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# **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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### **Funding**

There was no funding provided for this review.

### **Conflict of interest**

There are no conflicts of interest to declare by any author involved in this review.

**This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: [10.1002/msc.1410](https://doi.org/10.1002/msc.1410)**

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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).

## References

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211. doi:10.1016/0749-5978(91)90020-T
- Allen, K. D., Oddone, E. Z., Coffman, C. J., Jeffreys, A. S., Bosworth, H. B., Chatterjee, R., . . . Dolor, R. J. (2017). Patient, provider, and combined interventions for managing osteoarthritis in primary care: a cluster randomized trial. *Annals of Internal Medicine*, 166(6), 401-411.
- Alperstein, D., & Sharpe, L. (2016). The efficacy of motivational interviewing in adults with chronic pain: a meta-analysis and systematic review. *The Journal of Pain*, 17(4), 393-403. doi:10.1016/j.jpain.2015.10.021
- Ang, D. C., Kaleth, A. S., Bigatti, S., Mazzuca, S. A., Jensen, M. P., Hilligoss, J., . . . Saha, C. (2013). Research to encourage exercise for fibromyalgia (REEF): use of motivational interviewing, outcomes from a randomized-controlled trial. *Clinical Journal of Pain*, 29(4), 296-304. doi:10.1097/AJP.0b013e318254ac76
- Bandura, A. (1989). Human agency in social cognitive theory. *American Psychologist*, 44(9), 1175-1184. doi:10.1037/0003-066X.44.9.1175
- Bandura, A. (1998). Health promotion from the perspective of social cognitive theory. *Psychology and Health*, 13(4), 623-649.
- Ben-Ami, N. O. A., Shapiro, Y., Chodick, G., Mirovsky, Y., & Pincus, T. (2017). Increasing recreational physical activity in patients with chronic low back pain: a pragmatic controlled clinical trial. *Journal of Orthopaedic & Sports Physical Therapy*, 47(2), 57-66.
- Briggs, A. M., Woolf, A. D., Dreinhöfer, K., Homb, N., Hoy, D. G., Kopansky-Giles, D., . . . March, L. (2018). Reducing the global burden of musculoskeletal conditions. *Bulletin of the World Health Organization*, 96(5), 366-368. doi:10.2471/BLT.17.204891
- Cheng, D., Qu, Z., Huang, J., Xiao, Y., Luo, H., & Wang, J. (2015). Motivational interviewing for improving recovery after stroke. *Cochrane database of systematic reviews*(6). doi:10.1002/14651858.CD011398.pub2

- Ferguson, A., Ibrahim, F. A., Thomas, V., Weinman, J., Simpson, C., Cope, A. P., . . . Lempp, H. (2015). Improving medication adherence in rheumatoid arthritis (RA): a pilot study. *Psychology, Health & Medicine, 20*(7), 781-789. doi:10.1080/13548506.2015.1009917
- Fisher, W. A., Fisher, J. D., & Harman, J. (2003). The information-motivation-behavioral skills model: a general social psychological approach to understanding and promoting health behavior. In J. Suls & K. A. Wallston (Eds.), *Social psychological foundations of health and illness*. (pp. 82-106). Malden: Blackwell Publishing.
- Friedrich, M., Gittler, G., Halberstadt, Y., Cermak, T., & Heiller, I. (1998). Combined exercise and motivation program: effect on the compliance and level of disability of patients with chronic low back pain: a randomized controlled trial. *Archives of Physical Medicine & Rehabilitation, 79*(5), 475-487.
- Gale, J. (2012). *A practical guide to health behaviour change using the HCA approach*. New South Wales (Australia): Health Change Australia.
- Gale, J., & Skouteris, H. (2013). Health coaching: Facilitating health behaviour change for chronic condition prevention and self-management. In. Brisbane (Australia): Wiley-Blackwell.
- Gilbert, A. L., Lee, J., Ehrlich-Jones, L., Semanik, P. A., Song, J., Pellegrini, C. A., . . . Chang, R. W. (2018). A randomized trial of a motivational interviewing intervention to increase lifestyle physical activity and improve self-reported function in adults with arthritis. *Seminars in Arthritis and Rheumatism, 47*(5), 732-740.
- Glanz, K., & Maddock, J. (2002). Health-related behaviour. *The Encyclopaedia of Public Health*. Retrieved from <https://www.encyclopedia.com/medicine/psychology/psychology-and-psychiatry/health-behavior>
- Guyatt, G. H., Oxman, A. D., Vist, G. E., Kunz, R., Falck-Ytter, Y., Alonso-Coello, P., & Schünemann, H. J. (2008). GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *British Medical Journal, 336*(7650), 924-926.
- Hardcastle, S. J., Fortier, M., Blake, N., & Hagger, M. S. (2017). Identifying content-based and relational techniques to change behaviour in motivational interviewing. *Health Psychology Review, 11*(1), 1-16.

Higgins, J. P. T., & Green, S. (2011). *Cochrane handbook for systematic reviews of interventions*. In Cochrane handbook for systematic reviews of interventions, J. P. T. Higgins & S. Green (Eds.). Retrieved from <https://training.cochrane.org/handbook>

Keogh, A., Tully, M. A., Matthews, J., & Hurley, D. A. (2015). A review of behaviour change theories and techniques used in group based self-management programmes for chronic low back pain and arthritis. *Manual Therapy*, 20(6), 727-735. doi:10.1016/j.math.2015.03.014

Kerns, R. D., Burns, J. W., Shulman, M., Jensen, M. P., Nielson, W. R., Czapinski, R., . . . Rosenberger, P. (2014). Can we improve cognitive-behavioral therapy for chronic back pain treatment engagement and adherence? A controlled trial of tailored versus standard therapy. *Health Psychology*, 33(9), 938-947. doi:10.1037/a0034406

Knittle, K., De Gucht, V., Hurkmans, E., Peeters, A., Ronday, K., Maes, S., & Vlieland, T. V. (2015). Targeting motivation and self-regulation to increase physical activity among patients with rheumatoid arthritis: a randomised controlled trial. *Clinical Rheumatology*, 34(2), 231-238. doi:10.1007/s10067-013-2425-x

Knittle, K., De Gucht, V., Hurkmans, E., Vlieland, T. V., Maes, S., & De Gucht, V. (2016). Explaining physical activity maintenance after a theory-based intervention among patients with rheumatoid arthritis: process evaluation of a randomized controlled trial. *Arthritis Care & Research*, 68(2), 203-210. doi:10.1002/acr.22647

Lonsdale, C., Hall, A. M., Murray, A., Williams, G. C., McDonough, S. M., Ntoumanis, N., . . . Hurley, D. A. (2017). Communication skills training for practitioners to increase patient adherence to home-based rehabilitation for chronic low back pain: results of a cluster randomized controlled trial. *Archives of Physical Medicine & Rehabilitation*, 98(9), 1732-1743.

