**The effects of behavioural counselling on the determinants of health
behaviour change in adults with chronic musculoskeletal conditions making
lifestyle changes: a systematic review and meta-analysis.**

Behavioural counselling and lifestyle change

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Abstract

Objective: A systematic review and meta-analysis of controlled trials to examine the effect of behavioural counselling on determinants of behaviour change in adults with chronic, painful musculoskeletal conditions.

Data sources: Seven databases were searched until January 2019.

Trial selection: Two reviewers independently screened title/abstracts and full texts. Eligible trials included participants over 18 years with a chronic, painful musculoskeletal condition, a measurement of at least one behavioural determinant and lifestyle behaviour, and where behavioural counselling was the distinguishing intervention.

Data extraction: Two reviewers independently extracted data and assessed for risk of bias using the Cochrane Risk of Bias tool.

Data synthesis: Meta-analyses were conducted with standardised mean differences and 95% confidence intervals where at least two trials examined the same outcome. The quality of the evidence was evaluated using the Grades of Recommendation, Assessment, Development and Evaluation approach.

Results: Fourteen unique trials reported in 16 publications were included. Low quality evidence showed behavioural counselling has a small effect on increasing self-reported physical activity (standardised mean difference 0.26, 95%CI: 0.00 to 0.53). Very low-quality evidence showed behavioural counselling has a moderate effect on self-efficacy related to physical activity (standardised mean difference = 0.69, 95% CI: 0.19 to 1.18). Low quality

evidence suggests that behavioural counselling has no effect on symptoms of depression and anxiety.

Conclusion: Behavioural counselling may help to increase self-reported physical activity levels in adults with chronic painful musculoskeletal conditions. Self-efficacy may be a behavioural determinant in an underlying causal pathway explaining positive lifestyle change.

Keywords: behavioural counselling, motivational interviewing, health coaching, lifestyle change, behavioural determinant, chronic musculoskeletal condition, systematic review

Introduction

One in three people worldwide live with a chronic, painful musculoskeletal condition (Briggs et al., 2018). Musculoskeletal conditions impact on an individual's ability to participate fully and effectively in society, making musculoskeletal conditions the second highest contributor to disability globally (Vos et al., 2017; World Health Organisation, 2018). In terms of prevention and management, chronic painful musculoskeletal conditions share many of the same risk factors as other non-communicable diseases, including inadequate amounts of physical activity (PA), poor diet and being overweight (Briggs et al., 2018). Recommendations to increase exercise and PA, to change diets and to lose weight all rely on changing our health-related lifestyle behaviours. Changing lifestyle behaviours, particularly in a way that is sustainable, is notoriously difficult but increasingly important with the growing prevalence of chronic painful musculoskeletal conditions.

Many behaviour change theories have been developed to help explain health behaviour (Nutbeam, 2010), and these have informed models which hypothesise the underlying causal relationships between behaviour change interventions and health behaviour change (Michie, Johnston, Francis, Hardeman, & Eccles, 2008). Figure 1 shows a sample causal model where 'behavioural determinants' are the factors that require change for the goal

behaviour to occur. Thus, behavioural determinants are the key factors linking behaviour change techniques and performance of behaviours, such as increasing the amount of PA or exercise undertaken, changing diet or adhering to medication regimes. Michie and Abraham (Michie & Abraham, 2004) discuss that without understanding the underlying causal and psychological processes (i.e. behavioural determinants), by which lifestyle changes are enabled, refinement of behaviour change interventions to enhance efficacy is hampered.

Behavioural counselling is one type of health behaviour change intervention that can facilitate positive lifestyle changes. Behavioural counselling refers to a patient-centred, collaborative, conversational approach between equals, the patient and therapist, to achieve a specific goal (Miller & Rollnick, 2012). Behavioural counselling typically includes both 'relational' techniques such as empathy and building patient autonomy and 'content' techniques such as information sharing, goal-setting and exploring pros and cons of change (Hardcastle, Fortier, Blake, & Hagger, 2017). The use of behavioural counselling in healthcare settings has grown alongside the rise in lifestyle-related chronic diseases (Keogh, Tully, Matthews, & Hurley, 2015). Accordingly, there have been an increasing number of trials examining the effect of behavioural counselling interventions to help people with chronic disease make and sustain lifestyle changes.

Motivational interviewing has been defined by Miller and Rollnick (2012, pp. 410) as "a person-centred counselling style for addressing the common problem of ambivalence about change" and is a behavioural counselling approach shown to have a positive impact on health behaviours such as PA or adherence to chronic pain treatments in two recent systematic reviews (Alperstein & Sharpe, 2016; O'Halloran et al., 2014). Neither review examined behavioural determinants by which a change in lifestyle might have been enabled. In addition, the reviews included a broad population with any chronic health condition. However, adults with chronic painful musculoskeletal conditions face a set of unique challenges and goals. Other behavioural counselling approaches have observable overlap in the key relational and content techniques with motivational interviewing. These

include motivational enhancement therapy, health coaching methodologies (Gale & Skouteris, 2013) (e.g. HealthChange Australia (Gale, 2012)), and other less formal approaches. Our systematic review extends previous reviews (Alperstein & Sharpe, 2016; O'Halloran et al., 2014) by including all behavioural counselling interventions that encompass relational and content techniques and have similar aims (behaviour change) and comparable approaches. This review focusses on people with chronic conditions characterised by pain from musculoskeletal causes and highlights the effect of behavioural counselling on behavioural determinants that may be theorised to explain the process of behaviour change. The aim of this systematic review is therefore to examine how behavioural counselling impacts on theorised determinants of health behaviour change and positive lifestyle changes in adults with chronic, painful musculoskeletal conditions. We anticipate the findings will further our understanding of potential causal pathways through which behavioural counselling achieves improved health outcomes and may help to refine behaviour change interventions in the future.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline was used in the preparation of this report (Moher, Liberati, Tetzlaff, & Altman, 2009), and the review was registered with PROSPERO (Registration number CRD42018090900) prior to completion of data extraction.

Search Strategy

MEDLINE, PsycINFO, EMBASE, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews on the OVID platform and CINAHL and SPORTDiscus on the EBSCO platform were searched from date of inception until January 2019. Additionally, the Australian New Zealand Clinical Trials Registry and the International Clinical Trials Registry Platform were searched to verify no controlled trials were missed. The search strategies are listed in Appendix A. Search constructs were: 1) behavioural counselling (including terms: motivational interviewing, motivational counselling, health coaching, motivational change,

motivational intervention, directive counselling, behavioural counselling, Flinders Model, Stanford Chronic Disease Management, transtheoretical model, Acceptance and Commitment Therapy, shared decision making, telephone coaching), and 2) chronic painful musculoskeletal conditions (including terms: chronic or persistent pain, musculoskeletal diseases, musculoskeletal conditions, musculoskeletal injuries, chronic low back pain, low back pain, spinal pain, lumbago, knee or hip osteoarthritis). A supplementary hand search of reference lists of included articles was also completed.

Title and abstract screening and full text screening stages were carried out independently by any two of four possible reviewers (EM, CM, FD and TE) and conflicts were resolved by discussion.

Eligibility criteria

Types of Participants

Trials that included participants 18 years and over, with a chronic painful musculoskeletal condition were eligible for inclusion. Chronic was defined as a long-term condition lasting three months or longer. Musculoskeletal conditions were as defined by the World Health Organisation classification of diseases of the musculoskeletal system and connective tissues. These included osteoarthritis, rheumatoid arthritis, soft tissue injuries of peripheral joints that led to chronic pain, chronic back and neck pain, and fibromyalgia.

Types of Intervention

Trials that incorporated behavioural counselling interventions delivered one-to-one, between a health practitioner and patient/client (either face-to-face or remotely via telephone, telehealth or videoconference), used a conversational approach with open-ended questions, and aimed to facilitate behavioural change were eligible for inclusion. In addition, the behavioural counselling intervention had to include at least one relational technique and at least one content technique from the list described below. The list was

developed based on Hardcastle, Fortier, Blake and Hagger's work (Hardcastle et al., 2017) on the relational and content techniques of motivational interviewing.

Relational techniques included:

- a) collaboration (building a partnership where patient and therapist have equal involvement)
- b) empathy (an atmosphere of acceptance, compassion and understanding through active listening)
- c) building patient autonomy (respecting and encouraging the right of the patient to make their own decisions)
- d) evocation (drawing out the patient's own ideas and motivation)

Content techniques included:

- a) goal setting and reviewing (patients set their own short- and long-term goals and review progress towards those goals)
- b) reviewing pros and cons (sometimes referred to as decisional balance where the pros and cons of changing a behaviour are explored in a neutral environment)
- c) overcoming barriers/troubleshooting (discussing actual or possible barriers to a behaviour and brainstorming solutions to overcome those barriers)
- d) sharing knowledge/education (both patient and therapist have expertise which can be shared to enhance health literacy)
- e) reviewing the patient's beliefs and values (the patient's broader life beliefs and values are discussed in relation to the behaviour change goal)
- f) reviewing confidence and/or motivation for change (the patient's confidence or motivation to change is purposefully assessed or reviewed in relation to the behaviour change goal)

If the behavioural counselling intervention specified that motivational interviewing or motivational enhancement therapy was used, then it was assumed that all relational and

content techniques had been included, even if not explicitly stated in the intervention description of the trial.

