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Defining adherence to therapeutic exercise for musculoskeletal pain: A systematic review.

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Defining adherence to therapeutic exercise for musculoskeletal pain: A systematic review.

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Author contributions - DB, NF, MH & AB contributed to the design of the review. DB executed the search strategy with input from NF, MH & AB. DB, NF, AB & JQ assessed studies for inclusion and extracted data from each of the included studies. DB analysed the data and developed the first draft. All authors interpreted the data, contributed to the critical revision of the manuscript and approved the final version.

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ABSTRACT (248 words)

Objective: To establish the meaning of the term 'adherence' (including conceptual and measurement definitions) in the context of therapeutic exercise (TE) for musculoskeletal (MSK) pain.

Design: Systematic review using a search strategy including terms for: adherence, TE and MSK pain. Identified studies were independently screened for inclusion by two researchers. Two independent researchers extracted data on: study type; MSK pain population; type of TE used; definitions, parameters, measurement methods, and values of adherence.

Data sources: Seven electronic databases were searched from inception to December 2016.

Eligibility Criteria: Any study type featuring TE for adults with MSK pain and containing a definition of adherence, or a description of how adherence was measured.

Results: 459 studies were identified and 86 were included in the review. Most were prospective cohort studies and featured back and/or neck pain. Strengthening and stretching were the most common types of TE. A clearly identifiable definition of adherence was provided in 40% of the studies, with 12% using the same definition. Exercise frequency was the most commonly measured parameter of adherence, with self-report logs the most common measurement method. The most common value range used to determine satisfactory adherence was 80-99% of the recommended exercise dose.

Conclusion: No single definition of adherence to TE was apparent. We found no definition of adherence that specifically related to TE for MSK pain or described the dimensions of TE that should be measured. We recommend conceptualising adherence to TE for MSK pain from the perspective of all relevant stakeholders.

INTRODUCTION

There is strong evidence for exercise therapy as a treatment option for musculoskeletal (MSK) pain in primary care, with medium or large effect sizes for pain, function and quality of life outcomes¹. The effects of exercise compare favourably with other treatments including self-management, manual therapy, oral and topical pharmacological treatments, and surgery¹. Therapeutic exercise (TE) is an effective and safe treatment for MSK pain^{2,3,4} and is recommended in many clinical guidelines^{5,6,7,8}. However, the effectiveness of exercise is dependent upon the level of adherence to the recommended exercise protocol. A systematic review of 72 exercise treatments for low back pain (LBP) found that when adherence was encouraged to achieve a high dose of exercise, pain scores improved favourably compared to lower doses of exercise⁹. Higher exercise adherence can improve pain and physical function outcomes in patients with MSK pain and osteoarthritis (OA)^{10,11}. Adherence was identified by an expert consensus group as an important factor for determining outcomes from exercise in patients with knee or hip OA¹². To improve the effectiveness of exercise for MSK pain, various strategies to enhance adherence have been investigated, such as goal setting and automated reminders but with inconsistent results¹³.

Three recent systematic reviews of measures of exercise and self-management methods for MSK pain^{14,15,16}, found that measures of exercise adherence currently used within randomised controlled trials are highly variable (including questionnaires, diaries and class registers), lack evidence of a robust or considered development process, and demonstrate inadequate psychometric properties for reliability and validity. There is no existing measure of adherence that is fit for purpose^{14,15,16}. A valid and reliable measurement tool for adherence to TE for MSK pain is therefore required to enable interpretation of results from exercise trials and to robustly test the effectiveness of interventions intended to improve exercise adherence¹³⁻¹⁶.

To develop a measurement tool, the concept of interest must first be understood¹⁷ as the adequacy of an instrument will depend upon the conceptual framework from which it is developed¹⁸. However, exercise adherence is a multi-dimensional construct¹⁹, which is poorly defined¹⁶, with multiple synonyms used in the published literature to describe its meaning, such as: compliance, concordance, agreement, cooperation, partnership and therapeutic alliance²⁰. These terms are regularly used interchangeably, although arguably were originally intended to convey different meanings. Compliance and adherence both refer to the patient-healthcare practitioner (HCP) interaction, but adherence is viewed as reflecting a less paternalistic relationship, with the patient as an active decision maker rather than passive recipient. Similarly, concordance is seen to better reflect the creation of a therapeutic alliance between the patient and HCP²¹. A common definition of

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3 adherence used in the healthcare literature is that created by Sackett and Haynes in 1976^{20,22}, with
4 the following modified iteration published in the World Health Organisation's (WHO) Adherence
5 Project (2003)²³: "the extent to which a person's behaviour – taking medication, following a diet,
6 and/or executing lifestyle changes, corresponds with agreed recommendations from a healthcare
7 provider". This definition was not specifically developed for MSK pain or TE, nor does it provide any
8 guidance for operationalising the measurement of adherence in this context.
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12 Therefore, to inform the development of a new measurement tool, this review aims to establish the
13 dimensions of adherence to TE for MSK pain in adults reported in the published literature. The
14 dimensions of adherence to TE among adolescents and children may be different to adults and
15 warrants separate investigation. In this review, we use the term 'dimension' to refer to any single
16 element that contributes towards the concept of adherence. In order to establish relevant
17 dimensions of adherence, our objectives were: 1. Identify specific definitions of adherence used in
18 the context of TE for MSK pain; 2. Identify the parameters used to assess TE adherence (where a
19 parameter is a measurable aspect of adherence); 3. Identify the methods used to measure TE
20 adherence; 4. Identify values used to classify satisfactory TE adherence.
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30 **METHODS**

31 **Search strategy**

32 To maximise the sensitivity of the search, three separate search strings were combined, including
33 terms for MSK pain, therapeutic exercise, and adherence. The search strategy was adapted from a
34 Cochrane review of interventions to improve adherence to exercise for chronic MSK pain in adults¹³.
35 The adherence terms were limited to the title only to restrict the search to studies in which
36 adherence was the primary focus. A pilot search was conducted to refine the focus of the strategy
37 while maintaining sufficient sensitivity to identify key studies already known to the authors. The
38 review was not registered a priori.
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45 **Data sources**

46 Seven databases were searched from inception to December 2016 using the OvidSP and EBSCO
47 interfaces: MEDLINE, AMED, EMBASE, PsychINFO, HMIC, CINAHL and SPORTDiscus. The Cochrane
48 Database of Systematic Reviews was also searched and free text searching using Google Scholar was
49 carried out. The reference lists of included studies were checked, and Web of Science was searched
50 for papers that had cited included studies to identify further titles that may have met the inclusion
51 criteria. Identified titles and abstracts, then subsequent full texts were screened by pairs of
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3 researchers (DB, AB, MH, JQ) independently, and any conflicts were arbitrated by an additional
4 researcher (NF).
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6 **Studies were eligible if they featured all of the following:**

- 8 1. A definition of exercise adherence - either an explicit definition such as a quote or citation, or a
9 description of how exercise adherence was or should be measured.
- 11 2. Adults with MSK pain - including back, neck, hip, knee, ankle, foot, shoulder, elbow, wrist or
12 hand pain, MSK conditions with wider systemic effects such as fibromyalgia and rheumatoid
13 arthritis, post-surgical pain patients where the surgery was for a MSK condition, individuals with
14 a non-specific diagnosis of MSK pain, and those with a specific diagnosis (e.g. OA or adhesive
15 capsulitis) with or without supporting imaging or other diagnostic test results.
- 17 3. Therapeutic exercise - defined as any form of supervised or unsupervised exercise or physical
18 activity specifically provided to patients to treat their MSK pain condition. Any type of exercise
19 was included, such as strengthening, stretching, aerobic or mixed, and exercise delivered by an
20 HCP, trained lay representative, fitness instructor, or delivered as part of a multi-disciplinary
21 package of care. All study types were eligible, not just those where therapeutic exercise was
22 being assessed as an intervention.
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29 **Studies were excluded if they:**

- 31 1. Were not published in English.
- 32 2. Comprised conference proceedings where only the abstract has been published.
- 33 3. Involved exercise for a non-MSK pain condition, such as cancer, falls prevention, stroke or
34 cardiac rehabilitation.
- 35 4. Included participants under 18 years.
- 36 5. Included participants with no MSK pain.
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41 **Data extraction**

42 Data were extracted independently by two researchers using customised forms. Extracted data
43 were compared for inconsistencies and any corrections made following discussion by the
44 researchers. A third researcher was consulted if needed. We extracted: details of the study (design,
45 country, setting), participant details (age, sample size, population, inclusion/exclusion criteria, MSK
46 pain condition), the TE intervention (type, dosage, adherence measure time-point, exercise
47 prescriber, supervised or unsupervised exercise), definitions of adherence (quotes or citations were
48 extracted verbatim), the parameters of exercise adherence assessed (e.g. number of repetitions,
49 attendances or intensity of exercise), methods used for measuring adherence (e.g. class register or
50 self-report diary), and quantification or values assigned to adherence (e.g. number of exercises that
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3 should be completed to be classed as adherent). Systematic reviews and protocols were included if
4 they met the above criteria as it was possible they could include information about how adherence
5 is defined. However, only data on the definition of adherence was extracted from systematic
6 reviews to avoid the over-representation of studies that may have been included in a systematic
7 review as primary research in this review.
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10 11 **Analysis**

12 Data from included studies were summarised in tables. Terms used for describing parameters and
13 measurement methods were standardised and frequency and percentage counts applied. Values for
14 quantification of adherence were standardised by converting to percentages for ease of comparison
15 and grouped according to commonly observed ranges. We did not formally assess the risk of bias
16 since the methodological quality of included studies would not have influenced the utility or
17 relevance of the data that were extracted for the purposes of this systematic review.
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25 26 **RESULTS**

27 We identified 459 references, which reduced to 199 following screening of titles and abstracts.
28 Finally, 86 studies met the inclusion criteria and were included in the review (Figure 1).
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31 32 **Characteristics of included studies**

33 Included studies were published between 1976 and 2016 and originated from 20 different countries
34 (Table 1). Sixteen different study types were included and hospital outpatients was the most
35 common study setting (n=31). Seventeen different categories of MSK pain conditions featured, most
36 commonly back and/or neck pain (n=30). The type of TE could be broadly grouped as:
37 strengthening, stretching, aerobic, postural or mind-body exercise²⁴ (e.g. yoga), with strengthening
38 (n=43) and stretching (n=35) being the most common. The time-point at which exercise adherence
39 was measured in the studies varied from 1 week to 5 years.
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45 46 **Definitions of exercise adherence**

47 Adherence data findings extracted from included studies are shown in appendix 2. Sixty per cent of
48 studies (n=52) did not provide a clearly specified definition of adherence. Most studies defined
49 adherence by describing the parameters by which it had been assessed (n=73, 85% of 86).
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51 Thirty-four studies (40%) provided at least one clearly specified definition, the most common of
52 which are shown in Table 2. Five studies provided definitions that were the authors' own or were
53 uncited. Frost et al. (2016)²⁵ provided their own definition in addition to that of the WHO. Their
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definition, “the extent to which individuals undertake prescribed behaviour accurately and at the agreed frequency, intensity and duration” was based on the four parameters of adherence they believed characterised rehabilitation prescriptions, namely: frequency, duration, intensity and accuracy.