Michie, S., & Abraham, C. (2004). Interventions to change health behaviours: evidence-based or evidence-inspired? *Psychology & Health*, 19(1), 29-49. doi:10.1080/0887044031000141199

- Author Manuscript
- Michie, S., Johnston, M., Francis, J., Hardeman, W., & Eccles, M. (2008). From theory to intervention: mapping theoretically derived behavioural determinants to behaviour change techniques. *Applied Psychology, 57*(4), 660-680. doi:10.1111/j.1464-0597.2008.00341.x
- Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., . . . Wood, C. E. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. *Annals of Behavioural Medicine, 46*(1), 81-95.
- Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science, 6*(1), 42. doi:10.1186/1748-5908-6-42
- Miller, W. R., & Rollnick, S. (2012). *Motivational interviewing. [electronic resource] : helping people change* (3rd ed.): Guilford Press.
- Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Annals of Internal Medicine, 151*(4), 264-269.
- Niedermann, K., Buchi, S., Ciurea, A., Kubli, R., Steurer-Stey, C., Villiger, P. M., & De Bie, R. A. (2012). Six and 12 months' effects of individual joint protection education in people with rheumatoid arthritis: a randomized controlled trial. *Scandinavian Journal of Occupational Therapy, 19*(4), 360-369.  
doi:10.3109/11038128.2011.611820
- Niedermann, K., de Bie, R. A., Kubli, R., Ciurea, A., Steurer-Stey, C., Villiger, P. M., & Büchi, S. (2011). Effectiveness of individual resource-oriented joint protection education in people with rheumatoid arthritis. A randomized controlled trial. *Patient Education and Counseling, 82*, 42-48. doi:10.1016/j.pec.2010.02.014
- Nutbeam, D. (2010). *Theory in a nutshell : a practical guide to health promotion theories*. Sydney: McGraw-Hill.
- O'Halloran, P. D., Blackstock, F., Shields, N., Holland, A., Iles, R., Kingsley, M., . . . Taylor, N. F. (2014). Motivational interviewing to increase physical activity in people with chronic health conditions: a systematic review and meta-analysis. *Clinical Rehabilitation, 28*(12), 1159-1171. doi:10.1177/0269215514536210

- Prochaska, J. O., & Velicer, W. F. (1997). The transtheoretical model of health behavior change. *American Journal of Health Promotion*, 12(1), 38-48. doi:10.4278/0890-1171-12.1.38
- Simister, H. D., Tkachuk, G. A., Shay, B. L., Vincent, N., Pear, J. J., & Skrabek, R. Q. (2018). Randomized controlled trial of online acceptance and commitment therapy for fibromyalgia. *Journal of Pain*, 19(7), 741-753. doi:10.1016/j.jpain.2018.02.004
- Thomsen, T., Aadahl, M., Beyer, N., Hetland, M. L., Løppenthin, K., Midtgaard, J., . . . Esbensen, B. A. (2016). Motivational counselling and SMS-reminders for reduction of daily sitting time in patients with rheumatoid arthritis: a descriptive randomised controlled feasibility study. *BMC Musculoskeletal Disorders*, 17(1), 434.
- Thomsen, T., Aadahl, M., Beyer, N., Hetland, M. L., Løppenthin, K., Midtgaard, J., . . . Esbensen, B. A. (2017). The efficacy of motivational counselling and SMS reminders on daily sitting time in patients with rheumatoid arthritis: a randomised controlled trial. *Annals of the Rheumatic Diseases*, 76(9), 1603-1606. doi:10.1136/annrheumdis-2016-210953
- Vong, S. K., Cheing, G. L., Chan, F., So, E. M., & Chan, C. C. (2011). Motivational enhancement therapy in addition to physical therapy improves motivational factors and treatment outcomes in people with low back pain: a randomized controlled trial. *Archives of Physical Medicine & Rehabilitation*, 92(2), 176-183.
- Vos, T., Abajobir, A. A., Abate, K. H., Abbafati, C., Abbas, K. M., Abd-Allah, F., . . . Murray, C. J. L. (2017). Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: a systematic analysis for the global burden of disease study 2016. *The Lancet*, 390(10100), 1211-1259. doi:10.1016/S0140-6736(17)32154-2
- Williams, A., Wiggers, J., O'Brien, K. M., Wolfenden, L., Sze Lin, Y., Hodder, R. K., . . . Yoong, S. L. (2018). Effectiveness of a healthy lifestyle intervention for chronic low back pain: a randomised controlled trial. *Pain*, 159(6), 1137-1146. doi:10.1097/j.pain.0000000000001198
- World Health Organisation. (2018). Musculoskeletal conditions. Retrieved from <http://www.who.int/mediacentre/factsheets/musculoskeletal/en/>

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)<br>IG: 63.9 (9.3)  | CG: 71%<br>IG: 73%   | Symptomatic hip or knee osteoarthritis                | Depression (8-item Patient Health Questionnaire)  | Weight loss behaviours (Body Mass Index)<br>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)<br>IG: 46.0 (11.4) | CG: 95%<br>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)<br>IG: 42 (8)           | CG: 58%<br>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)<br>IG: 51 (14.1)     | CG: 100%<br>IG: 100% | Rheumatoid arthritis                                  | Beliefs about treatment (Beliefs About Medication Questionnaire)<br>Beliefs about illness (Illness Perception Questionnaire)<br>Depression (9-item Patient Health Questionnaire)<br>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)<br>IG: 43.3 (10.4)  | CG: 45%<br>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)<br>Appointment attendance (sessions attended) |
| Gilbert et al. 2018 (RCT)        | U.S.A, academic medical centre       | 340 | KOA: CG: 64.8 (12.6)<br>155 IG: 61.4 (13.3)<br>RA: RA: CG: 54.7 (13.7)<br>185 IG: 55.0 (14.0) | KOA: CG: 62%<br>IG: 58%<br>RA: CG: 85%<br>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)<br>IG: 55.5 (13.1)  | CG: 6%<br>IG: 12%                                 | Chronic back pain                                      | Depression (Beck Depression Inventory)   | Appointment attendance (sessions attended)<br>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)<br>IG: 60.7 (11.9) | CG: 55% Rheumatoid arthritis<br>IG: 79%  | Self-efficacy for PA (Bandura's 18-item questionnaire)<br>Autonomous motivation for PA (Treatment Self-Regulation Questionnaire)<br>Depression (Brief Symptom Inventory)<br>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)<br>IG: 44.1 (13.0) | CG: 52% Chronic low back pain<br>IG: 56% | Fear avoidance (Fear Avoidance Behaviour Questionnaire)<br>Competence (self-reported on a numerical rating scale)<br>Motivation (Treatment Self-Regulation Questionnaire)  | Adherence to home-based exercises (self-reported sessions completed during previous week)<br>Adherence to physiotherapist recommendations (self-reported on a numeric rating scale)<br>PA (International PA Questionnaire) |
| Niedermann et al. 2011 and 2012 (RCT)                     | Switzerland, rheumatology centres/clinic           | 53  | CG: 53.4 (15.7)<br>IG: 62.1 (12.6) | CG: 82% Rheumatoid arthritis<br>IG: 85%  | Joint protection self-efficacy (Self-efficacy Scale for Joint Protection)<br>Arthritis self-efficacy (Arthritis Self-efficacy Scale)<br>Anxiety (Hospital Anxiety and Depression Scale, Anxiety Subscale)<br>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)<br>IG: 64.5 (8.5)  | CG: 60% Rheumatoid arthritis<br>IG: 60%  | Self-efficacy (General Self-Efficacy Scale)<br>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)<br>IG: 59.7 (10.7) | CG: 80% Rheumatoid arthritis<br>IG: 81%                        | Self-efficacy (General Self-Efficacy Scale)<br>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)<br>IG: 44.6 (11.2) | CG: 58% Chronic low back pain<br>IG: 68%                       | Working alliance (Pain Rehabilitation Expectation Scale, Working Alliance Subscale)<br>Treatment expectancy (Pain Rehabilitation Expectation Scale, Treatment Expectancy Subscale)<br>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)<br>IG: 56.0 (13.3) | CG: 58% Chronic low back pain (overweight or obese)<br>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)<br>Physical Activity (Active Australia Survey)<br>Diet behaviours (Short Food Frequency Questionnaire; Alcohol Use Disorders Identification Test) |