In the case of multi-modal interventions, behavioural counselling must have been the main distinguishing component of the intervention.

Types of Comparison

The behavioural counselling intervention may have been compared to any other intervention or a non-exposed control group.

Types of Outcomes

The trial must have included a measure of at least one behavioural determinant and at least one lifestyle behaviour change. A behavioural determinant was defined as a mediator or process measure by which changes in health behaviours or lifestyle could be theorised to be enabled. Examples of such outcomes include measures of mood, fear avoidance behaviour, self-efficacy to manage pain or motivation to increase PA. A lifestyle behaviour was defined as a behaviour that could be considered health enhancing in relation to the health condition experienced. The Encyclopaedia of Public Health defines health behaviours as "any action that is related to disease prevention, health maintenance, health improvement, or the restoration of health" (Glanz & Maddock, 2002).

Types of trial design and publication

Randomised controlled trials (RCT), case-controlled trials and trials based on data from RCTs such as mediation analyses were included. Only full-text articles published in English in peer-reviewed journals were included.

Risk of bias assessment

The Cochrane Risk of Bias Tool, recommended in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins & Green, 2011), was used to assess the internal validity of included trials. Any two of three possible reviewers (EM, FD or TE) independently assessed

the risk of bias of all trials and conflicts were resolved by discussion. Risk of bias was assessed as low, high or unclear for the following domains: random sequence generation; allocation concealment; blinding of participants and personnel; blinding of outcome assessors; incomplete outcome data; selective outcome reporting; and other sources of bias. Publication bias for separate outcomes was assessed using funnel plot symmetry and Eggers test (Higgins & Green, 2011) when a sufficient number of trials (at least 10) was available for each outcome (Higgins & Green, 2011).

Data extraction and synthesis of results

Data were independently extracted from trials by two reviewers (EM and TE) using a customised template. Differences were resolved by discussion. Extracted data included details on: trial characteristics (country and setting; trial design; health condition; number of participants; participant age and sex; control group or comparison details; intervention details including any measures of treatment fidelity and who delivered the intervention; lifestyle or health behaviour targets and the outcome measures; behavioural determinant targets and the outcome measures; assessment timepoints; funding and potential conflicts of interest); any details of relational and content techniques included in the behavioural counselling intervention description; and the results from the immediately post-intervention time point and the longest follow-up time point.

Meta-analyses were conducted with standardised mean differences and 95% confidence intervals where at least two trials examined the same outcome. The quality of the evidence for separate outcomes was evaluated using the Grades of Recommendation, Assessment, Development and Evaluation (GRADE) approach (Guyatt et al., 2008).

A sensitivity analysis was planned to determine influence of trial fidelity on overall effects where possible. Trial fidelity was defined as when content and relational techniques were considered acceptable by the authors or significantly better than the control group. Subgroup analyses were planned by different health conditions where possible (i.e. two or more trials per outcome) to determine difference in effects between health conditions. A

meta-regression to assess the relationships between behavioural determinants and goal behaviours was the intention.

Results

Fourteen unique trials reported in 16 publications were included (Allen et al., 2017; Ang et al., 2013; Ben-Ami, Shapiro, Chodick, Mirovsky, & Pincus, 2017; Ferguson et al., 2015; Friedrich, Gittler, Halberstadt, Cermak, & Heiller, 1998; Gilbert et al., 2018; Kerns et al., 2014; Knittle et al., 2015; Knittle et al., 2016; Lonsdale et al., 2017; Niedermann et al., 2012; Niedermann et al., 2011; Thomsen et al., 2016; Thomsen et al., 2017; Vong, Cheing, Chan, So, & Chan, 2011; Williams et al., 2018). The process of identification of trials for inclusion and reasons for exclusion are summarised in the PRISMA flow diagram (Figure 2). Exclusions for 'incorrect intervention' was mostly due to interventions being delivered in a group-based format, and less often because behavioural counselling was not the main component in the intervention, or the intervention was not aiming to change behaviour. 'Incorrect population' included when chronic pain was not further described such that a musculoskeletal disorder could be confirmed as the cause. 'Incorrect trial design or publication type' were primarily because there was no comparison group or because it was not a full-text journal publication. Many otherwise eligible trials did not report any outcomes that could be theorised to be a behavioural determinant.

Trial Characteristics

Twelve of the 14 trials were RCTs, one trial was a non-randomised controlled trial and one was a pseudo-RCT (Table 1). Average population ages ranged from 42 to 65 years. Participants with rheumatoid arthritis were evaluated in six trials, chronic low back pain in six trials, hip or knee osteoarthritis in two trials, and fibromyalgia in one trial (Table 1).

The format of delivery of the behavioural counselling interventions varied between trials (Table 2). In four trials (Ben-Ami et al., 2017; Friedrich et al., 1998; Lonsdale et al., 2017; Vong et al., 2011) behavioural counselling was delivered in conjunction with physiotherapy.

Behavioural counselling was also delivered alongside a prescribed exercise routine including supervised exercise sessions (Ang et al., 2013), with occupational therapy (Niedermann et al., 2012; Niedermann et al., 2011), and with cognitive behavioural therapy (Kerns et al., 2014). In all these trials, the control group also received the adjunct therapies, thus behavioural counselling was the distinguishing feature between both interventions. In the remaining seven trials, behavioural counselling was delivered as a stand-alone intervention and included varying amounts of education related to the health condition and the targeted lifestyle change. The duration of the interventions ranged between six weeks to two years and specific dosages varied between 20 and 90 minutes. The method of delivery of behavioural counselling was exclusively telephone-based in two trials (Allen et al., 2017; Ang et al., 2013), with the remaining twelve trials having used either face-to-face or a combination of face-to-face and telephone-based behavioural counselling.

Table 3 summarises the relational and content techniques included within each of the behavioural counselling interventions. All relevant relational and content techniques were reported or were reasonably assumed in 10 trials. One or two relational and/or content techniques were missing in two trials (Lonsdale et al., 2017; Niedermann et al., 2012; Niedermann et al., 2011), and four or more techniques were missing in the remaining two trials (Ferguson et al., 2015; Friedrich et al., 1998). The most common technique to not be reported as part of the intervention was the “reviewing of pros and cons” followed by “reviewing patients’ values and beliefs”.

In terms of fidelity, all bar three trials (Ferguson et al., 2015; Gilbert et al., 2018; Knittle et al., 2015; Knittle et al., 2016) reported measuring fidelity to the planned intervention with most trials only measuring and reporting just the dosage received (e.g. number of behavioural counselling sessions attended). Only four trials (Ang et al., 2013; Kerns et al., 2014; Lonsdale et al., 2017; Vong et al., 2011) assessed the quality of the intervention and they used a variety of methods/tools. All four trials reported an acceptable level of fidelity

to the intervention and/or a significant difference between the interventions received by both groups. The results of fidelity testing are summarised in Appendix C.

A variety of behavioural determinants were examined, all using self-report questionnaires (Table 1). Behavioural determinants included measures examining symptoms of depression, anxiety and stress; mental health; self-efficacy; beliefs, attitudes and expectations; motivation; and working alliance. Lifestyle behavioural targets (Table 1) included PA or home exercise compliance; adherence to recommendations (e.g. medication or self-management skills practice); attendance to appointments; sedentary behaviours; and diet behaviours including weight or BMI (which for the purpose of this review were considered proxy measures of lifestyle behaviours aimed at losing weight).

Risk of bias

An overview of the assessed internal validity of included trials is provided in Figure 3 (Appendix B further presents internal validity of trials per individual outcome). Performance and detection bias relating to the blinding of participants, personnel and outcome assessors was the most common possible source of bias, present in eight trials. As patient-reported outcome measures were used in every trial, if participants were not blinded (introducing possible performance bias), then outcome assessors were therefore also not blinded (introducing possible detection bias). Six trials were rated as having low risk of bias in relation to participant and personnel blinding. Other potential sources of bias were identified in four trials including: i) the randomisation process (Friedrich et al., 1998) whereby five patients already randomised to the intervention group were excluded immediately after randomisation because of a 'protocol violation'; ii) the trial being underpowered to detect any change (Kerns et al., 2014; Thomsen et al., 2016); and iii) a lack of statistical correction when multiple outcomes were assessed (Lonsdale et al., 2017).

Outcome findings

Meta-analyses were appropriate for the behavioural determinants of depressive and anxiety-related symptoms, global measures of mental health, self-efficacy (disease and PA), fear avoidance behaviour and autonomous motivation. In relation to lifestyle targets, meta-analyses were appropriate for increasing PA and exercise, reducing sedentary time, increasing breaks in sedentary periods, and weight loss behaviours (BMI). The overall strength of the evidence was low to very low (Table 4). This was primarily due to the high risk of bias present in most trials. A downgrading of evidence was also commonly associated with high levels of statistical heterogeneity and less commonly due to imprecision (large confidence limits) of the effect estimate.