Table 2. Definitions of adherence used in studies

| Definition and source | Studies citing definition |
|---|--|
| “The extent to which a person’s behaviour – taking medications, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a healthcare provider”. (WHO 2003) | Beinart et al. (2013) Ezzar et al. (2014) Hall et al. (2014) Holden et al. (2014) Frost et al. (2016) Jack et al. (2010) Jordan et al. (2010) Pisters et al. (2010) Thompson et al. (2016) Van Koppen et al. (2016) |
| “The extent to which the patient’s behaviour (in terms of taking medications, following diets or executing other lifestyle changes) coincides with the clinical prescription”. (Sacket and Haynes 1976) | Alexandre et al. (2002) Brus et al. (1997) Brus et al. (1998) Ferguson and Bole (1979) Hammer et al. (2007) Medina-Mirapeix et al. (2009) Robinson et al. (2004) Schneider et al. (1998) Wig et al. (2004) |
| “Adherence is defined by the active cooperation and the attitude of the patient during the therapy session and during home exercise execution”. “The term adherence refers to the extent to which patients follow the instructions of their healthcare providers”. “Adherence is defined as the extent to which the patient undertakes the clinic-based and home-based prescribed components of the physiotherapy programme”. (all attributed to Meichenbaum and Turk 1987) | Hugli et al. (2014) Huyser et al. (1997) Mannion et al. (2009) |
| “Where adherence implies active voluntary involvement in the planning and implementation of the treatment and is defined as the extent to which the patient undertakes the clinic-based and home-based prescribed components of the physiotherapy programme.” “Adherence, which denotes a more contemporary approach to decision making in which the client or patient is an active and equal partner with the health professional.” (both attributed to Carr 2001) | Mannion et al. (2009) Marks and Allegrante (2005) |

Parameters used to assess exercise adherence

Frequency of exercise completion was the most commonly used parameter to assess adherence (n=47, 55%) (Table 3). Frequency was measured in different ways, including: exercise repetitions,

sets, or blocks of exercise time, and over different time-frames (e.g. exercises per day, week or month).

Behavioural parameters were measured to assess adherence in 16 studies (19% of 86). These included HCP assessed elements such as 'following guidance' and 'receptivity to change', as featured in the Sports Injury Rehabilitation Scale (SIRAS)¹⁹, and self-reported elements such as 'barriers to exercise'. Session attendance, which required the patient to be present at a supervised exercise session, was assessed in 22 (26%) studies. This was slightly different to 'session completion' assessed in 11 (13%) studies, which was a self-reported or HCP observed completion of recommended exercises during an exercise session.

Exercise exertion or intensity was assessed in 13 studies (15%), subjectively in eight (9%) and objectively in five (6%). Seven studies (8%) assessed a parameter reflecting the quality of the patients' replication of the recommended exercises, which was determined via HCP observation.

Table 3. Number of studies describing parameters used to assess TE adherence

| Parameter of TE adherence measured | Number of studies using parameter (%) |
|--|---------------------------------------|
| Exercise frequency | 47 (55%) |
| Session attendance | 22 (26%) |
| Behavioural component | 16 (19%) |
| Exercise time | 15 (17%) |
| Sessions completed | 11 (13%) |
| Exercise exertion (subjective measure) | 8 (9%) |
| Exercise replication | 7 (8%) |
| Exercise intensity (objective measure) | 5 (6%) |

(NB. Some studies described more than one parameter, hence totals do not sum to 100%)

Methods used to measure adherence

Of the 86 included studies, 74 (86%) described at least one method of measuring adherence. The most common measurement methods were self-report exercise logs (n=44, 51%), registers of attendance (n=18, 21%) and an existing measurement scale (n=15, 17%). Thirty-three studies (38%) used more than one type of measurement method. Six studies used an objective measure of exercise adherence (e.g. pedometer) (Table 4). Within the category of 'existing measurement scales', 12 different measures of exercise adherence were identified. These included the SIRAS¹⁹, General Adherence Scale (GAS)²⁶ and Adherence to Physiotherapists Recommendation Scale (APRS)²⁷.

Table 4. Number of studies describing a method of measuring TE adherence

| Measurement method | Number of studies using method (%) |
|-------------------------------------|------------------------------------|
| Self-report exercise log | 44 (51%) |
| Class register | 18 (21%) |
| Existing measurement scale | 15 (17%) |
| Healthcare practitioner observation | 11 (13%) |
| Self-developed questions | 12 (14%) |
| Objective measure | 6 (7%) |
| Interview | 6 (7%) |

(NB. Some studies described more than one method, hence totals do not sum to 100%).

Values for adherence

Half of the studies (n=44, 51%) did not provide information about what they considered to be a satisfactory value for TE adherence. Forty-two of the studies (49%) described values indicating 'satisfactory' TE adherence (Table 4). These were grouped into four ranges as shown in Table 5. The most common range of values for satisfactory adherence was between 80-99% completion of the prescribed exercise/s. Six studies (7%) provided values specifically describing 'low adherence'. These varied between 0-79% completion of the recommended exercises. It was unclear in many of the studies whether cut-off points for satisfactory adherence were determined *a priori* or *post hoc*, as they were not described in the methods. Where cut-off points were stated, no references to required therapeutic dosages or other guidelines were mentioned. Some studies used the

distribution of participants' adherence data to assign a value of satisfactory adherence. For example, Granlund et al. (1998)²⁸ used the median value of participants' adherence results to dichotomise them into adherent or non-adherent groups, whereas Van Gool et al. (2005)²⁹ ordered the participants according to their adherence results, then divided them into three equally sized groups described as 'low', 'intermediate' or 'high' adherence.

Table 5. Number of studies stating values for satisfactory TE adherence

| Value for satisfactory adherence | Number of studies using this level |
|----------------------------------|------------------------------------|
| 100% of recommended dose | 8 (9%) |
| 80-99% of recommended dose | 15 (17%) |
| 60-79% of recommended dose | 9 (10%) |
| 14-59% of recommended dose | 10 (12%) |
| No value given | 44 (51%) |

DISCUSSION

We aimed to establish the dimensions of adherence to TE for MSK pain, in other words, all information reported in relevant published literature that contributes towards the concept or meaning of adherence. This was achieved by identifying: specific definitions of TE adherence; the parameters used to assess TE adherence; the methods used to measure TE adherence and values for satisfactory adherence. We included studies from a wide range of countries featuring various methodologies, settings, MSK pain conditions, and TE interventions. Most commonly, study authors did not state a definition of TE adherence, even when this was a focus of their study. Where a definition was stated, most originated from the work of Sackett and Haynes (1976)²².

Exercise frequency was the most common parameter by which TE adherence was assessed, although it was commonly combined with other parameters. A variety of methods of TE adherence measurement were reported. A self-report exercise log was the most frequently used method, although the structure and implementation of these methods varied between studies. Most studies

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3 did not define what was considered a satisfactory level of adherence, however 80-99% completion
4 of the recommended exercises was most frequently used as a surrogate of satisfactory adherence.
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6 7 **Definitions of adherence**

8 Most studies did not state a definition of adherence. This may be because a definition of adherence
9 that is explicitly related to adherence to TE does not exist. Alternatively, it might be that the
10 meaning of adherence is so clear, having undergone so little development between the 1976 version
11 by Sackett and Haynes to the 2003 version from the WHO, that there is an assumption that the term
12 is tacitly understood among research and clinical communities. However, the lack of an agreed
13 communicable definition of adherence is a problem, because without a clear picture of what
14 adherence is, HCPs and patients cannot work together to achieve adherence as a shared goal, nor
15 measure or monitor its variability.
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21 The original definition by Sackett and Haynes (1976)²² used the term 'compliance' not 'adherence',
22 and concerns therapeutic regimens generally, not specifically MSK pain or TE. While the more recent
23 WHO iteration of this definition (2003)²³ uses the term 'adherence', to better reflect the autonomy
24 of the patient and his/her role as an 'active partner' in the treatment process, it was developed by
25 groups of experts focussing on adherence issues relating to chronic health conditions other than
26 MSK pain (including hypertension, epilepsy, HIV and tuberculosis). Consequently, pharmacological
27 intervention was the main treatment of concern for both these definitions, but it is not clear
28 whether adherence to TE can be defined in the same way. These possible differences may explain
29 why the WHO definition (2003)²³ has not been universally applied to TE for MSK pain. The WHO
30 definition lacks specificity, providing no indication of the parameters of treatment adherence that
31 should be assessed, how they should be measured, or what levels of adherence should be expected.
32 This ambiguity means definitions can be interpreted differently, as shown by this review, where
33 several interpretations of a single definition were associated with authors using different
34 parameters, measurement methods and cut-offs.
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44 It has been proposed that the term compliance should be used in efficacy trials where the
45 intervention has been determined according to the desired outcome and target population, but not
46 necessarily the individual patient or recipient³⁰. Adherence on the other hand, is proposed to reflect
47 the effectiveness of TE in trials or real-life contexts³⁰. Adherence considers the individual's role in
48 interpreting the appropriateness of the advised intervention and the influences upon their
49 behaviour and motivation, such as the environment, society, previous experience, knowledge,
50 symptoms, and resources. Adherence is a more complex measurement than simply comparing to a
51 reference standard intervention dose³⁰. Until the message we are trying to convey with these terms
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3 is clarified by all those to whom it pertains, including patients, the uptake of existing definitions may
4 remain inconsistent in MSK pain and TE literature.
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6 The definition of adherence provided by Frost et al. (2016)²⁵ is specific to TE for MSK pain and
7 identified the parameters of TE adherence that should be measured: frequency, duration, intensity,
8 and accuracy. However, its development was based on stroke rehabilitation³¹, public health³², falls
9 prevention³³ and the use of exercise sheets in physiotherapy,³⁴ not literature focussing specifically
10 on TE prescription for MSK pain. Therefore, it is possible that the definition does not reflect the
11 perceptions of patients with MSK pain or HCPs responsible for prescribing TE. While Frost et al.
12 (2016)²⁵ offer the first operational definition of TE adherence, its four parameters are different to
13 those identified as most commonly used in this review. Therefore, the concept of adherence to TE
14 for MSK pain may require further refinement before the development of a new measure of
15 adherence.
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23 **Parameters of adherence**