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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).<br><br>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.<br><br>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).<br><br>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 | <p>Physical therapist individual instruction and exercises over ten treatment sessions, each session 25 minutes, average two to three sessions/week.</p> <p>Told to exercise regularly at home, daily if possible.</p> | No restrictions on physical therapy interventions provided. | Motivation program | Behavioural counselling delivered during physiotherapy sessions.  | <p>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.</p> <p>Supervision was provided via two group discussions directed by the psychologist.</p> | 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                 | <p>Initial face-to-face session (45-60 minutes).</p> <p>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).</p> | 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.<br>Two face-to-face self-regulation coaching sessions (40 to 60-minutes) in Weeks 4 and 5.<br>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.<br>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 | <p>Joint protection education – 5 sessions of 45 minutes duration over 3 months.</p> <p>Oral and written information on rheumatoid arthritis and joint protection principles.</p> <p>Demonstrations and supervised practice of hand joint protection methods, and demonstration of appropriate assistive devices.</p> <p>Additional interventions (e.g. home exercise, final provision of assistive device, splints).</p> | Conventional joint protection therapy as per the common intervention. | Pictorial Representation of Illness and Self-Measure (PRISM) – joint protection. | <p>Psycho-educational approach to achieve behaviour change and long-term adherence delivered during the joint protection sessions.</p> <p>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).</p> | 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.<br><br>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.<br><br>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.<br>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).<br><br>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.<br><br>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 <sup>2</sup> (p-value) | Heterogeneity <sup>a</sup> | Indirectness <sup>b</sup> | Bias <sup>c</sup> | Imprecision <sup>d</sup> | Publication Bias <sup>e</sup> | Evidence quality <sup>f</sup> |
|------------------------------------|----------|----------|------------------------|--------------------------|----------------------------|---------------------------|-------------------|--------------------------|-------------------------------|-------------------------------|
| Depression                         | 7        | 909      | -0.02<br>(-0.16, 0.12) | 0%<br>(0.727)            | No (0)                     | No (0)                    | Very Serious (-2) | No (0)                   | N/A                           | L                             |
| Anxiety                            | 4        | 323      | 0.04<br>(-0.34, 0.40)  | 49%<br>(0.115)           | No (0)                     | No (0)                    | Very Serious (-2) | No (0)                   | N/A                           | L                             |
| Mental health                      | 6        | 889      | 0.22<br>(-0.18, 0.62)  | 87%<br>( $<0.001$ )      | Very Serious (-2)          | No (0)                    | Very Serious (-2) | No (0)                   | N/A                           | VL                            |
| Self-efficacy - physical activity  | 4        | 503      | 0.69<br>(0.19, 1.18)   | 80%<br>(0.002)           | Very Serious (-2)          | No (0)                    | Very Serious (-2) | No (0)                   | N/A                           | VL                            |
| Self-efficacy - disease            | 2        | 129      | 0.05<br>(-0.33, 0.44)  | 19%<br>(0.267)           | No (0)                     | No (0)                    | Very Serious (-2) | No (0)                   | N/A                           | L                             |
| Fear avoidance behaviour           | 2        | 414      | -0.19<br>(-0.43, 0.05) | 0%<br>(0.932)            | No (0)                     | No (0)                    | Very Serious (-2) | No (0)                   | N/A                           | L                             |
| Autonomous motivation              | 2        | 333      | 0.38<br>(-0.15, 0.92)  | 74%<br>(0.052)           | Very Serious (-2)          | No (0)                    | Very Serious (-2) | Very Serious (-2)        | N/A                           | VL                            |
| Daily sedentary time (objective)   | 2        | 170      | -0.91<br>(-2.04, 0.22) | 83%<br>(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<br>(-1.64, 1.19) | 89%<br>(0.003)           | Very Serious (-2)          | No (0)                    | Very Serious (-2) | Very Serious (-2)        | N/A                           | VL                            |
| Breaks in sedentary                | 2        | 170      | 0.16<br>(-0.14, 0.46)  | 0%<br>(0.418)            | No (0)                     | No (0)                    | Very Serious (-2) | No (0)                   | N/A                           | L                             |

periods  
(objective)

|                                 |   |       |                        |                     |                   |        |                   |        |     |    |
|---------------------------------|---|-------|------------------------|---------------------|-------------------|--------|-------------------|--------|-----|----|
| Weight loss behaviour           | 2 | 416   | -0.13<br>(-0.41, 0.16) | 39%<br>(0.202)      | No (0)            | No (0) | Very Serious (-2) | No (0) | N/A | L  |
| Physical activity (self-report) | 8 | 1,354 | 0.26<br>(0.00, 0.53)   | 80%<br>( $<0.001$ ) | Very Serious (-2) | No (0) | Very Serious (-2) | No (0) | N/A | VL |
| Physical activity (objective)   | 3 | 556   | 0.12<br>(-0.23, 0.47)  | 77%<br>(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 | <b>15 and 36</b>   | <b>512</b> |
| 38 | <b>Limit 37 to yr="2018-Current"</b>   | <b>48</b>  |

[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      |
| <b>36</b> | <b>14 and 35</b>   | <b>381</b> |
| <b>37</b> | <b>Limit 36 to yr="2018-Current"</b>   | <b>61</b>  |

[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      |
| <b>35</b> | <b>15 and 34</b>   | <b>252</b> |

|           |                                      |           |
|-----------|--------------------------------------|-----------|
| <b>36</b> | <b>Limit 35 to yr="2018-Current"</b> | <b>15</b> |
|-----------|--------------------------------------|-----------|