Behavioural determinants

Symptoms of depression and/or anxiety and stress were measured in eight trials (Table 1). Low quality evidence suggests that behavioural counselling had no effect on symptoms of anxiety (standardised mean difference, SMD 0.04 (95%CI: -0.34, 0.40); $I^2=49.4\%$) or depression (SMD -0.02 (95%CI: -0.16, 0.12); $I^2=0.0\%$) (Figure 4). Stress as measured in one medium quality trial (Williams et al., 2018) showed no statistically significant difference between control and intervention groups. Global measures of mental health were measured in five trials (Table 1). Low quality evidence indicated no significant effect of behavioural counselling on mental health (SMD 0.22 (95%CI: -0.18, 0.62); $I^2=86.8\%$).

Self-efficacy was measured in six trials (Table 1). Of these, four trials (Knittle et al., 2015; Knittle et al., 2016; Lonsdale et al., 2017; Thomsen et al., 2016; Thomsen et al., 2017) measured self-efficacy in relation to PA and two (Niedermann et al., 2012; Niedermann et al., 2011; Vong et al., 2011) in relation to disease management. Although there was low quality evidence of no significant effect of behavioural counselling on self-efficacy with respect to disease management (SMD 0.05 (95%CI: -0.33, 0.44); $I^2=18.9\%$), there was very low quality evidence of a moderate effect on self-efficacy with respect to PA (SMD 0.69 (95%CI: 0.19, 1.18); $I^2=80.3\%$) (Figure 5).

Behavioural determinant measures related to beliefs, attitudes and expectations about the health condition and treatment were measured in five trials of varied quality (Ferguson et al., 2015; Friedrich et al., 1998; Lonsdale et al., 2017; Vong et al., 2011; Williams et al., 2018). Most found no significant differences between intervention and control groups immediately post-intervention. The one exception being the measure of 'personal control', which was found to be different in favour of the behavioural counselling intervention (Ferguson et al., 2015). Two trials measured fear avoidance behaviour. Low quality evidence indicated no effect of behavioural counselling on fear avoidance behaviour (SMD - 0.19 (95%CI: -0.43, 0.05); $I^2=0.0\%$).

Various forms of motivation including autonomous motivation, controlled motivation and amotivation were measured (Table 1) and had varying results. Only autonomous motivation was measured in two trials (Knittle et al., 2015; Knittle et al., 2016; Lonsdale et al., 2017) enabling meta-analysis. Very low-quality evidence suggests that behavioural counselling has no significant effect on autonomous motivation (SMD 0.38 (95%CI: -0.15, 0.92); $I^2=73.5\%$). Controlled motivation as measured in one low quality trial showed no statistically significant difference between control and intervention groups whilst amotivation showed a statistically significant difference between groups in favour of the behavioural counselling intervention.

Lifestyle targets and measures

PA and home exercise completion was measured in nine trials (Table 1). PA was measured using only self-reported questionnaires in seven trials (Allen et al., 2017; Ben-Ami et al., 2017; Friedrich et al., 1998; Knittle et al., 2015; Knittle et al., 2016; Lonsdale et al., 2017; Vong et al., 2011; Williams et al., 2018), both a self-reported questionnaire and accelerometry in one trial (Ang et al., 2013), and accelerometry only in one trial (Gilbert et

al., 2018). Where multiple self-reported measures were used, time duration was the most commonly used unit of measure. Moderate-vigorous PA was the most common form of PA targeted in trials. The quality of evidence was very low for both objective and self-reported measures of PA. Although there was no significant effect of behavioural counselling on objectively-measured PA (SMD 0.12 (95%CI: -0.23, 0.47); $I^2=77.2\%$), there was a small effect on self-reported PA (SMD 0.26 (95%CI: 0.00, 0.53); $I^2=79.8\%$) (Figure 6).

Daily sedentary time and taking breaks during sedentary periods objectively measured using accelerometry, as well as self-reported leisure-time sitting, were measured in two trials (Thomsen et al., 2016; Thomsen et al., 2017). Very low-quality evidence suggests that behavioural counselling has no effect on objectively-measured sedentary time (SMD -0.91 (95%CI: -2.04, 0.22); $I^2=82.6\%$) or self-reported leisure-time sitting (SMD -0.22 (95%CI: -1.64, 1.19); $I^2=88.6\%$). Low quality evidence shows behavioural counselling has no effect on objectively-measured breaks during sedentary periods (SMD 0.16 (95%CI: -0.14, 0.46); $I^2=0.0\%$).

Weight loss behaviours (or a proxy measure for weight loss behaviour) was measured in two trials (Allen et al., 2017; Williams et al., 2018). Low quality evidence suggests that behavioural counselling has no effect on weight loss behaviour (SMD -0.13 (95%CI: -0.41, 0.16); $I^2=38.5\%$). One medium quality trial examined dietary behaviours (Williams et al., 2018) which showed no statistically significant difference between control and intervention groups immediately post intervention.

Adherence to recommendations made regarding a variety of health behaviours such as taking medications, self-management skills practice and adhering to physiotherapist recommendations generally showed varied results. Two trials of low quality showed improvements in adherence to joint protection strategies (Niedermann et al., 2012; Niedermann et al., 2011) and physiotherapist recommendations (Lonsdale et al., 2017) in favour of behavioural counselling immediately post-intervention. Two trials found no difference between groups post-intervention relating to medication (Ferguson et al., 2015)

and skills practice adherence (Kerns et al., 2014). Appointment attendance was examined in two very low-quality trials (Friedrich et al., 1998; Kerns et al., 2014) one of which found a statistically significant difference in favour of behavioural counselling.

The sensitivity analyses for depression and self-reported PA including four trials found equivalent effect sizes to the primary analyses supporting the robustness of the main findings. Subgroup analyses were appropriate for rheumatoid arthritis and chronic low back pain cohorts. Effect sizes were generally comparable irrespective of patient population for the outcomes of anxiety, depression, mental health, self-efficacy for PA and self-reported PA.

A meta-regression was not appropriate, and publication bias was not assessed due to the small number of included trials.

Discussion

This systematic review and meta-analyses investigated the impact of behavioural counselling on behavioural determinants and lifestyle behaviour changes in adults with chronic painful musculoskeletal disorders. The review found that behavioural counselling may help people make positive lifestyle changes, specifically improvements in self-reported PA and possibly adherence to other self-management advice, although the evidence pool was not high quality. Self-efficacy for PA - but not symptoms of depression, anxiety or general mental health - may be a behavioural determinant by which positive lifestyle changes are enabled with behavioural counselling.

The single most studied behavioural determinant was mood, including symptoms of depression and anxiety. The results consistently showed no difference in mood between groups with and without behavioural counselling, however, approximately half of these trials found a positive lifestyle change in favour of behavioural counselling. This finding suggests mood may not be a key mechanism by which behavioural counselling brings about behavioural change. This should perhaps not be surprising given neither the relational nor

content techniques directly address a person's feelings. Similarly, behavioural counselling did not improve general mental health, yet in three of the five trials the intervention achieved lifestyle changes. Thus, mental health also does not appear to be a determinant in the causal pathway between behavioural counselling and the achievement or otherwise of a successful lifestyle change.

The other most examined behavioural determinant was self-efficacy. Very low-quality evidence suggests that behavioural counselling has a moderate effect on self-efficacy related to PA. In trials where self-efficacy was found to improve more in the behavioural counselling group immediately post intervention, intervention group participants were also more successful at achieving at least one lifestyle change than control group participants. Thus, self-efficacy appears to be a plausible determinant linking the effects of behavioural counselling to a successful lifestyle change. A future meta-regression would be helpful in providing further support for this relationship.

Insufficient data was available to enable conclusions regarding whether motivation, beliefs, attitudes and expectations play a mechanistic role, and further trials including these determinants are recommended. Other important determinants may have been overlooked in the research and therefore also this review. Various behaviour change theories catalogue many possible behavioural determinants. The selection of constructs should be informed by behaviour change theory (Ajzen, 1991; Bandura, 1989; Bandura, 1998; Fisher, Fisher, & Harman, 2003; Michie, van Stralen, & West, 2011; Prochaska & Velicer, 1997), as well as the core techniques that characterise behavioural counselling (Hardcastle et al., 2017). Other possible determinants include knowledge, identity, values, cognitive fusion, autonomy and therapeutic alliance (Hardcastle et al., 2017; Simister et al., 2018). For future research to achieve a better understanding of the mechanisms by which behavioural counselling approaches work or do not work in bringing about lifestyle changes, greater consideration needs to be given to the inclusion and measurement of plausible behavioural determinants in trial designs.

A strength of this review is the combining of behavioural counselling interventions based on common aims, content and approach. This is in contrast with other systematic reviews (Cheng et al., 2015; O'Halloran et al., 2014) that limited their intervention to one technique, such as motivational interviewing, thus limiting their pool of data and their potential to develop a deeper understanding of the important active ingredients of conversational methodologies for facilitating behaviour change. Using relational techniques as a distinguishing feature of the included interventions helps to build evidence to support the hypotheses that relational techniques are important in facilitating behaviour change for people with chronic health issues (Hardcastle et al., 2017). These key components of behavioural counselling are currently not captured in Michie et al.'s Behaviour Change Technique Taxonomy (Michie et al., 2013).