24 We identified 8 categories of TE adherence parameters (measurable aspects of adherence). The
25 most common was exercise frequency, a finding consistent with other reviews, suggesting it is a
26 relevant dimension of TE adherence, or simply an easy parameter to measure. However, even
27 exercise frequency was assessed in various ways (e.g. repetitions or blocks of time, per day or week),
28 suggesting it is more complex than a simple representation of the total TE undertaken.
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33 The accuracy with which patients replicated their exercises, or the quality of their exercise
34 performance was included as a parameter in 7 studies. The scant attention paid to accuracy or
35 quality of performance may be because it is not an important dimension of TE adherence, or that it
36 is too challenging to incorporate into research, despite being a common parameter of adherence to
37 assess in clinical practice¹⁵. HCP observation has been recommended in the assessment of TE
38 adherence³⁵ and is a feature of one of the more commonly used measures: the SIRAS³⁶. For research
39 purposes, the constraint of requiring an observer and its associated cost implications may be why
40 these parameters have not been regularly assessed. While technology may be able to objectively
41 measure certain parameters of TE³⁷, the expense of such equipment, the expertise required to
42 operate it and the number of sensors required to measure more complex TE interventions, may limit
43 its implementation³⁸. The acceptability of the equipment by patients may also limit its effectiveness
44 as a measurement tool, as patients may not adhere to using the measurement device, despite
45 adhering to the TE intervention. Natural adherence behaviour may also be affected by overt
46 monitoring, such as wearing a measurement device, although similar changes may also be
47 associated with subjective measurement methods.
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3 Behavioural components featured in 16 studies, two of which, used self-reported barriers to exercise
4 completion as a parameter of adherence^{39, 40}. This is an uncommon approach, as barriers are
5 normally seen as modifiers of adherence levels. However, poor treatment adherence has been
6 associated with a greater perceived number of barriers⁴¹ indicating a potential role for barriers in the
7 assessment of adherence. Some studies identified single parameters of TE adherence, whereas other
8 studies identified combinations of parameters (e.g. exercise frequency and session attendance),
9 without justification. These findings suggest there are multiple relevant parameters of adherence to
10 TE, but no consensus as to their importance or relevance to a specific context. This may relate to
11 non-specific definitions such as the WHO's focus on pharmacological interventions, whereas TE
12 prescription may potentially have more parameters contributing to adherence, such as: frequency,
13 intensity, time, accuracy or a behavioural component, which require different methods for their
14 measurement.

21 22 **Methods of measuring adherence**

23 Multiple methods of measuring exercise adherence were identified, including self-report exercise
24 logs, class registers and existing measurement scales, mirroring the findings from recent systematic
25 reviews^{14,15,16}. However, different measurement methods were used across studies for the same
26 adherence parameter. For example, the parameter of session attendance was measured using a
27 class register, interview and self-report log. Such variation is understandable given the multiple
28 parameters of adherence and the non-specific guidance provided by the WHO's adherence report²³,
29 which suggests, "a multi-method approach combining self-reporting and objective measures".
30 However, the lack of a single valid and reliable measurement tool of TE adherence means that the
31 relative effectiveness of interventions is difficult to compare across studies^{13,14,15,16}.

32 There was large variability in time points at which adherence was measured, varying from 1 week to
33 5 years. As adherence is likely to change over time¹³, the point at which adherence is measured
34 could substantially influence the rates of adherence observed. To improve the comparability of
35 data, it may be useful to establish adherence measurement timescales (e.g. short, medium and long-
36 term). There should also be improved clarity in the reporting of adherence measurement timing
37 (e.g. whether measurements took place daily, weekly or monthly), and for studies where there are
38 multiple deliveries of the TE intervention (e.g. weekly exercise classes), the time interval between
39 the TE delivery and the adherence measurement.

40 41 42 **Values of adherence**

43 Fewer than half of included studies (49%) defined satisfactory adherence. Two approaches were
44 used, either a pre-determined cut-off or a distribution method. Distribution-based methods result in
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3 the adherence of an individual being judged relative to the performance of other study participants,
4 rather than any pre-determined target level of adherence. This explains why satisfactory adherence
5 levels ranged from 14-100% completion of prescribed exercises in this review. Only one study,
6 Hammer et al. (2007)⁴² used pre-determined adherence categories justified from the literature.⁴³
7 However, the original source provides no explanation of how these categories were derived. In our
8 review, satisfactory adherence was most commonly valued between 80-99% completion of the
9 prescribed exercises (n=15, 17%). Furthermore, several studies described low adherence, providing
10 ranges of prescribed exercise completion between 0 and 79%. This may suggest that 80% could be a
11 reasonable threshold for satisfactory adherence.
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17 If specific TE doses are unknown, it may be inappropriate and unhelpful to set arbitrary adherence
18 cut-off points for TE interventions for MSK pain. A systematic review and meta-analysis of
19 medication adherence showed that good adherence to placebo medication was associated with
20 lower mortality, a so called 'healthy adherer' effect⁴⁴. Therefore, it may be beneficial for a patient to
21 identify as adherent, even in the absence of a known therapeutic dosage. Identifying an MSK
22 patient as non-adherent when the therapeutic dosage of TE is unknown, may deny the patient the
23 benefits of the healthy adherer effect.
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29 **Research and clinical Implications**

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31 There is a need to focus on establishing a clear definition of adherence specifically relating to TE for
32 MSK pain, and the best way to measure adherence. Patients must be involved as active,
33 collaborative partners in future research so that the resulting construct of exercise adherence
34 incorporates their views⁴⁵. In the absence of a valid, reliable and acceptable measure of TE
35 adherence for MSK pain, the interpretation of results from trials investigating TE interventions or
36 methods for improving TE adherence may be questioned. This underscores the importance of
37 agreeing upon a satisfactory measure/s. From the clinician's perspective, if he or she cannot be sure
38 of how to accurately define and measure adherence, it may be difficult to determine whether a
39 patient's lack of progress despite treatment is due to inadequate engagement or ineffective
40 treatment.
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47 **Limitations**

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49 We adopted an inclusive approach using a modified versions of an established Cochrane search
50 strategy to include all study types and MSK pain conditions, however, it is possible that some studies
51 relating to adherence to TE for MSK conditions may have been missed. To minimise error and bias,
52 two independent reviewers assessed both title and abstract and full text papers for inclusion and
53 data extraction. The search terms were limited to title, or title and abstract. Restricting the search in
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3 this way, ensured that the included studies were specifically focused on adherence in the context of
4 TE for MSK pain and therefore more likely to be appropriate to this review. It is possible that some
5 relevant studies may have been missed that did not feature adherence in their title. However,
6 different search strategies were piloted to achieve results with a focus on adherence while
7 maintaining acceptable sensitivity.
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11 Since a definition of adherence was not provided in the majority of included studies despite their
12 title featuring a term for adherence, it is unlikely that articles not featuring an adherence term in
13 their title would discuss the concept in any detail. Equally, the majority of definitions used were
14 from the same source, and it is unlikely that this would change if more articles were reviewed. Six
15 studies were excluded as they were not published in English. Consequently, our review is at risk of
16 language bias, and the results may under-represent studies that are not published in English. The
17 countries of origin of the excluded studies were still represented in the final 86 included studies. No
18 low-income countries were studied. Therefore, our findings may only be generalisable to high
19 income countries and their cultures.
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29 **CONCLUSION**

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31 Most studies did not state a definition of adherence. Definitions most commonly used in the context
32 of TE for MSK pain were not developed specifically for TE or MSK pain, and did not describe the
33 context specific dimensions of this concept. The variability of the parameters of adherence assessed,
34 the wide variety of measurement methods used, and the seemingly arbitrary nature of determining
35 values for satisfactory adherence, lack sufficient consistency and detail as to inform a definition of
36 adherence or the required content of a suitable measure.
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SUMMARY

- Patients' adherence to therapeutic exercise prescribed for MSK pain is important for outcomes.
- The most commonly used definition of adherence was not developed specifically for MSK pain and lacks detail on the important dimensions or cut-point from which to determine satisfactory adherence.
- The meaning of adherence in the context of therapeutic exercise for MSK pain is unclear and should be conceptualised by relevant stakeholders.