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

EMBASE OVID 18 January 2019

| <b>Step #</b> | <b>Search string</b>  | <b>Hits</b> |
|---------------|---|-------------|
| 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     |
| <b>37</b> | <b>15 and 36</b>   | <b>1642</b> |
| <b>38</b> | <b>Limit 37 to yr="2018-Current"</b>   | <b>329</b>  |

[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*<br>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<br>CLBP OR lumbago  | 25505      |
| S18        | (MH "Osteoarthritis, Knee")   | 9644       |
| S19        | knee osteoarthriti* or knee oa  | 13503      |
| S20        | (MH "Osteoarthritis, Hip")  | 3326       |
| S21        | hip osteoarthriti* OR hip oa  | 4734       |
| S22        | S11 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21   | 277987     |
| <b>S23</b> | <b>S10 AND S22</b>  | <b>521</b> |
| <b>S24</b> | <b>S10 AND S22 Limiters 20180101-20191231</b>   | <b>85</b>  |

| Step #     | Search string  | Hits      |
|------------|--|-----------|
| S1         | motiv* interview* OR motiv* counsel* OR health coach* OR motiv* chang*<br>OR motiv* 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<br>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*<br>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     |
| <b>S18</b> | <b>S9 AND S17</b>  | <b>89</b> |
| <b>S19</b> | <b>S9 AND S17 Limiters 20180101-20191231</b>   | <b>17</b> |

**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  | Green | Green | Red   | Red   | Green | Green | Green |
| Williams et al. 2018 | Green | Green | Green | Green | Red   | Green | Green |

Low Risk of Bias 

High Risk of Bias 

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**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 |   |                                  |   |   |  |                                      |       |
| Vong et al 2011               |   |                                  |   |   |  |                                      |       |

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 |   |                                  |   |   |  |                                      |       |
| Lonsdale et al. 2017       |   |                                  |   |   |  |                                      |       |
| Thomsen et al. 2016        |   |                                  |   |   |  |                                      |       |

|                     |  |  |  |  |  |  |  |
|---------------------|--|--|--|--|--|--|--|
| 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 | 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 |


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           | Green                                       | Red                              | Green   | Green   | Green  | Green                                | Green |
| Gilbert et al. (KOA) 2018 | Green                                       | Green                            | Red   | Green   | Red  | Green                                | Green |
| Gilbert et al. (RA) 2018  | Green                                       | Green                            | Red   | Green   | Red  | Green                                | Green |

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          | Green                                       | Red                              | Red   | Red   | Green  | Red                                  | Green |
| Ang et al. 2013            | Green                                       | Red                              | Green   | Green   | Green  | Green                                | Green |
| Ben-Ami et al. 2017        | Red   | Red                              | Red   | Red   | Green  | Green                                | Green |
| Friedrich et al. 1998      | Red   | Red                              | Green   | Green   | Green  | Green                                | Red   |
| Knittle et al. 2015 & 2016 | Green                                       | Green                            | Red   | Red   | Green  | Green                                | Green |
| Lonsdale et al. 2017       | Green                                       | Green                            | Green   | Green   | Red  | Green                                | Red   |
| Vong et al. 2011           | Green                                       | Yellow                           | Green   | Green   | Green  | Green                                | Green |
| Williams et al. 2018       | Green                                       | Green                            | Green   | Green   | Red  | Green                                | Green |



### 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 |   |                                  |   |   |  |                                      |       |
| Thomsen et al. 2017 |   |                                  |   |   |  |                                      |       |

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 |   |                                  |   |   |  |                                      |       |
| Thomsen et al. 2017 |   |                                  |   |   |  |                                      |       |

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).<br>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.<br>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.<br>Intervention group participants completed a mean of 5.7 (SD 0.5) sessions compared with 5.5 (1.0) for the control group participants ( $p = 0.13$ ).<br>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.<br>Number of sessions completed.   | Results were not reported for measured stage of change at baseline or discharge.<br>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.<br>Fifty-three control group participants and 61 intervention group participants completed at least 3 sessions.  |

|                               |   |  |
|-------------------------------|---|--|
|                               | strategies.<br>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.<br>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)).<br>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.<br>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.

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SD = standard deviation; SE = standard error

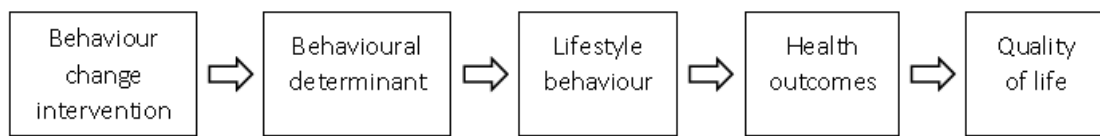


Figure 1. Sample causal modelling diagram (Michie, Johnston, Francis, Hardeman, & Eccles, 2008).