The findings from this review are naturally only as robust as the trials that contributed to them. Few of the trials had low overall risk of bias and data from trials with high risk of bias were not excluded. The resulting evidence for effectiveness in changing all lifestyle behaviours and behavioural determinants was low to very low quality, with the risk of bias increased across all measures because of the low numbers of trials. Thus, a degree of caution is required in interpreting the findings of this review and higher quality trials are needed to confirm them in future. Another limitation of this review is its limited applicability to people over 65 years of age since all included trials had an average mean age of 65 years or younger. Many older people live with chronic painful musculoskeletal conditions and stand to benefit from lifestyle changes such as increasing PA levels or by modifying their diet to lose weight. In order to minimise bias in this systematic review, a protocol was pre-published in PROSPERO, study selection and data extraction was duplicated, and a highly sensitive search strategy was developed albeit excluding non-English language reports. While publication bias was not assessed statistically, trial registries were searched for possible unpublished work.

The efficacy of behavioural counselling in effecting lifestyle changes demonstrated in this systematic review are not dissimilar to results found in other systematic reviews (Alperstein & Sharpe, 2016; O'Halloran et al., 2014). That is motivational interviewing has been found to have a positive effect on adherence to chronic pain treatment programs and in increasing PA levels. In this current review, behavioural counselling affected positive change in at least one of the targeted lifestyle changes in eight out of the twelve trials that provided efficacy data. Our meta-analyses found that PA was the only lifestyle behaviour that improved with behavioural counselling.

Also similar to the previous systematic review on the effectiveness of motivational interviewing for increasing PA (O'Halloran et al., 2014), less than a third of trials in our review tested and reported treatment fidelity in terms of quality of the intervention. A lack of clarity around whether the behavioural counselling interventions were delivered as intended makes it difficult to confirm whether the lack of evidence for effect of behavioural counselling on some of the determinants and behaviours reflects an ineffective intervention, or an unsuccessful attempt at implementing behaviour counselling. Reporting on treatment fidelity is especially important when health professionals not traditionally trained to deliver behavioural counselling, including physiotherapists, occupational therapists and health educators, deliver the interventions.

Behavioural counselling as defined within this review included a variety of interventions or approaches including motivational interviewing, motivational enhancement therapy and other specific conversational strategies delivered in a one-to-one format. Whilst approaches such as Acceptance and Commitment Therapy, the Flinders Model and the Stanford Chronic Disease Management model would have potentially fit our operational definition for behavioural counselling of including relational and content techniques, none of these approaches have been studied in trials where they were delivered in a one-to-one format. By requiring at least one relational technique (such as collaborating as equals or showing empathy), plus at least one content technique (such as goal-setting or discussing pros and

cons) in order to change a lifestyle behaviour, our review excluded interventions such as patient education programs, decision aids and Cognitive Behavioural Therapy. Inclusion for this review therefore relied on an accurate and detailed description of the intervention in order to identify it as a behavioural counselling intervention. Trials providing a limited description of their intervention makes it difficult not only to interpret the results but to replicate the intervention in a clinical setting. Behaviour change interventions need to be described in detail so that the key 'active ingredients' can be better understood, the interventions delivered reliably, and enable them to be refined and developed further (Hardcastle et al., 2017; Michie et al., 2013).

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TABLES AND TABLE LEGENDS

Table 1. Characteristics of included trials

Citation (trial design)	Country and setting	N	Mean age, years (SD)	Sex, % female	Health Condition	Behavioural determinant (measure)	Lifestyle behaviour (measure)
Allen et al. 2017 (RCT)	U.S.A, community- based primary care clinics	257	CG: 63.9 (10.2) IG: 63.9 (9.3)	CG: 71% IG: 73%	Symptomatic hip or knee osteoarthritis	Depression (8-item Patient Health Questionnaire)	Weight loss behaviours (Body Mass Index) PA (Community Health Activities Model Program for Seniors)
Ang et al. 2013 (RCT)	U.S.A, primary health care	216	CG: 45.7 (11.0) IG: 46.0 (11.4)	CG: 95% IG: 96%	Fibromyalgia	Depression (8-item Patient Health Questionnaire)	Exercise (Community Health Activities Model Program for Seniors; accelerometry)
Ben-Ami et al. 2017 (NRCT)	Israel, community clinics	220	CG: 42 (7) IG: 42 (8)	CG: 58% IG: 51%	Chronic low back pain +/- radiation to the lower limb	Mental health (12-item Short-Form Health Survey, Mental Component Subscale)	PA (Baecke PA Questionnaire)
Ferguson et al. 2015 (RCT)	United Kingdom, rheumatology outpatient clinic	18	CG: 46 (17.0) IG: 51 (14.1)	CG: 100% IG: 100%	Rheumatoid arthritis	Beliefs about treatment (Beliefs About Medication Questionnaire) Beliefs about illness (Illness Perception Questionnaire) Depression (9-item Patient Health Questionnaire) Anxiety (7-item General Anxiety Disorder)	Adherence to medications (Medication Adherence Rating Scale; Morinsky Adherence Scale)

Friedrich et al. 1998 (RCT)	Australia, outpatient department	93	CG: 44.9 (11.0) IG: 43.3 (10.4)	CG: 45% IG: 57%	Chronic and recurrent low back pain	Level of distress, internal locus of control, and attitude toward exercise (3 independent subscales generated from a psychotherapy motivation questionnaire)	Exercise (self-reported time since ceasing therapy; total number of training weeks x number of training days/week x number of minutes trained each day) Appointment attendance (sessions attended)
Gilbert et al. 2018 (RCT)	U.S.A, academic medical centre	340	KOA: CG: 64.8 KOA: (12.6) 155 IG: 61.4 (13.3) RA: RA: 185 CG: 54.7 (13.7) IG: 55.0 (14.0)	KOA: CG: 62% IG: 58% RA: CG: 85% IG: 83%	Knee osteoarthritis (KOA) or rheumatoid arthritis (RA)	Mental health (36-item Short-Form Health Survey, Mental Component Subscale)	PA (accelerometry)
Kerns et al. 2014 (Modified RCT)	U.S.A, ambulatory healthcare setting	128	CG: 55.0 (10.0) IG: 55.5 (13.1)	CG: 6% IG: 12%	Chronic back pain	Depression (Beck Depression Inventory)	Appointment attendance (sessions attended) Adherence to recommendations (self-rated scale)

Knittle et al. 2015 and 2016 (RCT and mediation analysis)	United Kingdom, outpatient rheumatology department	78	CG: 64.7 (11.5) IG: 60.7 (11.9)	CG: 55% Rheumatoid arthritis IG: 79%	Self-efficacy for PA (Bandura's 18-item questionnaire) Autonomous motivation for PA (Treatment Self-Regulation Questionnaire) Depression (Brief Symptom Inventory) Skills acquisition (Self-Regulation Skills Battery)	Leisure-time PA (Short Questionnaire to Assess Health-Enhancing PA; self-reported number of days/week engaged in at least 30 minutes of moderately vigorous PA over the past month)
Lonsdale et al. 2017 (RCT)	Ireland, hospital and community clinics	255	CG: 46.7 (13.5) IG: 44.1 (13.0)	CG: 52% Chronic low back pain IG: 56%	Fear avoidance (Fear Avoidance Behaviour Questionnaire) Competence (self-reported on a numerical rating scale) Motivation (Treatment Self-Regulation Questionnaire)	Adherence to home-based exercises (self-reported sessions completed during previous week) Adherence to physiotherapist recommendations (self-reported on a numeric rating scale) PA (International PA Questionnaire)
Niedermann et al. 2011 and 2012 (RCT)	Switzerland, rheumatology centres/clinic	53	CG: 53.4 (15.7) IG: 62.1 (12.6)	CG: 82% Rheumatoid arthritis IG: 85%	Joint protection self-efficacy (Self-efficacy Scale for Joint Protection) Arthritis self-efficacy (Arthritis Self-efficacy Scale) Anxiety (Hospital Anxiety and Depression Scale, Anxiety Subscale) Depression (Hospital Anxiety and Depression Scale, Depression Subscale)	Joint protection behaviour (German version of Joint Protection Behavioural Assessment)
Thomsen et al. 2016 (Pilot RCT)	Denmark, rheumatology outpatient clinic	20	CG: 54.0 (14.0) IG: 64.5 (8.5)	CG: 60% Rheumatoid arthritis IG: 60%	Self-efficacy (General Self-Efficacy Scale) Mental health (36-item Short-Form Health Survey, Mental Component Subscale)	Sitting time and sitting breaks (accelerometry; self-reported sitting time at work and at leisure)

Thomsen et al. 2017 (RCT)	Denmark, rheumatology outpatient clinic	150	CG: 59.5 (12.7) IG: 59.7 (10.7)	CG: 80% Rheumatoid arthritis IG: 81%	Self-efficacy (General Self-Efficacy Scale) Mental health (36-item Short-Form Health Survey, Mental Component Subscale)	Sitting time and sitting breaks (accelerometry; self-reported sitting time at work and at leisure)
Vong et al. 2011 (RCT)	China, outpatient physiotherapy department	76	CG: 45.1 (10.7) IG: 44.6 (11.2)	CG: 58% Chronic low back pain IG: 68%	Working alliance (Pain Rehabilitation Expectation Scale, Working Alliance Subscale) Treatment expectancy (Pain Rehabilitation Expectation Scale, Treatment Expectancy Subscale) Self-efficacy to manage pain (Pain Self-Efficacy Questionnaire)	Home exercise compliance (self-reported sessions completed per week)
Williams et al. 2018 (RCT)	Australia, Tertiary Hospital	159	CG: 57.4 (13.6) IG: 56.0 (13.3)	CG: 58% Chronic low back pain (overweight or obese) IG: 61%	Back pain beliefs (Survey of Pain Attitudes), Emotional distress (Depression Anxiety Stress Scale-21), Fear avoidance (Fear Avoidance Belief Questionnaire, physical component), Mental health (12-item Short-Form Health Survey)	Weight (self-reported weight; objectively-measured weight; objectively-measured waist circumference; self-reported BMI; objectively-measured BMI) Physical Activity (Active Australia Survey) Diet behaviours (Short Food Frequency Questionnaire; Alcohol Use Disorders Identification Test)

RCT: randomised controlled trial; NRCT: non-randomised controlled trial; CG: Control Group; IG: Intervention Group; PA: Physical Activity.

