report 5 point Likert assessing how often they adhered to frequency and durationrecommendation (Never-Always).	**Difficulties fitting exercise in**, OR=7.4, p<0.05;**satisfaction with physiotherapist**, OR=1.2, p<0.05; **positive emotional support**, OR=3.5, p<0.05	**Number of exercises**, OR = 0.2, p<0.05; **self-efficacy**, OR=1.5, p<0.05; **previous poor adherence**, OR=0.3, p<0.05; **clarification of doubts and questions answered**, OR=4.1, p<0.05; **supervision of exercises**; OR=3.3, p<0.05
[39]	Niven, et al. (2012) Longitudinal prospective study	87 athletes (65 men, 22 women), mean age = 28.95 years, (SD 7.7 years)post ACL repair operation, UK	Eight week home based rehabilitation programme post-surgery including mobilisation and stretching of affected leg.	Participants' self-report estimation in rehabilitation diary and 7-point Likert scale regarding extent to which they adhered in previous 2 weeks at 2, 4, 6 and 8 weeks.		**Intention (at week 4)**, adj. R^2= 0.47, p<0.01

[40]	Scherzer, et al. (2001) Prospective study	54 athletes (17 female, 37 male), mean age = 28 years (SD 8.33 years) post ACL surgery , USA	Home-based rehabilitation exercises following ACL repair surgery focusing on knee extension and flexion, quadriceps strength and normal gait.	Patients rated their completion of prescribed home exercises since their last appointment for five weeks post-surgery.	No significant findings discussed in this review – included as investigated a number of common factors but these were not found to predict HBPT adherence in this study.	
[49]	Schoo, et al. (2005) Prospective study	115 adults (41 male, 74 female), mean age = 70.4 years (SD 6.80 years), osteoarthritis of hips or knee, Australia	Eight week programme of home mobility and strengthening exercises for knees and hips. Supported with brochure.	Calculated from participant self-report log sheet as percentage of exercises completed for prescribed routine.		**Previous good adherence**, OR=19.86, p<0.001; **high levels of physical activity**, OR=5.58, p=0.033; **perceptions of physical inactivity**, OR=0.07, p=0.009
[50]	Seckin, et al. (2000) Prospective observational study	120 adults (20 male, 100 female), mean age 57.3 years (SD 8.4 years) with osteoarthritis of the knee	3 month home-based exercise programme to be conducted daily including flexibility, strength, endurance and active range of motion movements.	Asked at each follow-up visit: how many days they had done the exercises, how often they did the exercises per day, and the number of times they had exercised.	**Pain score,** r=0.40, p<0.05	
[42]	Sjosten, et al. (2007) Prospective secondary data analysis from RCT	293 over 65 year-olds (214 female, 79 male), mean age 73.4 years (SD 6.0 years) at risk of frequent falls, Finland	Tailored home exercises to be performed three times per week over one year intervention. Lower leg muscle strength, balance and coordination exercises increasing in intensity as individual progressed.	Participant self-report daily diaries returned monthly. Total number of performed sessions over intervention divided by number of monthly diaries returned - this was divided by 30 and multiplied by 7 for weekly rates.	No significant findings discussed in this review – included as investigated a number of common factors but these were not found to predict HBPT adherence in this study.	
[43]	Spink, et al. (2011) Prospective secondary data analysis from RCT	153 older adults (47 male, 105 female) mean age 74.2 years (SD 6.0 years) high risk of falls, Australia	Home-based foot and ankle exercises - 30 minutes, 3 times per week for 6 months, aimed at stretching and strengthening muscles	Self-report daily exercise diary - advised to return each month.		**Physical health status**, Canonical R^2 = 0.05, p=0.007
[41]	Taylor & May (1996) Prospective study	62 athletes (42 female, 20 male) mean age 21.7 years (SD 2.85 years), various sports injuries, UK	Home-based exercises part of individualised sports injury rehabilitation plan recommended by physiotherapist (3-10 day follow-up)	Compliance data sheets completed by patient and physiotherapist at 1st and 2nd appointment - estimation of extent to which they complied with the exercises (0 to 5).	**Perceived susceptibility***, r=0.28, p<0.05; **perceived treatment efficacy***, r=0.26, p<0.05	**Perceived severity***; **perceived susceptibility****; **perceived treatment efficacy****; **self-efficacy***