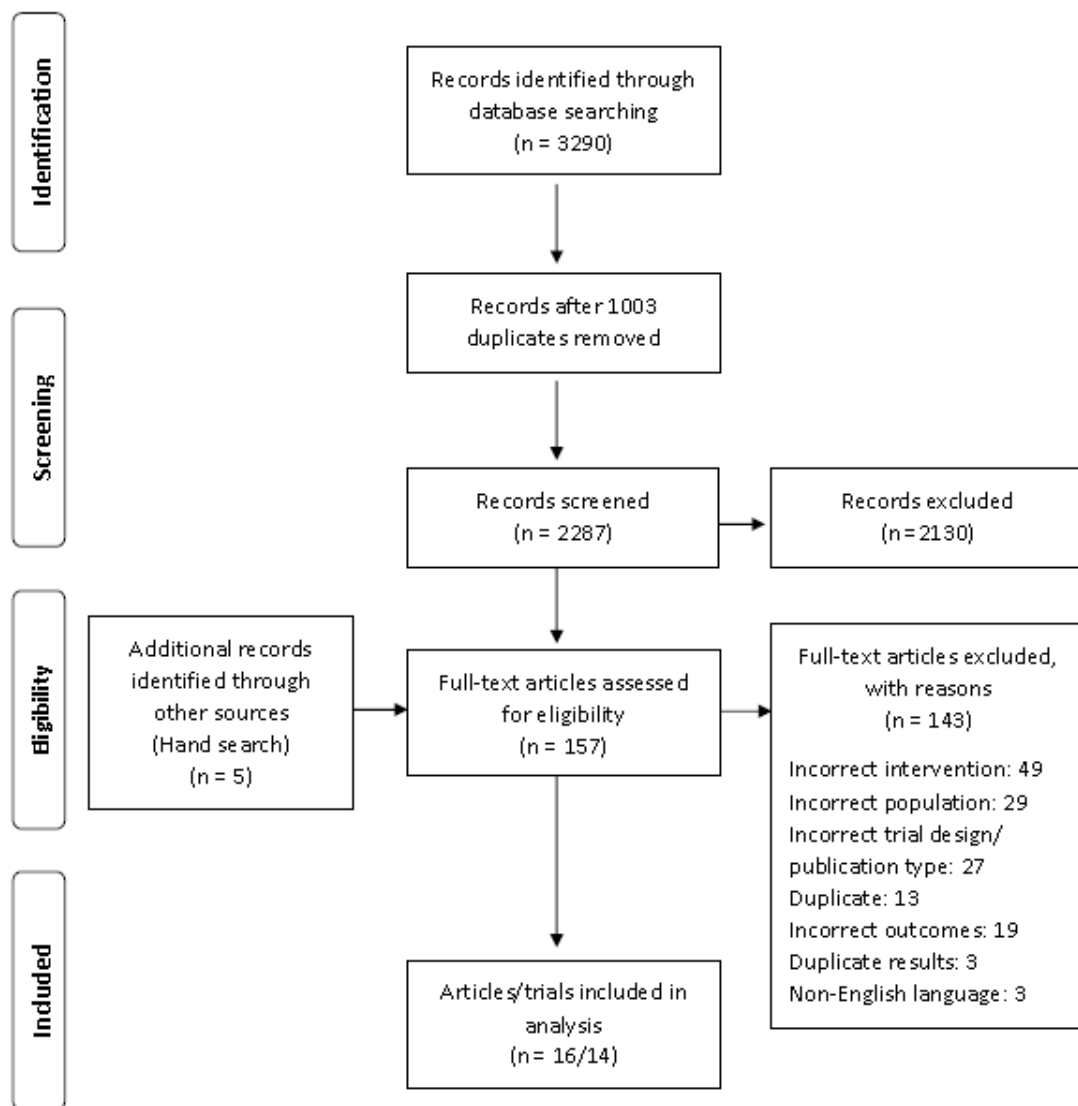


Figure 2. PRISMA flowchart of included trials.