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APPENDIX

1. Search strategy

1. exp pain/
2. pain.ti,ab.
3. 1 or 2
4. joint/ or joint\$.ti,ab.
5. back.ti,ab.
6. knee.ti,ab.
7. shoulder.ti,ab.
8. neck.ti,ab.
9. elbow.ti,ab.
10. hand.ti,ab.
11. hip.ti,ab.
12. foot.ti,ab.
13. feet.ti,ab.
14. 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13
15. 3 and 14
16. exp back pain/
17. neck pain.ti,ab.
18. sciatica.ti,ab.
19. referred pain.ti,ab.
20. (musculoskeletal adj2 (disease\$ or disorder\$ or pain)).ti,ab.
21. (chronic adj2 pain).ti,ab.
22. (radiculopathy or radicular).ti,ab.
23. (osteoarthr\$ or arthriti\$ or arthros?s).ti,ab.
24. (referred adj2 pain).ti,ab.
25. fibromyalgia.ti,ab.
26. 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25
27. exp exercise/
28. exercis\$.ti,ab.
29. exp exercise therapy/
30. (physical adj1 (active or activities or activity)).ti,ab.
31. exp rehabilitation/
32. (rehab or rehabilitation).ti,ab.
33. 27 or 28 or 29 or 30 or 31 or 32
34. concordance.ti.
35. (adhere\$ or adhering).ti.
36. (complan\$ or complying).ti.
37. nonadher\$.ti.
38. noncomplan\$.ti.
39. "therapeutic alliance".ti.
40. conformity.ti.
41. cooperation.ti.
42. 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41
43. 26 and 33 and 42

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2. Table of adherence data extracted from included studies

| Study ID | Study overview | Explicitly stated definitions of adherence. | Parameters used which define adherence. | Measures of adherence used. | Quantification of adherence. |
|-----------------------|---|--|---|---|--|
| Alexandre et al. 2002 | <p>Design: Prospective cohort study</p> <p>Condition: LBP</p> <p>Setting: Hospital outpatient</p> <p>Exercise intervention: Aerobic, strengthening, stretching and postural</p> <p>Adherence: between 2 to 6 weeks</p> | <p>“The extent to which a person’s behaviour (in terms of taking medications, following diets, or achieving lifestyle changes) coincides with advice from physicians or other healthcare providers.”¹</p> <p>“We defined compliance as the extent to which a patient’s behaviour coincided with a clinical prescription. We defined noncompliance as not adhering to prescribed physical therapy appointments, educational activities, and/or a</p> | <p>Exercise session attendance</p> <p>Reported exercise frequency</p> | <p>Class register</p> <p>Self-report exercise log</p> | <p>High compliance = 80% or more attendance.</p> <p>Low compliance = less than 80% attendance.</p> <p>No compliance = attending no sessions.</p> |

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| | | home exercise regimen.” ² | | | |
| Almekinders & Almekinders 1994 | Design: Retrospective study Condition: Chronic overuse sports injury Setting: Private physiotherapy Exercise intervention: Strengthening and stretching Adherence: 27 months on average | None provided | Whether the participants followed the physical therapy programme as prescribed | Telephone questionnaire | None provided |
| Anderson 2011 | Design: Prospective study nested within an RCT Condition: Neck and shoulder pain Setting: Community Exercise intervention: Strengthening Adherence: 10 weeks | None provided | Reported exercise sessions completed | Self-report exercise log | High adherence = 60% of recommended exercises completed. Medium adherence = 20-60% of recommended exercises completed. Low adherence = less than 20% of recommended exercises completed |
| Basler et al. 2007 | Design: Prospective randomised trial Condition: Chronic LBP Setting: Hospital inpatient Exercise intervention: Aerobic, strengthening, stretching Adherence: 6 or 7 weeks and 6 months | None provided | Whether 30 minutes of recommended daily physical activity was achieved | Self-report exercise log | None provided |
| Beinart et al. 2013 | Design: Systematic Review Condition: Chronic LBP Setting: Community Exercise intervention: Various | “The extent to which a person’s behaviour corresponds with | None provided in addition to those in included articles | None provided in addition to those in included articles | None provided in addition to those in included articles |

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| | Adherence: Various | agreed recommendations from a healthcare provider ^{1,3} | | | |
| Belza et al. 2002 | Design: RCT Condition: OA Setting: Community Exercise intervention: Aquatic Adherence: 20 weeks | None provided | Session attendance | Self-report exercise log | Adherence = attending at least 2 classes per week for 16 of 20 weeks (i.e. >80%). |
| Bossen et al. 2013 | Design: Mixed methods study of one treatment arm of a previous RCT Condition: Knee or hip OA Setting: Community Exercise intervention: Aerobic Adherence: 9 weeks | None provided | The number of modules completed | Self-report exercise log (via computer based software which also monitored engagement) | Adherence = completion of at least 6 out of 9 modules (i.e. >66%). |
| Bruno 1995 | Design: Prospective cohort study Condition: Back or neck pain resulting from motor vehicle or work-related accidents Setting: Hospital inpatient and outpatient Exercise intervention: Aerobic, stretching, posture and self-care activities. Adherence: 12 weeks | None provided | Failure to increase or decrease activity levels as recommended by HCPs | Session attendance Self-report exercise log HCP observation | Non-adherence = failure to comply with the rehabilitation programme on more than one occasion. |
| Brus et al. 1997 | Design: Literature review Condition: RA Setting: Various Exercise intervention: Various Adherence: Various | "The extent to which a person's behaviour coincides with the medical or health advice." ¹ | None provided in addition to those in included articles | None provided in addition to those in included articles | None provided in addition to those in included articles |
| Brus et al. 1998 | Design: RCT Condition: RA Setting: Hospital outpatient Exercise intervention: Aerobic | "The extent to which a person's behaviour coincides with the medical or | Exercise frequency Exercise time (minutes) | Questionnaire | None provided |

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| | Adherence: 1 year | health advice" ¹ | | | |
| Byerly et al. 1994 | Design: Cohort study Condition: Musculoskeletal injury Setting: Private physiotherapy Exercise intervention: Not stated Adherence: Until discharged | None provided | Session attendance (0 or 1 point) Session % completion (0, 0.25, 0.5, 0.75 or 1 point) | Class register HCP observation | Adherence = average daily score of 1.75 - 2.0 (i.e. >88%). |
| Campbell et al. 2001 | Design: Qualitative study nested in RCT Condition: Patellofemoral OA Setting: Outpatient physiotherapy Exercise intervention: Strengthening Adherence: 3 and 12 months | "Non-compliance is traditionally defined as a failure by patients to follow advice." ^{4,5} | None provided | HCP observation | None provided |
| Carpenter & Davis 1976 | Design: Cohort study Condition: RA Setting: Hospital inpatient Exercise intervention: Not stated Adherence: 4 months | "Compliance may for example be operationally defined in both quantitative and qualitative terms; in terms of how much the patient complies and how well he complies. Does the patient perform and exercise as often as prescribed and exactly as directed?" No citation | Sessions completed | Questionnaire Self-report exercise log HCP observation | Adherence = completion of the exercise regimen as described (i.e. 100%). |
| Cheung et al. 2015 | Design: Cross sectional survey Condition: Knee OA | None provided | Time Frequency | Self-report exercise log | No |

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| | Setting: Community Exercise intervention: Other: yoga Adherence: 6 months | | Accuracy | Interview Video tape | |
| Coppack et al. 2012 | Design: RCT Condition: LBP Setting: Private physiotherapy Exercise intervention: Aerobic, strengthening, stretching, movement coordination Adherence: 3 weeks | None provided | Participant's exertion Participant's compliance with HCP instructions Participant's receptivity to programme change | Sport Injury Rehabilitation Adherence Scale (SIRAS) | None provided |
| Dalager et al. 2015 | Design: RCT Condition: Neck and shoulder pain Setting: Community Exercise intervention: Strengthening Adherence: 20 weeks | None provided | Exercise repetitions Exercise time | Self-report exercise log Self-reported compliance 1-6 scale | At least 40 minutes of 60-minute recommendation (i.e. 66%) |
| Dobkin et al. 2006 | Design: Prospective study nested in RCT Condition: Fibromyalgia Setting: Community Exercise intervention: Aerobic, strengthening, stretching Adherence: 12 weeks | "Attrition from treatment is the variable used most often to approximate adherence" ^{6,7,8} "Almost all the exercise studies reviewed defined adherence as the number of sessions attended" ⁹⁻¹² | Exercise frequency Exercise time (minutes) | Self-report exercise log | Adherence = 100% completion of prescribed exercises. |
| Dobkin et al. 2008 | Design: Prospective study Condition: Fibromyalgia Setting: Hospital outpatient Exercise intervention: Aerobic, strengthening, stretching | "Attendance at treatment sessions" ¹³⁻¹⁶ | Session attendance Exercise frequency Reported difficulty in following recommendations | Class register General Adherence Scale (GAS) Specific Adherence Scale (SAS) | 87% observed median session attendance was described as "very good". |

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| | Adherence: 3 months | | | | |
| Dobkin et al. 2009 | Design: Prospective study Condition: Fibromyalgia Setting: Hospital outpatient Exercise intervention: Aerobic, strengthening, stretching Adherence: 3 months | None provided | Reported difficulty in following recommendations Exercise frequency | General Adherence Scale (GAS) | None provided |
| Ezzat et al. 2014 | Design: Systematic review Condition: RA or OA Setting: Various Exercise intervention: Various Adherence: Various | “Adherence can be defined as the extent to which a person’s behaviour corresponds with the agreed recommendations from healthcare providers” ³ | None provided in addition to those in included articles | None provided in addition to those in included articles | None provided in addition to those in included articles |
| Ferguson & Bole 1979 | Design: Cohort study Condition: RA Setting: Hospital outpatient Exercise intervention: Not stated Adherence: Not stated | “The extent to which a person’s behaviour coincides with the medical or health advice” ¹ | Exercise frequency | Self-report exercise log | None provided |
| Friedrich et al. 1998 | Design: Double blinded prospective RCT Condition: LBP Setting: Hospital outpatient Exercise intervention: Aerobic, strengthening, stretching Adherence: 4 and 12 months | None provided | Session attendance Exercise time (minutes) | Class register Self-report exercise log | None provided |
| Frih et al. 2009 | Design: Prospective RCT Condition: LBP Setting: Hospital outpatient Exercise intervention: Strengthening, stretching and self-positioning Adherence: 4 weeks and 3 months | None provided | Exercise frequency | HCP observation | None provided |