[52]	Terpstra, et al. (1992) Retrospective cross-sectional study	104 patients (28 men, 71 women, 5 undisclosed), mean age 59 years (range 18-78 years) with diagnosis of definite or classical rheumatoid arthritis, Netherlands	Daily home-based exercise programme post discharge from hospital consisting of 26 exercises for all parts of the body.	Four items of the questionnaire asked about whether, and how often, participants exercised: during the month after discharge, and in the past month.	**Stimulation by health care professional,** p=0.043**; belief that exercising worthwhile,** p=0.003**; belief that exercising does good,** p=0.001 (Mann-Whitney U tests – effect sizes not presented)	
[21]	Wright, et al. (2014) Cross-sectional study	87 patients (62 female, 25 male) mean age 43.8 years (SD 17.57 years), various musculoskeletal injuries, Australia	Home exercises prescribed as part of various individualised physiotherapy regimens for musculoskeletal injuries	3 item self-report asking whether participants: completed all exercises recommended (yes/no); how much effort they put into exercises (– 'a lot of effort' to 'no effort'); and percentage of exercises they completed	**Self-efficacy**, r=0.27 (p value not reported)	**Satisfaction with physiotherapist**, r^2=0.16, p=0.001
[19]	Yardley & Donovan-Hall (2007) Prospective observational study	150 (44 male, 106 female) mean age = 61.1 years (SD 14.68 years), vestibular-related dizziness and balance disorders, UK	12 week programme of Vestibular Rehabilitation Exercises conducted daily at home with periodic nurse support phone calls.	Self-report postal questionnaire - first 12 items: problems faced in adhering. Asked how many weeks they continued therapy and if they stopped because asymptomatic.	**Perceived behavioural control**, r=0.19, p<0.05 pre-treatment, r=0.39, p<0.01 post-treatment	**Intention**, OR=1.23, p<0.05 (post-treatment), final model r^2=0.39

Note: *, physiotherapist estimate of adherence only; **, time-based element of compliance measure only

Table 2. Summary of evidence strength for predictive factors of adherence to HBPTs based on number and size of significant findings and evidence quality

Factor Investigated	Strong evidence				Moderate evidence				Weak evidence			
	+	-	NS	I	+	-	NS	I	+	-	NS	I
Perceived severity *			[46]		[32]		[33]	[41]	[15,36, 38]	[37]	[1]	
Perceived susceptibility *			[42]		[33,32]			[41]				
Perceptions of health status *	[18,43]		[37,42]			[50]	[48]		[45]		[1]	
Number of exercises **		[35,20]									[1]	
Attitudes towards therapy*			[38]		[33]				[54]			
Expectations of therapy outcome ***			[46, 38]				[32,33]	[41]	[52]		[1]	
Not having time for exercises **		[15,20]				[43]						
Forgetting to do exercises **		[15,37]										
Perceived ability to complete therapy ***	[36,37, 46,20, 21,19, 38]		[39]		[33,41]		[32]					[47]
Intention to adhere ***	[39,19]				[33,53]		[36]		[47]			
Self-motivation ***	[34,24]				[33,18]				[1]			
Previous adherence behaviour ***	[36,20, 49]				[33]							
Current Physical Activity Level *	[49]		[43,21]								[1]	
Daily stress *		[35]								[15]		
Distraction coping style *					[33]							
Palliative coping style *						[33]						
Instrumental coping style *					[33]							
Negative cognitions and emotional experiences *		[35]			[48]					[45]		
Social support and guidance ***	[34,24, 20,21]			[33]					[1, 52]		[52]	

Note: **+**, positive association; **-**, negative association; **NS**, no significant association; **I**, inconsistent evidence of association; [#], ID of study providing evidence; ***, strong overall evidence of association with adherence; **, moderate overall evidence of association with adherence; *, limited overall evidence of association with adherence.