**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<br>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

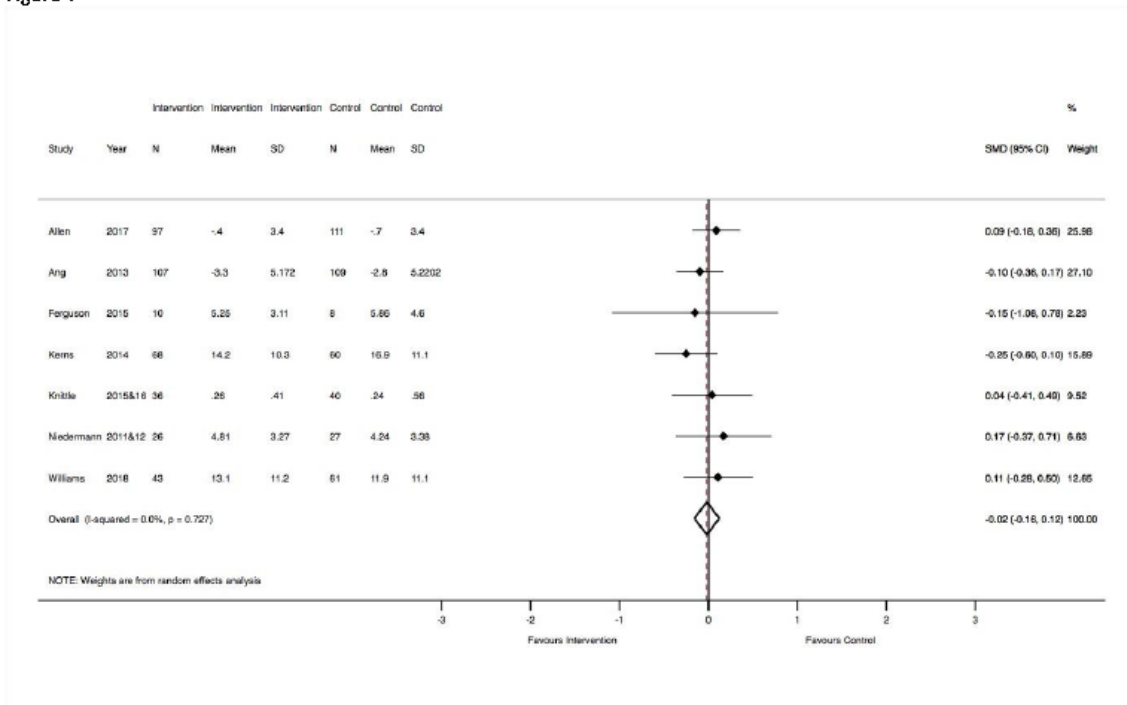


Figure 4. Forest plot for depression

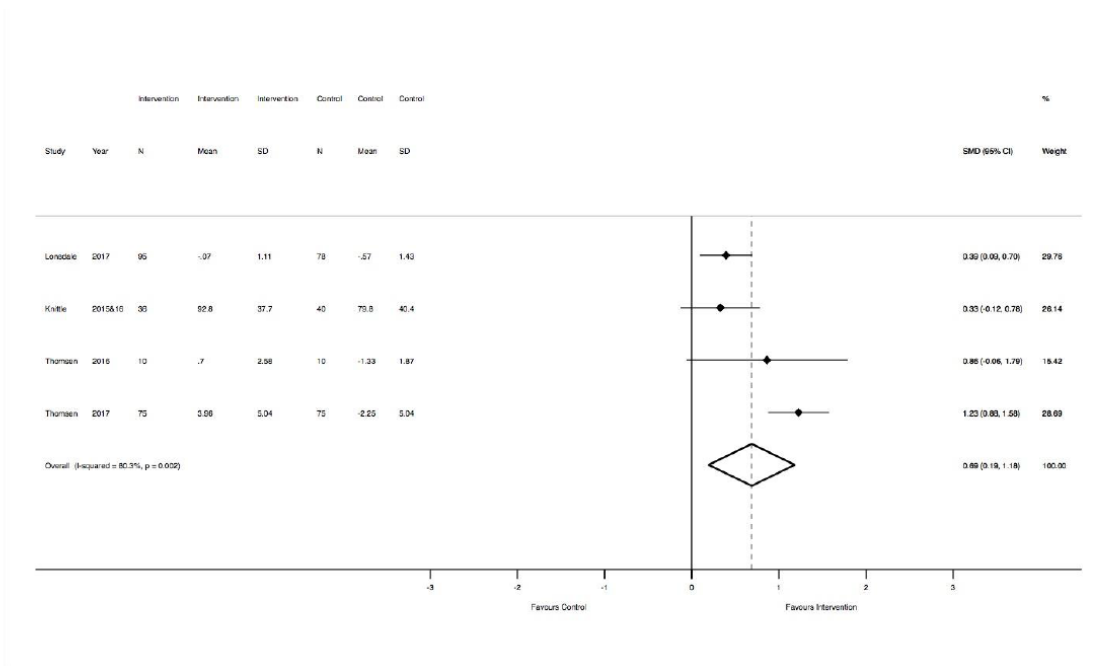


Figure 5. Forest plot for self-efficacy for physical activity

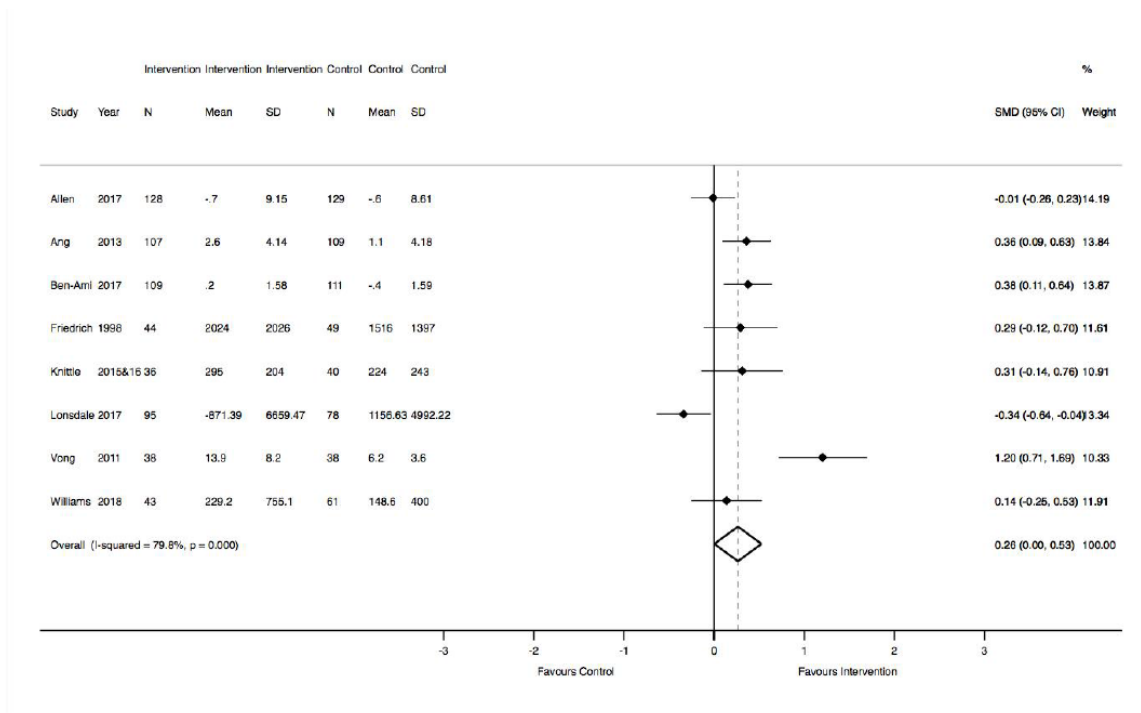
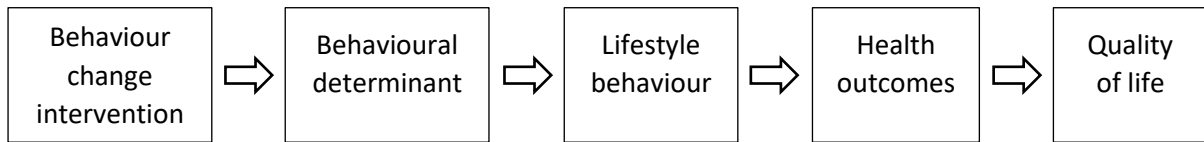


Figure 6. Forest plot for self-reported physical activity levels

FIGURES AND FIGURE LEGENDS

**Figure 1**



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

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Figure 2

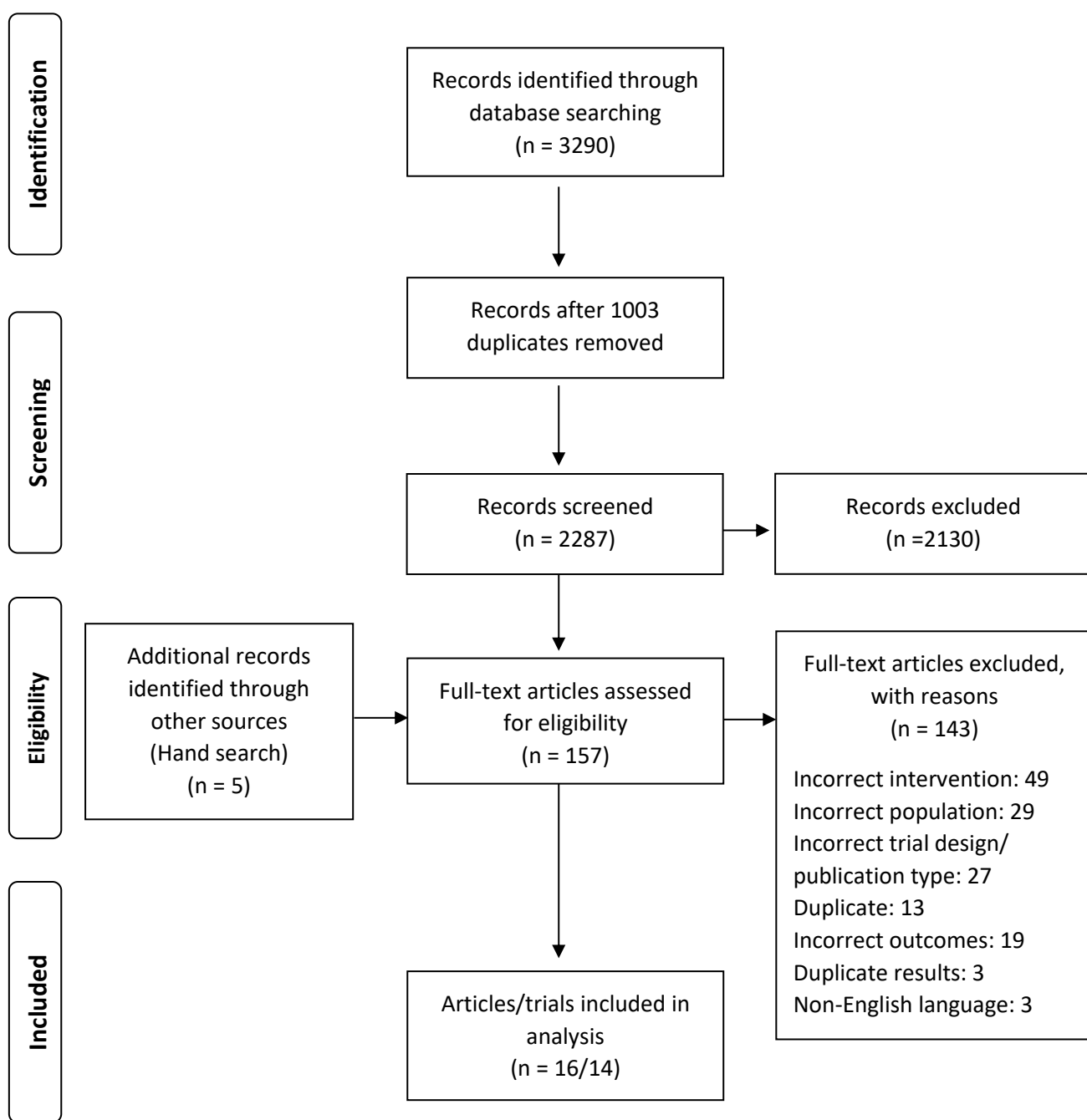


Figure 2. PRISMA flowchart of included trials.