Table 2. Intervention characteristics and control group comparison.

Citation	Common intervention(s)	Control	Intervention name	Intervention description (dosage)	Who delivered intervention and their training	Treatment period	Treatment fidelity
Allen et al. 2017	Provided with educational materials, an exercise video and an audio CD for relaxation exercises.	Usual care for osteoarthritis as recommended by providers with no restrictions.	Behavioural intervention using motivational interviewing (MI) strategies.	Telephone-delivered behavioural counselling (twice/month for first 6 months, then monthly for last 6 months).	Counsellors with training in osteoarthritis and behaviour change.	1 year	Number of sessions completed.
Ang et al. 2013	Aerobic exercise prescription and two individualised supervised exercise sessions from a qualified exercise instructor prior to telephone calls.	Education which included fibromyalgia self-management lessons delivered in didactic format.	MI	(Six telephone-delivered sessions over 12 weeks, calls lasting approximately 24 minutes).	Health practitioners trained in MI.	12 weeks	25% of audio-recorded phone contacts assessed using motivational intervention treatment integrity (MITI). Number of sessions completed.

Ben-Ami et al. 2017	An initial physiotherapy examination of 40 minutes, with subsequent physiotherapy sessions limited to 20 to 30 minutes.	No restrictions on physiotherapy interventions provided.	Enhanced theoretical model intervention	Behavioural counselling delivered face-to-face during physiotherapy sessions. Physiotherapy interventions were restricted to a maximum of four specific back-pain exercises prescribed only if they resulted in pain reduction within the session. Graded activity and in vivo exposure targeting fear of movement.	Physical therapists who received two days of training in communication, using stages of change and MI questioning with telephone supervision between sessions.	Minimum of two physiotherapy sessions with no upper limit.	Measured stage of change at baseline and discharge (results not reported). Number of sessions completed.
Ferguson et al. 2015	None.	Waitlist control.	Compliance therapy	(Six weekly 50-minute sessions).	Psychologists using an adapted version of a Compliance Therapy manual.	6 weeks	Not reported.

Friedrich et al. 1998	Physical therapist individual instruction and exercises over ten treatment sessions, each session 25 minutes, average two to three sessions/week. Told to exercise regularly at home, daily if possible.	No restrictions on physical therapy interventions provided.	Motivation program	Behavioural counselling delivered during physiotherapy sessions.	Physical therapists who were given a detailed introduction to the results of compliance research whereby building a good patient-therapist relationship is of utmost importance. Supervision was provided via two group discussions directed by the psychologist.	5 weeks	Number of sessions completed.
Gilbert et al. 2018	Brief physician recommendation to increase physical activity to meet national guidelines.	Common intervention only.	MI	Initial face-to-face session (45-60 minutes). Then in-person or telephone-delivered (10-15 minutes at 3, 6 and 12 months and at least every 6 months in the second year).	Nurses or occupational therapists who completed training with a member of the motivational interviewing network of trainers	2 years	Not reported.

Kerns et al. 2014	Research assistant administered semi-structured interview involving a brief description of each of the nine pain coping skill modules.	Standard Cognitive Behavioural Therapy with 10 face-to-face 60-minute sessions over 14-week period. Participants were allocated modules to complete.	Tailored cognitive behavioural therapy	Behavioural counselling delivered during Cognitive Behavioural Therapy sessions. Participants chose which modules they completed. (Ten weekly face-to-face 60-minute sessions over a 14-week period).	Doctoral level clinical psychologists with prior experience in delivering Cognitive Behavioural Therapy for chronic pain and specific training for MI.	14 weeks	Audiotapes of 30% of therapy sessions in each group were rated for 'certainty' as to whether they included MI strategies. Number of sessions completed.
Knittle et al. 2015 & 2016	One group-based patient education session conducted by a physiotherapist about PA and rheumatoid arthritis.	Common intervention only.	MI and self-regulation coaching sessions.	One face-to-face session (no longer than 45minutes) in Week 2. Two face-to-face self-regulation coaching sessions (40 to 60-minutes) in Weeks 4 and 5. Follow-up phone calls in Weeks 6, 12 and 18 (lasting no more than 20 minutes).	Physical therapists who had received training in the delivery of MI. Rheumatology nurses delivered the self-regulation coaching sessions and follow-up phone calls using a structured guide.	18 weeks	Not reported.

Lonsdale et al. 2017	Physiotherapy without restrictions.	Common intervention only.	Communication style and exercise compliance in physiotherapy (CONNECT) based on the 5A-framework (ask, advise, agree, assist, arrange) and self-determination theory.	Behavioural counselling delivered during regular physiotherapy sessions.	Physiotherapists who had completed eight hours of communication skills training delivered by a researcher who holds a PhD in Sports and Exercise Psychology.	No restrictions on number of physiotherapy sessions.	Independent observers rated the support provided by physiotherapists in the intervention group only using the Health Care Climate Questionnaire. Number of sessions completed.

Niederman et al. 2011 & 2012	Joint protection education – 5 sessions of 45 minutes duration over 3 months. Oral and written information on rheumatoid arthritis and joint protection principles. Demonstrations and supervised practice of hand joint protection methods, and demonstration of appropriate assistive devices. Additional interventions (e.g. home exercise, final provision of assistive device, splints).	Conventional joint protection therapy as per the common intervention.	Pictorial Representation of Illness and Self-Measure (PRISM) – joint protection.	Psycho-educational approach to achieve behaviour change and long-term adherence delivered during the joint protection sessions. Quantitatively and qualitatively assesses a person's suffering caused by an illness. A tool is used to visually summarise relationships between an illness and important aspects of a person's life (e.g. work, family, hobbies, friends).	Occupational therapists who were trained by two researchers in a two-day course. Regular supervision meetings were held to ensure correct application of PRISM interventions.	3 months	Number of sessions completed.

Thomsen et al. 2016	Not applicable.	Instructed to maintain their usual lifestyles.	MI	Face-to-face sessions (three x 60-90 minutes duration) delivered in Weeks 1, 2 and 10. Text messages delivered over a 16-week period (maximum of one text/weekday).	Nurses or occupational therapists who attended a one-day tailored MI training course supervised by a clinical psychologist with broad experience in MI and health behaviour change. Continuous supervision by the psychologist during the trial.	16 weeks	Number of sessions completed.
Thomsen et al. 2017	Not applicable.	As per Thomsen et al. 2016.	As per Thomsen et al. 2016.	As per Thomsen et al. 2016.	As per Thomsen et al. 2016.	As per Thomsen et al. 2016.	As per Thomsen et al. 2016.
Vong et al. 2011	Ten 30-minute physiotherapy sessions in eight weeks including 15 mins of interferential therapy and a tailor-made back exercise program. Home exercises were prescribed, and patients requested to exercise daily.	Common intervention only.	Motivational enhancement therapy (MET)	Behavioural counselling delivered during regular physiotherapy sessions.	Physical therapists who were provided with eight hours of training by a clinical psychologist.	8 weeks	A 5-point MET strategy scale was used to count the frequency of using MET strategies during one session.

Williams et al. 2018	On waitlist for orthopaedic specialist consultation. Allowed to attend orthopaedic consult and access care outside the trial as desired.	Common intervention only.	Healthy lifestyle intervention	Initial brief telephone advice. Offer of a 1-hour physiotherapy consultation including assessment and behavioural counselling. Up to 10 individually delivered telephone calls over a 6-month period.	Physiotherapist (training not described). Qualified health professionals (dietitians, exercise physiologists, psychologists) received training to ensure telephone coaching met the requirements of the service and to ensure consistency. Health professionals also attended a 2-hour interactive workshop including provision of resources regarding evidence-based advice for low back pain.	6 months	Number of health coaching telephone calls received. Number of participants who attended the physiotherapy consult.