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| Frost et al. 2016 | Design: Systematic review Condition: Any Setting: Community Exercise intervention: n/a Adherence: n/a | “Adherence is the extent to which a person’s behaviour coincides with agreed clinical recommendations” ³ “The extent to which individuals undertake a prescribed behaviour accurately and at the agreed frequency, intensity and duration” No citation | None provided in addition to those in included articles | None provided in addition to those in included articles | None provided in addition to those in included articles |
| Granlund et al. 1994 | Design: Cohort study Condition: LBP Setting: Community Exercise intervention: Aerobic, strengthening, stretching, postural, relaxation Adherence: 5 and 10 months | None provided | Session attendance | Questionnaire | None provided |
| Granlund et al. 1998 | Design: Cohort study Condition: LBP Setting: Community Exercise intervention: Strengthening, stretching Adherence: Weekly for 5 months | None provided | Session attendance | Class register | Observed median adherence = 16.1% higher adheres = >16.1% Lower adherers = <16.1% Mean adherence rate of 35.7% was described as quite low. |

| | | | | | | |
|--|----------------------|--|---|---|---|--|
| 1 2 3 4 5 6 7 8 9 | Gisla et al. 2015 | Design: Evidence based practice project Condition: CLBP Setting: Hospital outpatient Exercise intervention: Stretching Adherence: 3, 6 and 12 months | No | Exercise frequency | Self-developed questions in questionnaire | Compliance defined as completing the exercises 50% of the time or more |
| 10 11 12 13 14 15 16 | Hakkinen et al. 2004 | Design: RCT Condition: RA Setting: Hospital outpatient Exercise intervention: Strengthening, stretching Adherence: 2 and 5 years | None provided | Exercise frequency Exercise time (minutes) | Questionnaire Self-report exercise log | None provided |
| 17 18 19 20 21 22 23 24 25 26 27 28 | Hall et al. 2015 | Design: Systematic review Condition: Chronic musculoskeletal conditions Setting: Various Exercise intervention: Various Adherence: Various | “The extent to which a person’s behaviour (taking medication, following a diet or exercise plan, and/or executing lifestyle change), corresponds with recommendations from a healthcare professional.” ³ | None provided in addition to those in included articles | None provided in addition to those in included articles | None provided in addition to those in included articles |
| 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 | Han et al. 2015 | Design: Retrospective database study Condition: ACL reconstruction Setting: Hospital outpatient Exercise intervention: Strengthening/Aerobic/Other: neuromuscular & sport specific training Adherence: 1 year | No | Session attendance | Register by HCP | Fully Compliant = attend 16 out of 20 sessions (>80%), moderately compliant = 6-15 sessions (25%-75%), and noncompliant = less than 6 sessions |

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| | | | | | (<25%). |
| Hammer et al. 2007 | Design: Prospective study Condition: LBP Setting: Community Exercise intervention: Repeated movements according to directional preference Adherence: 2 months | “This phenomenon is usually referred to as compliance the reaching by patients of pre-established performance goals...” ¹⁷ “... or adherence the responsible co-operation in treatment by a patient.” ^{18,19} | Exercise frequency | Self-report exercise log | Low compliance = 0-33% Moderate compliance = 34-66% High compliance = 67% ²⁰ |
| Harkapaa et al. 1989 | Design: Prospective RCT Condition: LBP Setting: Hospital inpatient and hospital outpatient Exercise intervention: Strengthening, stretching, postural Adherence: 3 months | None provided | Exercise replication Exercise frequency | HCP observation Interview | None provided |
| Harkapaa et al. 1990 | Design: Prospective RCT Condition: LBP Setting: Hospital inpatient and hospital outpatient Exercise intervention: Strengthening, stretching, postural Adherence: 2.5 years | None provided | Exercise replication Exercise frequency | HCP observation Interview | None provided |
| Hartigan et al. 2000 | Design: Prospective observational study Condition: LBP Setting: Hospital outpatient Exercise intervention: Aerobic, strengthening, stretching | None provided | Exercise frequency | Self-report exercise log Objective physical function measures | None provided |

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| | Adherence: 3 and 12 months | | | | |
| Hicks et al. 1985 | Design: Review Condition: RA Setting: Various Exercise intervention: Various Adherence: N/A | “Compliance in reference to rheumatic disease is the extent to which a person’s behaviour in terms of taking medication, following rehabilitation treatment plans, or executing lifestyle changes coincides with medical or health advice” No citation. | None provided in addition to those in included articles | None provided in addition to those in included articles | None provided in addition to those in included articles |
| Hicks et al. 2012 | Design: Observational study Condition: Back pain Setting: Community Exercise intervention: Strengthening, postural, flexibility and aerobic Adherence: Continuously over 12 months | None provided | Session attendance | Class register | Adherence = participation in 75% of the exercise sessions over 12 months. |
| Holden et al. 2014 | Design: Systematic review protocol Condition: Musculoskeletal disorders Setting: Primary care Exercise intervention: Various Adherence: N/A | “the extent to which a person’s behaviour corresponds with agreed recommendations from a healthcare provider” ³ | None provided in addition to those in included articles | None provided in addition to those in included articles | None provided in addition to those in included articles |
| Hugli et al. 2014 | Design: Randomised controlled pilot trial Condition: Non-specific low back pain | “Adherence is defined by the | Exercise time Participant’s | Self-report exercise log | None provided |

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| | Setting: Community Exercise intervention: Augmented feedback motor control exercise Adherence: on average at 49 days | active cooperation and the attitude of the patient during the therapy session and during HE execution" ²⁰ | exertion Participant's compliance with HCP instructions Participant's receptivity to programme change | SIRAS | |
| Huyser et al. 1997 | Design: RCT Condition: Fibromyalgia Setting: Hospital outpatient Exercise intervention: Aerobic, strengthening, stretching, postural Adherence: Weekly over 6 weeks | "The term adherence refers to the extent to which patients follow the instructions of their healthcare providers" ²⁰ | Exercise frequency | Questionnaire | Adherence = 3 or more exercise sessions a week. Prescribed dosage not stated. Median adherence rate of 5 across the groups were described as high. This equated to participants completing their exercises 3 or more times per week in 5 out of the 6 weeks (i.e. 83%) |
| Jack et al. 2010 | Design: Systematic review Condition: Musculoskeletal dysfunction Setting: Physiotherapy outpatient Exercise intervention: Various Adherence: N/A | "The extent to which a person's behaviour corresponds with agreed recommendations from a healthcare provider" ³ | None provided in addition to those in included articles | None provided in addition to those in included articles | None provided in addition to those in included articles |
| Jackson 1994 | Design: RCT | "The extent to | Exercise frequency | Self-report exercise | None provided |

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| | Condition: Back and/or neck pain Setting: Hospital in patient Exercise intervention: Not stated Adherence: 3 weeks | which patients decide to follow the recommendations of their physician or other health professional” ²¹ | | log | |
| Jansons et al. 2016 | Design: Systematic review Condition: OA Setting: Various Exercise intervention: n/a Adherence: n/a | No | Exercise frequency | None provided in addition to those in included articles | None provided in addition to those in included articles |
| Jordan et al. 2010 | Design: Systematic review Condition: Persistent or episodic pain lasting more than three months in the axial skeleton (neck and low back) or large peripheral joints (hip, knee, shoulder). Setting: Primary Care Exercise intervention: Various Adherence: N/A | “the extent to which a person’s behaviour corresponds with agreed recommendations from a healthcare provider” ³ | Summarised as: Exercise frequency Exercise time (minutes) Sessions completed Exercise replication | None provided in addition to those in included articles | None provided in addition to those in included articles |
| Kingston et al. 2014 | Design: RCT Condition: Traumatic hand injury Setting: Hospital outpatient Exercise intervention: Not stated Adherence: 6 weeks | None provided | Exercise frequency Exercise time (minutes) Exercise replication Session attendance | Self-report exercise log Class register HCP observation | None provided |
| Kolt & McEvoy 2003 | Design: Cohort study Condition: Lumbar pain Setting: Private Physiotherapy clinics Exercise intervention: Not stated Adherence: Weekly, up to the point of discharge (maximum 4 weeks) | None provided | Session attendance Exercise frequency Participant’s exertion Participant’s compliance with HCP instructions Participant’s receptivity to | HECA SIRAS | Observed mean attendance of 87.7% described as high. |

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| | | | programme change | | |
| Lee et al. 2016 | Design: Mixed methods pilot study (cohort study) Condition: Knee OA Setting: Community Exercise intervention: Strengthening/Stretching/Other: range of movement Adherence: 12 weeks | No | Exercise frequency Exercise accuracy | Self-report exercise log | Mean adherence of 91% described as high. |
| Linton & Jenson 1987 | Design: Cohort study Condition: Neck and shoulder pain Setting: Community Exercise intervention: Relaxation gymnastics Adherence: 5 weeks | None provided | Exercise frequency | Self-report exercise log | Adherence = exact completion of prescription of 6 exercises per day (i.e. 100%). |
| Linton et al. 1996 | Design: RCT Condition: Back pain Setting: Community Exercise intervention: None specifically recommended Adherence: 6 months | None provided | Exercise frequency | Self-report exercise log | Adherence = 100% completion of prescribed exercises. |
| Loew et al. 2016 | Design: Survey Condition: Knee OA Setting: Community Exercise intervention: Aerobic (walking) Adherence: 3, 6 and 9 months | "The extent to which a person follows and accepts a treatment recommended by health professionals and is able to successfully reach the therapeutic goals" ²² | Session attendance Session completion | Self-report exercise log | Adherent if completing 2 of 3 prescribed sessions (66%) |
| Lonsdale et al. | Design: RCT outline | None provided | Session attendance | Short Form Physical | None provided |