**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<br>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             | Green                                       | Red                              | Red   | Red   | Green  | Red                                  | Green |
| Ang et al. 2013               | Green                                       | Red                              | Green   | Green   | Green  | Green                                | Green |
| Ben-Ami et al. 2017           | Red   | Red                              | Red   | Red   | Green  | Green                                | Green |
| Ferguson et al. 2015          | Red   | Red                              | Red   | Red   | Green  | Red                                  | Green |
| Friedrich et al. 1998         | Red   | Red                              | Green   | Green   | Green  | Green                                | Red   |
| Gilbert et al. 2018           | Green                                       | Green                            | Green (a)   | Red (b)   | Red  | Green                                | Green |
| Kerns et al. 2014             | Red   | Red                              | Green   | Green   | Red  | Green                                | Red   |
| Knittle et al. 2015 & 2016    | Green                                       | Green                            | Red   | Red   | Green  | Green                                | Green |
| Lonsdale et al. 2017          | Green                                       | Green                            | Green   | Green   | Red  | Green                                | Red   |
| Niedermann et al. 2011 & 2012 | Green                                       | Green                            | Red   | Red   | Green  | Green                                | Green |
| Thomsen et al. 2016           | Green                                       | Green                            | Red   | Red   | Green  | Green                                | Red   |
| Thomsen et al. 2017           | Green                                       | Green                            | Red   | Red   | Green  | Green                                | Green |
| Vong et al. 2011              | Green                                       | Yellow                           | Green   | Green   | Green  | Green                                | Green |
| Williams et al. 2018          | Green                                       | Green                            | Green   | Green   | Red  | Green                                | Green |

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

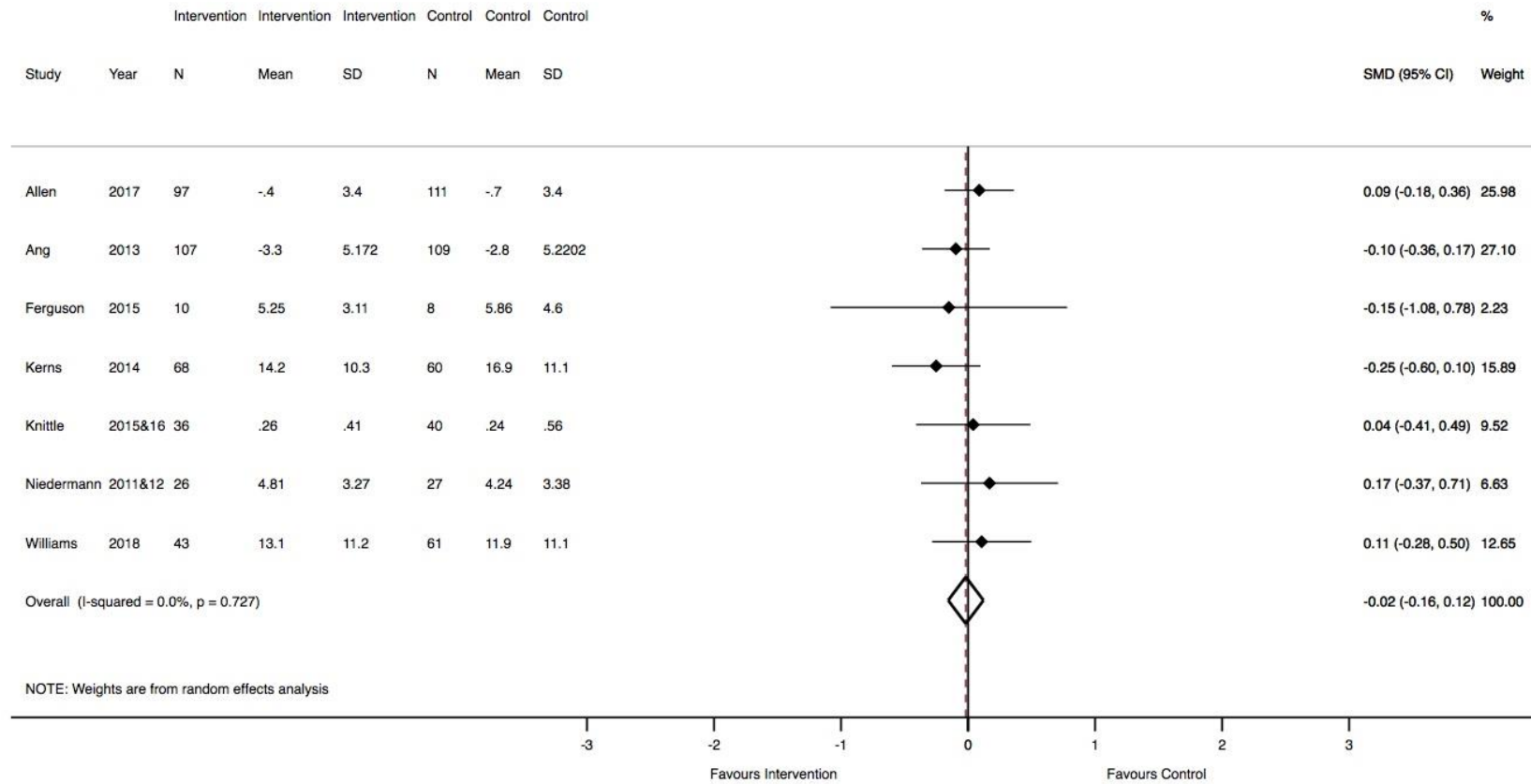


Figure 4. Forest plot for depression.