Table 3. Relational and content techniques reported in behavioural counselling intervention descriptions

Citation	RELATIONAL TECHNIQUES				CONTENT TECHNIQUES					
	Collaboration	Empathy	Building autonomy	Evocation	Goal setting/reviewing	Reviewing pros and cons	Overcoming barriers	Sharing knowledge/education	Reviewing beliefs and values	Reviewing confidence/motivation
Allen et al. 2017	✓	✓	✓	✓	✓	✓	✓	✓	Assumed	✓
Ang et al. 2013	✓	Assumed	✓	✓	✓	✓	✓	✓	Assumed	✓
Ben-Ami et al. 2017	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ferguson et al. 2015	✗	✗	✗	✓	✗	✓	✓	✓	✓	✗
Friedrich et al. 1998	✓	✗	✓	✓	✓	✗	✓	✓	✗	✗
Gilbert et al. 2018	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Kerns et al. 2014	✓	Assumed	✓	Assumed	✓	Assumed	✓	Assumed	✓	✓
Knittle et al. 2015 & 2016	✓	Assumed	✓	✓	✓	✓	✓	✓	✓	Assumed
Lonsdale et al. 2017	✓	✓	✓	✓	✓	✗	✓	✓	✗	✓
Niedermann et al. 2012	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓
Thomsen et al. 2016	Assumed	Assumed	✓	✓	✓	✓	✓	✓	✓	✓

Thomsen et al. 2017	Assumed	Assumed	✓	✓	✓	✓	✓	✓	✓	✓
Vong et al. 2011	✓	Assumed	Assumed	Assumed	Assumed	Assumed	Assumed	Assumed	Assumed	✓
Williams et al. 2018	Assumed	✓	✓	✓	✓	Assumed	✓	✓	✓	Assumed

✓ identified in the intervention description; ✗ not identified

Table 4 GRADE assessment for the behavioural determinants and lifestyle targets entered in meta-analyses.

Outcome	<i>k</i>	<i>n</i>	SMD (95%CI)	I ² (p- value)	Heterogeneity ^a	Indirectness ^b	Bias ^c	Imprecision ^d	Publication Bias ^e	Evidence quality ^f
Depression	7	909	-0.02 (-0.16, 0.12)	0% (0.727)	No (0)	No (0)	Very Serious (-2)	No (0)	N/A	L
Anxiety	4	323	0.04 (-0.34, 0.40)	49% (0.115)	No (0)	No (0)	Very Serious (-2)	No (0)	N/A	L
Mental health	6	889	0.22 (-0.18, 0.62)	87% (<0.001)	Very Serious (-2)	No (0)	Very Serious (-2)	No (0)	N/A	VL
Self-efficacy - physical activity	4	503	0.69 (0.19, 1.18)	80% (0.002)	Very Serious (-2)	No (0)	Very Serious (-2)	No (0)	N/A	VL
Self-efficacy - disease	2	129	0.05 (-0.33, 0.44)	19% (0.267)	No (0)	No (0)	Very Serious (-2)	No (0)	N/A	L
Fear avoidance behaviour	2	414	-0.19 (-0.43, 0.05)	0% (0.932)	No (0)	No (0)	Very Serious (-2)	No (0)	N/A	L
Autonomous motivation	2	333	0.38 (-0.15, 0.92)	74% (0.052)	Very Serious (-2)	No (0)	Very Serious (-2)	Very Serious (-2)	N/A	VL
Daily sedentary time (objective)	2	170	-0.91 (-2.04, 0.22)	83% (0.016)	Very Serious (-2)	No (0)	Very Serious (-2)	Very Serious (-2)	N/A	VL
Leisure-time sitting (self- report)	2	170	-0.22 (-1.64, 1.19)	89% (0.003)	Very Serious (-2)	No (0)	Very Serious (-2)	Very Serious (-2)	N/A	VL
Breaks in sedentary	2	170	0.16 (-0.14, 0.46)	0% (0.418)	No (0)	No (0)	Very Serious (-2)	No (0)	N/A	L

periods (objective)										
Weight loss behaviour	2	416	-0.13 (-0.41, 0.16)	39% (0.202)	No (0)	No (0)	Very Serious (-2)	No (0)	N/A	L
Physical activity (self-report)	8	1,354	0.26 (0.00, 0.53)	80% (<0.001)	Very Serious (-2)	No (0)	Very Serious (-2)	No (0)	N/A	VL
Physical activity (objective)	3	556	0.12 (-0.23, 0.47)	77% (0.013)	Very Serious (-2)	No (0)	Very Serious (-2)	No (0)	N/A	VL

SMD: Standardised mean difference

a: None if $I^2 < 50\%$; serious if $I^2 51\%-69\%$; very serious if $I^2 \geq 70\%$

b: Serious if some indirectness from either population, intervention, comparator, outcome or indirect comparisons; very serious if multiple indirectness sources

c: Serious if evidence is mostly from trials of unclear risk of bias or trials with high risk of bias for one criteria which may seriously affect the results; very serious if evidence is mostly from trials of high risk of bias on multiple criterion and likely to very seriously affect the results

d: Serious if < 400 participants and if upper or lower confidence limit include little/no effect and an appreciable benefit/harm (spans an effect size of 0.5 in either direction); Very serious if < 400 participants and the upper and lower confidence limit include little/no effect and an appreciable benefit and harm (spans an effect size of 0.5 in either direction)

e: N/A means publication bias unable to be assessed as insufficient (less than 10 trials (k) per outcome).

f: Evidence Quality: M = moderate, L = low, VL = very low. Evidence rating from RCTs starts at high quality and is downgraded. Downgrading can be serious/strongly suspected (downgraded by 1) or very serious (downgraded by 2)

Appendix A. Search strategy

Medline OVID 18 January 2019

Step #	Search string	Hits
1	exp Motivational Interviewing/	1434
2	motivat* interview*.mp.	4036
3	motivat* counsel*.mp.	145
4	health coach*.mp.	614
5	motivat* chang*.mp.	321
6	motivat* intervention.mp.	432
7	exp Directive Counseling/	3584
8	flinders model.mp.	6
9	Stanford chronic disease management.mp.	0
10	transtheoretical model.mp.	1374
11	exp "Acceptance and Commitment Therapy"/	269
12	shared decision making.mp.	6245
13	tele* coach*.mp.	176
14	Behavio?r* counsel*	950
15	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14	16041
16	exp pain/	368754
17	Chronic.mp.	1244026
18	Persistent.mp.	208981
19	17 or 18	1421246
20	16 and 19	65589
21	exp MUSCULOSKELETAL DISEASES/	1025023

22	exp back pain/	36186
23	Low back pain.mp.	31377
24	chronic low back pain.mp	5775
25	Lumbar pain.mp.	1395
26	spin* pain.mp.	1702
27	LBP.mp.	6882
28	CLBP.mp.	1317
29	Lumbago.mp.	1327
30	Osteoarthritis, Knee/	17101
31	knee osteoarthriti*.mp.	9172
32	knee oa.mp.	4800
33	exp Osteoarthritis, Hip/	7865
34	hip osteoarthriti*.mp.	2031
35	hip oa.mp.	1092
36	20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35	1108830
37	15 and 36	512
38	Limit 37 to yr="2018-Current"	48

[mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

Cochrane Central Register of Controlled Trials and Cochrane Database of Systematic Reviews OVID 18 January 2019

Step #	Search string	Hits
1	motivat* interview*.mp.	2913
2	motivat* counsel*.mp.	134
3	health coach*.mp.	389

4	motiv* chang*.mp.	362
5	motiv* intervention.mp.	447
6	Directive Counsel*.mp.	484
7	flinders model.mp.	2
8	Stanford chronic disease management.mp.	0
9	transtheoretical model.mp.	403
10	(Acceptance and Commitment Therapy).mp.	555
11	shared decision making.mp.	890
12	tele* coach*.mp.	213
13	behavio?r* counsel*.mp.	582
14	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13	6690
15	Chronic	111454
16	Persistent	17798
17	15 or 16	125396
18	Pain	130171
19	17 and 18	22494
20	Musculoskeletal condition*	309
21	Musculoskeletal disease*	2018
22	Musculoskeletal injur*	332
23	Back pain	10348
24	Low back pain.mp.	7610
25	chronic low back pain.mp	2800
26	Lumbar pain.mp.	153
27	spin* pain.mp.	370

28	LBP.mp.	1410
29	CLBP.mp.	617
30	Lumbago.mp.	218
31	knee osteoarthritis*.mp.	4320
32	knee oa.mp.	1902
33	hip osteoarthritis*.mp.	676
34	hip oa.mp.	210
35	19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34	35001
36	14 and 35	381
37	Limit 36 to yr="2018-Current"	61

[mp=ti,ot,ab,sh,hw,kw,tx,ct]

PsycINFO OVID 18 January 2019

Step #	Search string	Hits
1	Exp motivational interviewing/	2229
2	motivat* interview*.mp.	3890
3	motivat* counsel*.mp.	126
4	health coach*.mp.	208
5	motivat* chang*.mp.	480
6	motivat* intervention.mp.	458
7	Directive Counsel*.mp.	163
8	flinders model.mp.	4
9	Stanford chronic disease management.mp.	0
10	transtheoretical model.mp.	1751
11	(Acceptance and Commitment Therapy).mp.	2074