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| 2012 | <p>Condition: Low back pain Setting: Outpatient physiotherapy Exercise intervention: Not specified Adherence: 4, 12 and 24 weeks</p> | | <p>Exercise frequency Participant's exertion Participant's compliance with HCP instructions Participant's receptivity to programme change</p> | <p>Activity Questionnaire SIRAS (adapted) HECA (adapted) Adherence to Physiotherapists Recommendation Scale (APRS)</p> | |
| Lyncoln et al. 2002 | <p>Design: Cohort study Condition: Distal fracture of radius Setting: Hospital-in patient Exercise intervention: Strengthening, stretching and functional Adherence: 6 weeks</p> | <p>"The term adherence can comprise a wide variety of behaviours, including performance of home exercises, attending therapy appointments and following health practitioner's advice during appointments."²³</p> | <p>Sessions completed Exercise frequency Participant's exertion Participant's compliance with HCP instructions Participant's receptivity to programme change</p> | <p>Self-report exercise log SIRAS Class register</p> | <p>None provided</p> |
| Mailloux et al. 2006 | <p>Design: Case series design with survey data collection Condition: Chronic back pain Setting: Hospital outpatient delivered by private physiotherapists Exercise intervention: Aerobics, strengthening and stretching Adherence: 2 years</p> | <p>None provided</p> | <p>Exercise frequency</p> | <p>Questionnaire</p> | <p>Adherence = exercising at least once a week (participants were advised to exercise on a daily basis) i.e. 14%.</p> |
| Mannion et al. 2009 | <p>Design: Prospective study Condition: Low back pain</p> | <p>"Where adherence implies active</p> | <p>Session attendance Exercise frequency</p> | <p>Class register Self-report exercise</p> | <p>Observed median values of: MAI 89%:</p> |

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| | <p>Setting: Primary care/hospital-out patient</p> <p>Exercise intervention: Spinal segmental stabilisation</p> <p>Adherence: 9 weeks</p> | <p>voluntary involvement in the planning and implementation of the treatment and is defined as the extent to which the patient undertakes the clinic-based and home-based prescribed components of the physiotherapy programme."^{20, 24, 25}</p> | <p>Participant's exertion</p> <p>Participant's compliance with HCP instructions</p> <p>Participant's receptivity to programme change</p> | <p>log SIRAS</p> <p>Multi-dimensional Adherence Index (MAI combining % values of above measures)</p> | <p>attendance 100%: commitment (SIRAS) 96%: and home exercise completion 75% were described as 'very good'.</p> |
| Marks & Allegrante 2005 | <p>Design: Literature review</p> <p>Condition: OA</p> <p>Setting: N/A</p> <p>Exercise intervention: Various</p> <p>Adherence: N/A</p> | <p>"Adherence, which denotes a more contemporary approach to decision making in which the client or patient is an active and equal partner with the health professional."²⁶</p> | <p>None provided in addition to those in included articles</p> | <p>None provided in addition to those in included articles</p> | <p>None provided in addition to those in included articles</p> |
| Mayoux-Benhamou et al. 2008 | <p>Design: Prospective RCT</p> <p>Condition: RA</p> <p>Setting: Hospital outpatient</p> <p>Exercise intervention: Strengthening and stretching</p> <p>Adherence: 6 and 12 months</p> | <p>None provided</p> | <p>Exercise frequency</p> | <p>Self-report exercise log</p> <p>Baecke questionnaire-recording habitual physical activity</p> | <p>Adherence = >30% completion of prescribed exercises.</p> |
| Medina-Mirapeix et al. 2009 | <p>Design: Observational study</p> <p>Condition: Chronic non-specific neck or low back pain</p> | <p>"Adherence has been defined as the extent to which a</p> | <p>Exercise frequency</p> <p>Exercise time (minutes)</p> | <p>Questionnaire</p> | <p>Adherence = "always" or "almost always" complying</p> |

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| | <p>Setting: Primary Care</p> <p>Exercise intervention: Strengthening and stretching</p> <p>Adherence: 1 month (after the 4 weeks of supervised exercises).</p> | person's behaviour coincides with professional advice." ²⁷ | | | to exercise recommendation as reported on the questionnaire. |
| Mori et al. 2006 | <p>Design: RCT</p> <p>Condition: Musculoskeletal pain associated with Persian Gulf War Veteran Illness (GWVI).</p> <p>Setting: Hospital outpatient</p> <p>Exercise intervention: Aerobic, stretching</p> <p>Adherence: 3, 6 and 12 months</p> | None provided | <p>Exercise frequency</p> <p>Exercise time (minutes)</p> <p>Exercise intensity</p> | Self-report exercise log including objective measures | Adherence = 100% completion of prescribed exercises |
| Munneke et al. 2003 | <p>Design: RCT</p> <p>Condition: RA</p> <p>Setting: Hospital outpatient</p> <p>Exercise intervention: Aerobic and strengthening</p> <p>Adherence: 2 years</p> | None provided | Session attendance | Class register | <p>Sufficient adherence = 50-75% attendance</p> <p>High adherence = 75-100% attendance</p> |
| Neuberger et al. 1993 | <p>Design: Pilot study</p> <p>Condition: Rheumatoid arthritis</p> <p>Setting: Hospital outpatient</p> <p>Exercise intervention: Range of movement exercises</p> <p>Adherence: 3-16 weeks after the self-instructional programme completion</p> | None provided | Exercise frequency | Self-report exercise log | No provided |
| Newman-Beinart et al. 2016 | <p>Design: Questionnaire development</p> <p>Condition: Chronic low back pain</p> <p>Setting: Hospital outpatient</p> <p>Exercise intervention: Not stated</p> <p>Adherence: 3 and 7 weeks</p> | No | <p>Exercise frequency</p> <p>Exercise repetitions</p> | EARS self-report questionnaire | No |
| Nordgren et al. 2014 | <p>Design: Observational cohort study</p> <p>Condition: RA</p> <p>Setting: Hospital outpatient</p> | None provided | <p>Exercise frequency</p> <p>Session attendance</p> | Short form of the International Physical Activity | Adherence = 50% of circuit training sessions and 70% |

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| | Exercise intervention: Aerobic and strengthening Adherence: 1 year | | | Questionnaire (IPAQ) Exercise Stage Assessment Instrument (ESAI) Text messages to collect data on number of days exercised each week Class register | total Health Enhancing Physical Activity (HEPA) |
| O'Brien et al. 2013 | Design: Feasibility study using randomised controlled design Condition: Hip or knee OA Setting: Community Exercise intervention: Aerobic, strengthening and stretching Adherence: 12 weeks | None provided | Session attendance Exercise frequency Participant's exertion Participant's compliance with HCP instructions Participant's receptivity to programme change | Class register SIRAS Self-report exercise rating | Adherence = attending at least 1 class per week (3 advised i.e. 33%). Mean class attendance of 16/31 (intervention) and 17/31 (control) described as low. SIRAS of 4.5/5 (intervention) and 4.6/5 (control) described as high. Self-report exercise rating ranging from 3.5/5 to 3.9/5 described as high |
| Peterson et al. 2015 | Design: RCT Condition: Chronic whiplash Setting: Primary Care Exercise intervention: Aerobic/Strengthening/Postural | No | Session attendance Behavioural components | Session attendance Self-report exercise log | Compliance = at least 50% attendance at sessions |

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| | Adherence: 3 and 6 months | | | | |
| Petrofsky & Laymon 2016 | Design: RCT Condition: Chronic knee pain Setting: Hospital outpatient Exercise intervention: Strengthening/Stretching/Postural Adherence: 2 weeks | No | Exercise time | Self-report exercise log | No |
| Petty & Mastria 1983 | Design: Case study Condition: Chronic back pain Setting: Hospital outpatient Exercise intervention: Strengthening and relaxation Adherence: Weekly for 23 weeks | None provided | Exercise frequency | Self-report exercise log | Adherence to 80% of prescribed exercises was described as 'moderate' |
| Pisters et al. 2010a | Design: Cluster randomised trial Condition: Hip or knee OA Setting: Primary care Exercise intervention: Aerobic, strengthening and stretching Adherence: Weeks 13 and 65 | None prescribed | Sessions completed | Participants self-rated their adherence to recommendations for home exercises and activities on a 5-point scale where 1 = almost never; 5 = very often | Adherence = a self-report of 4 (often adherent) or 5 (very often adherent). |
| Pisters et al. 2010b | Design: Prospective observational study Condition: Hip or knee OA Setting: Primary care Exercise intervention: Aerobic, strengthening and stretching Adherence: 3, 15 and 60 months | "Adherence was defined as the extent to which a person's behaviour corresponds to agreed recommendations by the patient's physical therapist" ³ | Sessions completed | Participants self-rated their adherence to recommendations for home exercises and activities on a 5-point scale where 1 = almost never; 5 = very often | Adherence = a self-report of 4 (often adherent) or 5 (very often adherent). |
| Rejeski et al. 1997 | Design: Single blind randomised controlled trial | None provided | Exercise time (minutes) | Self-report exercise log | None provided |

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| | <p>Condition: Knee OA Setting: Not stated Exercise intervention: Aerobic and strengthening Adherence: 3,9 and 16 months</p> | | Session attendance | Class register | |
| Resnick et al. 2008 | <p>Design: RCT Condition: Post hip fracture Setting: Hospital outpatient Exercise intervention: Aerobic, strengthening and stretching Adherence: 12 months</p> | Adherence rates are defined as the total number of sessions completed/the total number of sessions included in the intervention. | Session attendance, the Exercise intensity Exercise time (minutes) | Data collected by HCPs at sessions | None provided |
| Robinson et al. 2004 | <p>Design: Telephone follow up study Condition: Chronic musculoskeletal pain Setting: Hospital outpatient Exercise intervention: Not stated Adherence: >6 months post intervention</p> | “the extent to which a person’s behaviour (in terms of medications, following diets, or executing lifestyle changes) coincides with medical or health advice” ¹ | None provided | Participant Compliance Reporting Scale (PCRS) Health Professional Compliance Evaluation (HPCE) Both of the above used self-reported compliance ratings out of 100. | None provided |
| Rosal et al. 2011 | <p>Design: RCT protocol Condition: Total knee replacement Setting: Hospital pre-op then inpatient, then outpatient Exercise intervention: Not specified Adherence: 8 weeks, 6 and 12 months</p> | None provided | Exercise intensity Session completion Exercise frequency | Objective physical function measures Self-report exercise log | None provided |
| Schneiders et al. 1998 | <p>Design: Randomised prospective survey Condition: Non-specific LBP Setting: Private physiotherapy Exercise intervention: Not specified</p> | “Compliance to a therapeutic regimen is defined as the extent to | Exercise frequency | Self-report exercise log | None provided |