**Figure 5**

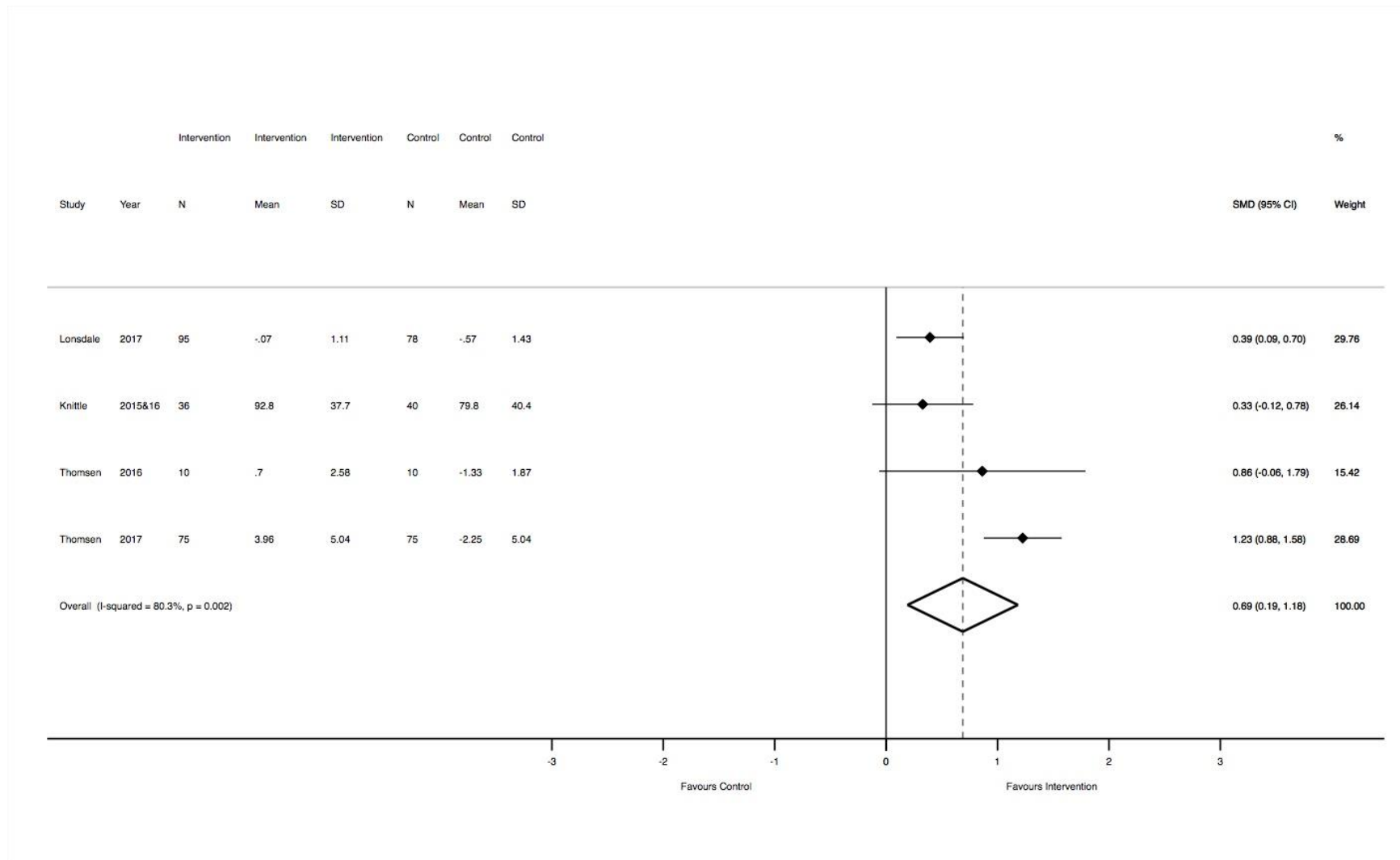


Figure 5. Forest plot for self-efficacy for physical activity

Figure 6

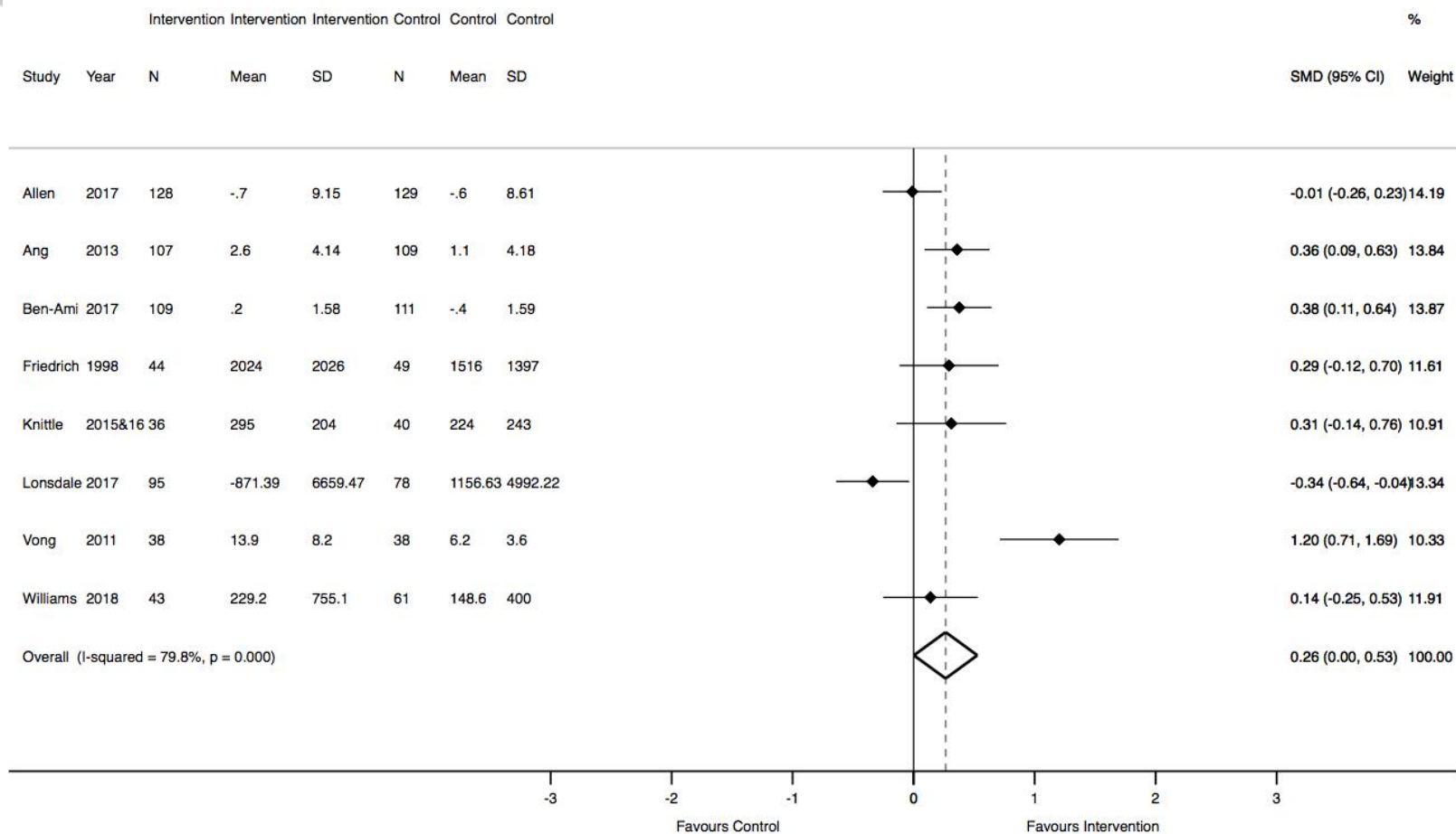


Figure 6. Forest plot for self-reported physical activity levels