12	shared decision making.mp.	2323
13	tele* coach*.mp.	103
14	behavio?r* counsel*.mp.	746
15	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14	11851
16	exp pain/	53885
17	Chronic.mp.	140715
18	Persistent.mp.	30774
19	17 or 18	167271
20	16 and 19	21424
21	exp Musculoskeletal Disorders/	16831
22	exp back pain/	3642
23	Low back pain.mp.	3360
24	chronic low back pain.mp	1409
25	Lumbar pain.mp.	56
26	spin* pain.mp.	245
27	LBP.mp.	820
28	CLBP.mp.	379
29	Lumbago.mp.	37
30	knee osteoarthritis*.mp.	364
31	knee oa.mp.	143
32	hip osteoarthritis*.mp.	65
33	hip oa.mp.	27
34	20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33	38678
35	15 and 34	252

36	Limit 35 to yr="2018-Current"	15

[mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]

EMBASE OVID 18 January 2019

Step #	Search string	Hits
1	exp Motivational Interviewing/	3908
2	motivat* interview*.mp.	6548
3	motivat* counsel*.mp.	223
4	health coach*.mp.	932
5	motivat* chang*.mp.	376
6	motivat* intervention.mp.	605
7	exp Directive Counseling/	828
8	flinders model.mp.	7
9	Stanford chronic disease management.mp.	0
10	transtheoretical model.mp.	1663
11	(Acceptance and Commitment Therapy).mp.	1419
12	shared decision making.mp.	9933
13	tele* coach*.mp.	291
14	behavio?r* counsel*.mp.	1197
15	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14	23144
16	Exp Pain/	1259858
17	Chronic.mp.	1816721
18	Persistent.mp.	307562
19	17 or 18	2075412
20	16 and 19	223642

21	Exp musculoskeletal disease/	2285845
22	Exp backache/	102422
23	Low back pain.mp.	60523
24	chronic low back pain.mp	7926
25	Lumbar pain.mp.	2391
26	spin* pain.mp.	4488
27	LBP.mp.	9082
28	CLBP.mp.	1803
29	Lumbago.mp.	2148
30	Exp knee osteoarthritis/	28511
31	Knee osteoarthriti*.mp.	30174
32	Knee oa.mp.	9435
33	Exp hip osteoarthritis/	11356
34	Hip osteoarthriti*.mp.	11985
35	Hip oa.mp.	1973
36	20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35	2429823
37	15 and 36	1642
38	Limit 37 to yr="2018-Current"	329

[mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word]

CINAHL (EBSCO) 18 January 2019

Step #	Search string	Hits
S1	(MH "Motivational Interviewing")	2670

S2	motivat* interview* OR motivat* counsel* OR health coach* OR motivat* chang* OR motivat* intervention OR behaviour* counsel* OR behavior* counsel*	9822
S3	"directive counsel*"	86
S4	flinders model	6
S5	stanford chronic disease management	25
S6	transtheoretical model	1549
S7	(MH "Acceptance and Commitment Therapy")	284
S8	shared decision making	4160
S9	tele* coach*	291
S10	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9	15808
S11	(MH "Musculoskeletal Diseases+")	223006
S12	(MH "Pain+")	175668
S13	chronic or persistent or long term or ongoing	449750
S14	S12 AND S13	40866
S15	(MH "Back Pain+")	26479
S16	(MH "Chronic Pain")	18323
S17	low back pain OR chronic low back pain OR lumbar pain OR spin* pain OR LBP OR CLBP OR lumbago	25505
S18	(MH "Osteoarthritis, Knee")	9644
S19	knee osteoarthritis* or knee oa	13503
S20	(MH "Osteoarthritis, Hip")	3326
S21	hip osteoarthritis* OR hip oa	4734
S22	S11 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21	277987
S23	S10 AND S22	521
S24	S10 AND S22 Limiters 20180101-20191231	85

Step #	Search string	Hits
S1	motivat* interview* OR motivat* counsel* OR health coach* OR motivat* chang* OR motivat* intervention OR behaviour* counsel* OR behaviour* counsel*	2128
S2	"directive counsel*"	13
S3	flinders model	2
S4	stanford chronic disease management	5
S5	transtheoretical model	451
S6	shared decision making	149
S7	tele* coach*	167
S8	Acceptance and commitment therapy	78
S9	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8	2923
S10	Musculoskeletal condition* OR Musculoskeletal disease* OR Musculoskeletal injur*	5234
S11	pain	53890
S12	chronic or persistent or long term or ongoing	60060
S13	S11 AND S12	12288
S14	back pain OR low back pain OR chronic low back pain OR lumbar pain OR spin* pain OR LBP OR CLBP OR lumbago	9603
S15	knee osteoarthritis* OR knee oa	3145
S16	hip osteoarthritis* OR hip oa	879
S17	S10 OR S13 OR S14 OR S15 OR S16	26909
S18	S9 AND S17	89
S19	S9 AND S17 Limiters 20180101-20191231	17

Appendix B. Internal validity of each included trial per outcome

Depression

	Random sequence generation (selection bias)	Allocation bias (selection bias)	Blinding of participants & personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data addressed (attrition bias)	Selective reporting (reporting bias)	Other
Allen et al. 2017	Low Risk of Bias	High Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias
Ang et al. 2013	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias
Ferguson et al. 2015	High Risk of Bias	High Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias
Kerns et al. 2014	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	High Risk of Bias
Knittle et al. 2015 & 2016	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias
Niedermann et al. 2011 & 2012	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias
Williams et al. 2018	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias

Low Risk of Bias

High Risk of Bias

Anxiety

	Random sequence generation (selection bias)	Allocation bias (selection bias)	Blinding of participants & personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data addressed (attrition bias)	Selective reporting (reporting bias)	Other
Ferguson et al. 2015	High Risk of Bias	High Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias
Niedermann et al. 2011 & 2012	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias
Williams et al. 2018	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias

Low Risk of Bias

High Risk of Bias

Mental Health

	Random sequence generation (selection bias)	Allocation bias (selection bias)	Blinding of participants & personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data addressed (attrition bias)	Selective reporting (reporting bias)	Other
Ben-Ami et al. 2017	High Risk of Bias	High Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias
Gilbert et al. (KOA) 2018	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias
Gilbert et al. (RA) 2018	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias
Thomsen et al. 2016	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	High Risk of Bias

Thomsen et al. 2017							
Williams et al. 2018							

Low Risk of Bias

High Risk of Bias

Self-efficacy - Disease

	Random sequence generation (selection bias)	Allocation bias (selection bias)	Blinding of participants & personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data addressed (attrition bias)	Selective reporting (reporting bias)	Other
Niedermann et al. 2011 & 2012	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias
Vong et al 2011	Low Risk of Bias	Unclear Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias

Low Risk of Bias

High Risk of Bias

Unclear Risk of Bias

Self-efficacy - Physical Activity

	Random sequence generation (selection bias)	Allocation bias (selection bias)	Blinding of participants & personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data addressed (attrition bias)	Selective reporting (reporting bias)	Other
Knittle et al. 2015 & 2016	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias
Lonsdale et al. 2017	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	High Risk of Bias
Thomsen et al. 2016	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	High Risk of Bias

Thomsen et al. 2017							

Low Risk of Bias

High Risk of Bias

Fear Avoidance Behaviour

	Random sequence generation (selection bias)	Allocation bias (selection bias)	Blinding of participants & personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data addressed (attrition bias)	Selective reporting (reporting bias)	Other
Lonsdale et al. 2017							
Williams et al. 2018							

Low Risk of Bias

High Risk of Bias

Autonomous Motivation

	Random sequence generation (selection bias)	Allocation bias (selection bias)	Blinding of participants & personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data addressed (attrition bias)	Selective reporting (reporting bias)	Other

Knittle et al. 2015 & 2016							
Lonsdale et al. 2017							

Low Risk of Bias

High Risk of Bias

Physical Activity (Objective)

	Random sequence generation (selection bias)	Allocation bias (selection bias)	Blinding of participants & personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data addressed (attrition bias)	Selective reporting (reporting bias)	Other
Ang et al. 2013	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias
Gilbert et al. (KOA) 2018	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias
Gilbert et al. (RA) 2018	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias

Low Risk of Bias

High Risk of Bias

Physical Activity (Self-report)

	Random sequence generation (selection bias)	Allocation bias (selection bias)	Blinding of participants & personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data addressed (attrition bias)	Selective reporting (reporting bias)	Other
Allen et al. 2017	Low Risk of Bias	High Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias
Ang et al. 2013	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias
Ben-Ami et al. 2017	High Risk of Bias	High Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias
Friedrich et al. 1998	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	High Risk of Bias
Knittle et al. 2015 & 2016	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias
Lonsdale et al. 2017	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	High Risk of Bias
Vong et al. 2011	Low Risk of Bias	Unclear Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias
Williams et al. 2018	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias

Low Risk of Bias ■
 High Risk of Bias ■
 Unclear Risk of Bias ■

Weight Loss Behaviours (BMI)

	Random sequence generation (selection bias)	Allocation bias (selection bias)	Blinding of participants & personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data addressed (attrition bias)	Selective reporting (reporting bias)	Other
Allen et al. 2017	Low Risk of Bias	High Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias
Williams et al. 2018	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias