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| | Adherence: 14 days | which a person's behaviour coincides with health advice" ²⁷ | | | |
| Schoo et al. 2005a | Design: Randomised trial Condition: Hip or knee osteoarthritis Setting: Private physiotherapy Exercise intervention: Strengthening and stretching Adherence: 4 and 8 weeks | "Adherence can be defined as the level of compliance with a prescribed exercise program." ¹⁸ | Exercise replication Exercise frequency | Correctness of Exercise Performance Scale (COEP) Self-report exercise log | Median home exercise adherence rates of between 87% and 93% were described as 'high'. |
| Schoo et al. 2005b | Design: Cohort study Condition: Hip and knee OA Setting: Hospital outpatient and private physiotherapy Exercise intervention: Strengthening and stretching Adherence: 4 and 8 weeks | None provided | Exercise frequency Exercise replication Participant's exertion Participant's compliance with HCP instructions Participant's receptivity to programme change | Self-report exercise log COEP SIRAS | None provided |
| Seckin et al. 2000 | Design: Cohort study Condition: Knee OA Setting: Not stated Exercise Intervention: Strengthening, stretching and functional. Adherence: 3 months | None provided | Exercise frequency | Interview | The observed compliance rate (85-90% across time points) was described as 'high'. |
| Taal et al. 1993 | Design: Cohort study Condition: RA Setting: Hospital outpatient Exercise intervention: Not stated Adherence: 4 weeks | None provided | Problems adhering with recommendations | Interview using a "problem-index" which ranged from 0 (no problems) to 1 (problems with every recommendation). | None provided |

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| 1 2 3 4 5 6 7 8 9 10 11 12 13 | Terpstra et al. 1992 | Design: Retrospective study Condition: RA Setting: Hospital-out patient Exercise intervention: Not specified Adherence: Between 6-18 months | None provided | Exercise frequency | Questionnaire | Very compliant = exercising 1-2 times per day for at least 6 body parts (prescribed dose was for 7 body parts daily) i.e. 86%. |
| 14 15 16 17 18 19 20 21 22 | Thompson et al. 2016 | Design: Systematic review Condition: Chronic pain Setting: Various Exercise intervention: n/a Adherence: n/a | “The extent to which a person’s behaviour (in terms of medications, following diets, or executing lifestyle changes) coincides with medical or health advice” ³ | None provided in addition to those in included articles | None provided in addition to those in included articles | None provided in addition to those in included articles |
| 23 24 25 26 27 28 | Tilbrook et al. 2014 | Design: Methodological study nested in RCT Condition: Chronic LBP Setting: Primary care Exercise intervention: Yoga Adherence: 3, 6 and 12 months | None provided | Session attendance Sessions completed | Class register Self-report exercise log | Adherence = attendance at 6 out of the 12 sessions, i.e. 50%. |
| 29 30 31 32 33 34 35 | Tuakli-Wosornu et al. 2016 | Design: Secondary analysis of RCT Condition: Knee OA Setting: Hospital outpatient Exercise intervention: Aerobic/Strengthening/Stretching/Postural Adherence: Bi-weekly for 12 weeks | No | Session attendance Exercise frequency | Telephone interview | Non-adherence = less than 50% prescribed exercises. |
| 36 37 38 39 40 41 42 43 44 45 46 47 | Van Dillen et al. 2016 | Design: RCT Condition: Chronic low back pain Setting: Community Exercise intervention: Other: Motor | No | Exercise frequency | Self-report exercise log | No |

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| | control and movement training, performance training Adherence: Daily for 6/52, then at 6/12 and 12/12 | | | | |
| Van Gool et al. 2005 | Design: RCT Condition: Knee OA Setting: Community Exercise intervention: Aerobic and strengthening Adherence: 6 and 18 months | None provided | Sessions attended Sessions completed | Class register Self-report exercise log | Participant's exercise adherence scores were split into 3 equally sized tertiles: low <40%, intermediate 41–70%, and high >71%. |
| Van Koppen et al. 2016 | Design: Observational study Condition: Non-specific low back pain Setting: Private physiotherapy Exercise intervention: Aerobic Adherence: Daily for 1 week | "The extent to which a person's behaviour (in terms of medications, following diets, or executing lifestyle changes) coincides with medical or health advice" ³ | Exercise time Exercise intensity Barrier list | DynaPort MoveMonitor which measures intensity and duration of physical activity and if the device is being worn | 100% adherence required to be classed as adherent |
| Waggoner & LeLievre 1981 | Design: Multiple time series Condition: RA with hand involvement Setting: Hospital outpatient Exercise intervention: Strengthening Adherence: Weekly over 7 weeks. | "100% adherence to the exercise regimen. Any deviance from 100% was described as non-compliance." ²⁸ | Exercise frequency | Objective measure Self-report exercise log | Adherence = completion of 100% of the prescribed exercise regimen. |
| Wig et al. 2004 | Design: Cohort study Condition: Temporomandibular Disorder Setting: Hospital outpatient Exercise intervention: Stretching and relaxation Adherence: 3x daily for 2 weeks | "The extent to which a person's behaviour (in terms of taking medications, following diets, or | Exercise frequency | Self-report exercise log | Adherence = completion of 1 out of 3 exercises per day for 2 weeks, i.e. 33%. |

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| | | executing lifestyle changes) coincides with medical or health advice.” ¹ | | | |
| Zandwijk et al. 2015 | Design: Observational study Condition: Non-specific low back pain Setting: Private physiotherapy Exercise intervention: Aerobic Adherence: Daily for 1 week | No | Exercise time Exercise intensity Barrier list | DynaPort MoveMonitor which measures intensity and duration of physical activity and if the device is being worn | 100% adherence required to be classed as adherent |

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Table 1. Details of the included studies

| Authors | Year | Country | Setting | Study Design | MSK Pain Condition | Exercise Type | Adherence Measurement Time-Point |
|---------------------------|------|-------------|-----------------------------------|------------------------------|-------------------------------|---|----------------------------------|
| Alexandre et al. | 2002 | USA | Hospital outpatient | Prospective cohort study | LBP | Aerobic, strengthening, stretching and postural | 2-6 weeks |
| Almekinders & Almekinders | 1994 | USA | Private physiotherapy | Retrospective study | Chronic overuse sports injury | Strengthening and stretching | 27 months on average |
| Anderson | 2011 | Denmark | Community | Prospective study | Neck and shoulder pain | Strengthening | 10 weeks |
| Basler et al. | 2007 | Germany | Hospital inpatient | Prospective randomised trial | Chronic LBP | Aerobic, strengthening, stretching | 6-7 weeks and 6 months |
| Beinart et al. | 2013 | UK | Community | SR | Chronic LBP | Not extracted | Not extracted |
| Belza et al. | 2002 | USA | Community | RCT | OA | Aquatic | 20 weeks |
| Bossen et al. | 2013 | Netherlands | Community | Mixed methods | Knee or hip OA | Aerobic | 9 weeks |
| Bruno | 1995 | USA | Hospital inpatient and outpatient | Prospective cohort study | Back or neck pain | Aerobic, stretching, posture and self-care | 12 weeks |
| Brus et al. | 1997 | Netherlands | Various | Literature review | RA | Not extracted | Not extracted |
| Brus et al. | 1998 | Netherlands | Hospital outpatient | RCT | RA | Aerobic | 1 year |
| Byerly et al. | 1994 | USA | Private physiotherapy | Cohort study | Musculoskeletal injury | Not stated | Until discharged |
| Campbell et al. | 2001 | UK | Outpatient physiotherapy | Qualitative study | Patellofemoral OA | Strengthening | 3 and 12 months |
| Carpenter & Davis | 1976 | USA | Hospital inpatient | Cohort study | RA | Not stated | 4 months |
| Cheung et al. | 2015 | USA | Community | Cross sectional study | Knee OA | Yoga | 6 months |
| Coppack et al. | 2012 | UK | Private physiotherapy | RCT | LBP | Aerobic, strengthening and stretching | 3 weeks |
| Dalager et al. | 2015 | Denmark | Community | RCT | Neck and shoulder pain | Strengthening | 20 weeks |
| Dobkin et al. | 2006 | Canada | Community | Prospective study | Fibromyalgia | Aerobic, strengthening and stretching | 12 weeks |
| Dobkin et al. | 2008 | Canada | Hospital outpatient | Prospective study | Fibromyalgia | Aerobic, strengthening and stretching | 3 months |
| Dobkin et al. | 2009 | Canada | Hospital outpatient | Prospective study | Fibromyalgia | Aerobic, strengthening and stretching | 3 months |