Low Risk of Bias

High Risk of Bias

Daily Sedentary Time (Objective)

	Random sequence generation (selection bias)	Allocation bias (selection bias)	Blinding of participants & personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data addressed (attrition bias)	Selective reporting (reporting bias)	Other
Thomsen et al. 2016	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	High Risk of Bias
Thomsen et al. 2017	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias

Low Risk of Bias

High Risk of Bias

Daily Breaks in Sedentary Periods (Objective)

	Random sequence generation (selection bias)	Allocation bias (selection bias)	Blinding of participants & personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data addressed (attrition bias)	Selective reporting (reporting bias)	Other
Thomsen et al. 2016	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	High Risk of Bias
Thomsen et al. 2017	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias

Low Risk of Bias

High Risk of Bias

Leisure-Time Sitting (Self-report)

	Random sequence generation (selection bias)	Allocation bias (selection bias)	Blinding of participants & personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data addressed (attrition bias)	Selective reporting (reporting bias)	Other
Thomsen et al. 2016	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	High Risk of Bias
Thomsen et al. 2017	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias

Low Risk of Bias

High Risk of Bias

Appendix C. Fidelity Testing Results

Study	Fidelity Testing	Results
Allen et al. 2017	Number of sessions completed.	Participants in the intervention group completed a mean of 7.8 (SD 4.6) telephone calls of a possible 18.
Ang et al. 2013	25% of audio-recorded phone contacts assessed using Motivational Intervention Treatment Integrity (MITI). Number of sessions completed.	Intervention group therapists showed solid adherence to the principles of MI 80% of the time versus 20% of the time for control group therapists. On a scale of 5 to 25, the mean global rating for the intervention group sessions was 22.02 (SE 2.83) versus 13.67 (2.79) for the control group. Intervention group participants completed a mean of 5.7 (SD 0.5) sessions compared with 5.5 (1.0) for the control group participants ($p = 0.13$). Intervention group therapists spent approximately the same amount of time as control group therapists with participants (intervention group mean 24 (SD 10) versus control group 24.8 (7) minutes/session).
Ben-Ami et al. 2017	Measured stage of change at baseline and discharge. Number of sessions completed.	Results were not reported for measured stage of change at baseline or discharge. Control group participants attended a mean 5.1 (SD 3.4) number of sessions compared with 3.5 (1.9) sessions for intervention group participants.
Ferguson et al. 2015	Not reported.	Not applicable.
Friedrich et al. 1998	Number of sessions completed.	Control group participants attended a mean of 8.6 (SD 2.1) sessions compared with 9.6 (1.1) sessions for intervention group participants out of a possible 10 sessions.
Gilbert et al. 2018	Not reported.	Not applicable.
Kerns et al. 2014	Audiotapes of 30% of therapy sessions in each group were rated for 'certainty' as to whether they included MI	100% of sessions were correctly classified. Fifty-three control group participants and 61 intervention group participants completed at least 3 sessions.

	strategies. Number of sessions completed.	For those who attended at least 3 sessions, intervention group participants completed a mean of 8.9 (SD 2.3) sessions and the control group participants completed 9.1 (2.1) sessions of a possible 10 sessions.
Knittle et al. 2015 & 2016	Not reported.	Not applicable.
Lonsdale et al. 2017	Independent observers rated the support provided by physiotherapists in the intervention group only using the Health Care Climate Questionnaire. Number of sessions completed.	An independent samples t-test demonstrated a large between-arm difference in needs-support scores ($d=2.27$; 95% confidence interval 1.18 to 3.21; $p<0.001$), with intervention arm physiotherapists (mean 4.57 (SD 0.85)) rated as significantly more supportive than control arm physiotherapists (2.78 (0.72)). The mean number of sessions attended in the intervention group and control group was 3.0. All except 19 patients had completed treatment before week 12.
Niedermann et al. 2011 & 2012	Number of sessions completed.	One participant in the intervention group did not attend all five sessions (attending 2 sessions only). Otherwise all sessions were attended in both the intervention and control groups.
Thomsen et al. 2016	Number of sessions completed.	All intervention group participants completed the three motivational counselling sessions which ranged from 29-102 minutes (mean 68 minutes).
Thomsen et al. 2017	Number of sessions completed.	All intervention group participants completed the 3 motivational counselling sessions (30–90 minutes).
Vong et al. 2011	A 5-point Motivational Enhancement Therapy (MET) strategy scale was used to count the frequency of using MET strategies during one session. 0 indicates did not use any MET strategy (0%); 1, rarely used (25%); 2, occasionally used (50%); 3, frequently used (75%); and 4, used MET strategies most of the time in a session (>90%).	Intervention group therapists had a mean score of 2 or 3. Control group therapists had a mean score of 0 or 1.
Williams et al. 2018	Number of health coaching telephone calls received. Number of participants who attended the physiotherapy	96.2% intervention group participants had at least one Get Healthy Service phone call, 48.1% intervention group participants received at least 3 calls, and 41.8% intervention group participants received 6 or more

consult.

calls. Mean number of calls received by intervention group participants was 5.1 (SD 4.5).
 46.8% intervention group participants attended the physiotherapy consult.
 29.1% intervention group participants attended the physiotherapy consult AND received 6 or more GHS calls.

SD = standard deviation; SE = standard error

Figure 1. Sample causal modelling diagram (Michie, Johnston, Francis, Hardeman, & Eccles, 2008).

Figure 2. PRISMA flowchart of included trials.

Figure 3

	Random sequence generation (selection bias)	Allocation bias (selection bias)	Blinding of participants & personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data addressed (attrition bias)	Selective reporting (reporting bias)	Other
Allen et al. 2017							
Ang et al. 2013							
Ben-Ami et al. 2017							
Ferguson et al. 2015							
Friedrich et al. 1998							
Gilbert et al. 2018			a b				
Kems et al. 2014							
Knittle et al. 2015 & 2016							
Lonsdale et al. 2017							
Niedermann et al. 2011 & 2012							
Thomsen et al. 2016							
Thomsen et al. 2017							
Vong et al. 2011							
Williams et al. 2018							

Low Risk of Bias High Risk of Bias Unclear Risk of Bias

a = Self-reported behavioural determinant - mood; b = Objectively-measured lifestyle target – physical activity

Figure 3. Assessment of internal validity of included trials.

Figure 4. Forest plot for depression

Figure 5. Forest plot for self-efficacy for physical activity

Figure 6. Forest plot for self-reported physical activity levels

FIGURES AND FIGURE LEGENDS

Figure 1

Figure 1. Sample causal modelling diagram (Michie, Johnston, Francis, Hardeman, & Eccles, 2008).

Figure 2

Figure 2. PRISMA flowchart of included trials.

Figure 3

	Random sequence generation (selection bias)	Allocation bias (selection bias)	Blinding of participants & personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data addressed (attrition bias)	Selective reporting (reporting bias)	Other
Allen et al. 2017							
Ang et al. 2013							
Ben-Ami et al. 2017							
Ferguson et al. 2015							
Friedrich et al. 1998							
Gilbert et al. 2018			a b				
Kerns et al. 2014							
Knittle et al. 2015 & 2016							
Lonsdale et al. 2017							
Niedermann et al. 2011 & 2012							
Thomsen et al. 2016							
Thomsen et al. 2017							
Vong et al. 2011							
Williams et al. 2018							

Low Risk of Bias ☐ High Risk of Bias ☒ Unclear Risk of Bias ☐

a = Self-reported behavioural determinant - mood; b = Objectively-measured lifestyle target – physical activity

Figure 3. Assessment of internal validity of included trials.

Figure 3

	Random sequence generation (selection bias)	Allocation bias (selection bias)	Blinding of participants & personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data addressed (attrition bias)	Selective reporting (reporting bias)	Other
Allen et al. 2017	Low Risk of Bias	High Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias
Ang et al. 2013	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias
Ben-Ami et al. 2017	High Risk of Bias	High Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias
Ferguson et al. 2015	High Risk of Bias	High Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias
Friedrich et al. 1998	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	High Risk of Bias
Gilbert et al. 2018	Low Risk of Bias	Low Risk of Bias	a b	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias
Kerns et al. 2014	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	High Risk of Bias
Knittle et al. 2015 & 2016	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias
Lonsdale et al. 2017	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	High Risk of Bias
Niedermann et al. 2011 & 2012	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias
Thomsen et al. 2016	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	High Risk of Bias
Thomsen et al. 2017	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias
Vong et al. 2011	Low Risk of Bias	Unclear Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias
Williams et al. 2018	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	Low Risk of Bias	High Risk of Bias	Low Risk of Bias	Low Risk of Bias

Low Risk of Bias ■ High Risk of Bias ■ Unclear Risk of Bias ■

a = Self-reported behavioural determinant - mood; b = Objectively-measured lifestyle target – physical activity

Figure 3. Assessment of internal validity of included trials.

Figure 4

Figure 4. Forest plot for depression.

Figure 5

Figure 5. Forest plot for self-efficacy for physical activity

Figure 6

Figure 6. Forest plot for self-reported physical activity levels

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