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|------------------|------|-------------|--|---------------------------------|-----------------------------|--|-----------------------------|
| Ezzar et al. | 2014 | Canada | Various | SR | RA or OA | Not extracted | Not extracted |
| Ferguson & Bole | 1979 | USA | Hospital outpatients | Cohort study | RA | Not stated | Not stated |
| Friedrich et al. | 1998 | Austria | Hospital outpatients | RCT | LBP | Aerobic, strengthening and stretching | 4 and 12 months |
| Frih et al. | 2009 | Tunisia | Hospital outpatients | RCT | LBP | Strengthening, stretching and self-positioning | 4 weeks and 3 months |
| Frost et al. | 2016 | UK | Community | SR | MSK pain | Not extracted | Not extracted |
| Gisla et al. | 2015 | Germany | Hospital outpatient | Evidence based practice project | CLBP | Stretching | 3, 6 and 12 months |
| Granlund et al. | 1994 | Sweden | Community | Cohort study | LBP | Aerobic, strengthening, stretching, postural and relaxation | 5 and 10 months |
| Granlund et al. | 1998 | Sweden | Community | Cohort study | LBP | Strengthening & stretching | Weekly for 5 months |
| Hakkinen et al. | 2004 | Finland | Hospital outpatient | RCT | RA | Strengthening & stretching | 2 and 5 years |
| Hall et al. | 2015 | Ireland | Various | SR | Chronic MSK conditions | Not extracted | Not extracted |
| Hammer et al. | 2007 | Sweden | Community | Descriptive and correlation | LBP | Repeated movements | 2 months |
| Han et al. | 2015 | Singapore | Hospital outpatient | Retrospective database study | ACL reconstruction | Strengthening/Aerobic/Other: neuromuscular & sport specific training | 1 year |
| Harkapaa et al. | 1989 | Finland | Hospital inpatient and hospital outpatient | Prospective RCT | LBP | Strengthening, stretching and postural | 3 months |
| Harkapaa et al. | 1990 | Finland | Hospital inpatient and hospital outpatient | Prospective RCT | LBP | Strengthening, stretching and postural | 2.5 years |
| Hartigan et al. | 2000 | USA | Hospital outpatient | Prospective observational study | Low back pain | Aerobic, strengthening, stretching | 3 and 12 months |
| Hicks et al. | 1985 | USA | Various | Review | RA | Not extracted | Not extracted |
| Hicks et al. | 2012 | Italy | Community | Observational study | Back pain | Strengthening, postural, flexibility and aerobic | Continuously over 12 months |
| Holden et al. | 2014 | UK | Primary care | SR protocol | Musculoskeletal disorders | Any | N/A |
| Hugli et al. | 2014 | Switzerland | Community | RCT pilot | Non-specific low back pain | Motor control exercise | Average of 49 days |
| Huyser et al. | 1997 | USA | Hospital outpatient | RCT | Fibromyalgia | Aerobic, strengthening, stretching and postural | Weekly for 6 weeks |
| Jack et al. | 2010 | UK | Physiotherapy outpatient | SR | Musculoskeletal dysfunction | Not extracted | Not extracted |
| Jackson | 1994 | USA | Hospital inpatient | RCT | Back and/or neck pain | Not stated | 3 weeks |
| Jansons et al. | 2016 | Australia | Various | SR | OA | Not extracted | Not extracted |
| Jordan et al. | 2010 | UK | Primary Care | SR | Chronic MSK pain | Not extracted | Not extracted |
| Kingston et al. | 2014 | Australia | Hospital outpatient | RCT | Traumatic hand injury | Not stated | 6 weeks |

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|------------------------|-------|-------------|----------------------------------|---------------------------|--|---|---------------------|
| Kolt & McEvoy | 2003 | Australia | Private physiotherapy clinics | Cohort study | Lumbar pain | Not stated | maximum 4 weeks |
| Lee et al. | 2016 | Hong Kong | Community | Mixed methods | Knee OA | Strengthening/Stretching/Other: range of movement | 12 weeks |
| Linton & Jenson | 1987 | Sweden | Community | Cohort study | Neck and shoulder pain | Relaxation gymnastics | 5 weeks |
| Linton et al. | 1996 | Sweden | Community | RCT | Back pain | Not stated | 6 months |
| Loew et al. | 2016 | Canada | Community | Survey | Knee OA | Aerobic | 3, 6 and 9 months |
| Lonsdale et al. | 2012 | Ireland | Outpatient physiotherapy | RCT outline | Low back pain | Not specified | 4, 12 and 24 weeks |
| Lyncoln et al. | 2002 | Australia | Hospital inpatient | Cohort study | Distal fracture of radius | Strengthening, stretching and functional | 6 weeks |
| Mailloux et al. | 2006 | USA | Hospital outpatient | Case series survey | Chronic back pain | Aerobics, strengthening and stretching | 2 years |
| Mannion et al. | 2009 | Switzerland | Primary care/hospital outpatient | Prospective study | LBP | Spinal segmental stabilisation | 9 weeks |
| Marks & Allegrante | 2005 | USA | N/A | Literature review | OA | Not extracted | Not extracted |
| Mayoux-Benhamou et al. | 2008 | France | Hospital outpatient | Prospective RCT | RA | Strengthening & stretching | 6 and 12 months |
| Medina-Mirapeix et al. | 2009 | Spain | Primary care | Observational study | Chronic non-specific neck or low back pain | Strengthening and stretching | 1 month |
| Mori et al. | 2006 | USA | Hospital outpatient | RCT | MSK pain | Aerobic and stretching | 3, 6 and 12 months |
| Munnek et al. | 2003 | Netherlands | Hospital outpatient | RCT | RA | Aerobic and strengthening | 2 years |
| Neuberger et al. | 1993 | USA | Hospital outpatient | Pilot study | RA | Stretching | 3-16 weeks |
| Newman-Beinart et al. | 2016 | UK | Hospital outpatient | Questionnaire development | Chronic LBP | Not stated | 3 and 7 weeks |
| Nordgren et al. | 2014 | Sweden | Hospital outpatient | Observational study | RA | Aerobic and strengthening | 1 year |
| O'Brien et al. | 2013 | New Zealand | Community | Feasibility study | Hip or knee OA | Aerobic, strengthening and stretching | 12 weeks |
| Peterson et al. | 2015 | Sweden | Primary care | RCT | Chronic whiplash | Aerobic/Strengthening/Postural | 3 and 6 months |
| Petrofsky & Laymon | 2016 | USA | Hospital outpatient | RCT | Chronic knee pain | Strengthening/Stretching/Postural/Other: ROM | 2 weeks |
| Petty & MASTRIA | 1983 | USA | Hospital outpatient | Case study | Chronic back pain | Strengthening and relaxation | Weekly for 23 weeks |
| Pisters et al. | 2010a | Netherlands | Primary care | Cluster randomised trial | Hip or knee OA | Aerobic, strengthening and stretching | Weeks 13 and 65 |
| Pisters et al. | 2010b | Netherlands | Primary care | Prospective observational | Hip or knee OA | Aerobic, strengthening and stretching | 3, 15 and 60 months |

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|-----------------------|-------|-------------|---|-------------------------------|--------------------------|---|--|
| | | | | study | | | |
| Rejeski et al. | 1997 | Canada | Not stated | RCT | Knee OA | Aerobic and strengthening | 3, 9 and 16 months |
| Resnick et al. | 2008 | USA | Hospital outpatient | RCT | Post hip fracture | Aerobic, strengthening and stretching | 12 months |
| Robinson et al. | 2004 | USA | Hospital outpatient | Telephone follow-up study | Chronic MSK pain | Not stated | Minimum 6 months |
| Rosal et al. | 2011 | USA | Hospital pre-op then inpatient, then outpatient | RCT protocol | Total knee replacement | Not specified | 8 weeks, 6 and 12 months |
| Schneiders et al. | 1998 | Australia | Private physiotherapy | Randomised prospective survey | Non-specific LBP | Not specified | 14 days |
| Schoo et al. | 2005a | Australia | Private physiotherapy | Randomised trial | Hip or knee OA | Strengthening & stretching | 4 and 8 weeks |
| Schoo et al. | 2005b | Australia | Hospital outpatient and private physiotherapy | Cohort study | Hip and knee OA | Strengthening & stretching | 4 and 8 weeks |
| Seckin et al. | 2000 | Turkey | Not stated | Cohort study | Knee OA | Strengthening, stretching and functional. | 3 months |
| Taal et al. | 1993 | Netherlands | Hospital outpatient | Cohort study | RA | Not stated | 4 weeks |
| Terpstra et al. | 1992 | Netherlands | Hospital outpatient | Retrospective study | RA | Not stated | 6-18 months |
| Thompson et al. | 2016 | Australia | Various | SR | Chronic pain | Not extracted | Not extracted |
| Tilbrook et al. | 2014 | UK | Primary care | Methodological study | Chronic LBP | Yoga | 3, 6 and 12 months |
| Tuakli-Wosornu et al. | 2016 | USA | Hospital outpatient | Secondary analysis of RCT | Knee OA | Aerobic/Strengthening/Stretching/Postural | Bi-weekly for 12 weeks |
| Van Dillen et al. | 2016 | USA | Community | RCT | Chronic LBP | Motor control and movement training, performance training | Daily for 6/52, then at 6/12 and 12/12 |
| Van Gool et al. | 2005 | USA | Community | RCT | Knee OA | Aerobic and strengthening | 6 and 18 months |
| Van Koppen et al. | 2016 | Netherlands | Private physiotherapy | Observational study | Non-specific LBP | Aerobic | 1 week |
| Waggoner & LeLievre | 1981 | USA | Hospital outpatient | Multiple time series | RA with hand involvement | Strengthening | 7 weeks. |
| Wig et al. | 2004 | USA | Hospital outpatient | Cohort study | TMJ disorder | Stretching & relaxation | 3x daily for 2 weeks |
| Zandwijk et al. | 2015 | Netherlands | Private physiotherapy | Observational study | Non-specific LBP | Aerobic | 1 week |

Abbreviations: CLBP – chronic low back pain, ACL – anterior cruciate ligament, TMJ – temporo-mandibular joint, SR – systematic review

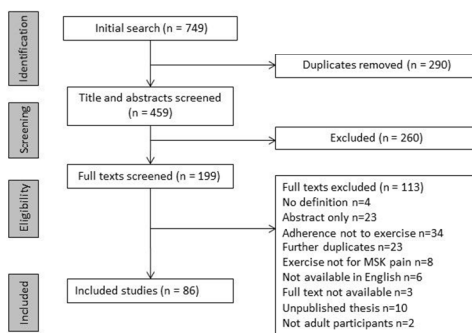
Not extracted – this data was not extracted as it was from studies included within SRs and therefore not eligible or already included separately.

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Figure 1. PRISMA flow diagram of study selection



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