

Combining a psychological intervention with physiotherapy. A systematic review to determine the effect on physical function and quality of life for adults with chronic pain.

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Background

Chronic pain affects approximately 28 million people in the UK. It does not always respond to conventional curative treatments and can have a devastating impact on an individual's ability to function and perform life roles in the way they would like. Psychological approaches to pain management have been advocated for over 40 years, but it is unclear whether the addition of such approaches to physiotherapy increases treatment effectiveness.

Objectives

To systematically review the literature to determine whether the addition of psychological approaches to physiotherapy is more effective in improving physical functioning and quality of life than physiotherapy alone.

Methods

An electronic database search focused on randomised controlled trials comparing a physiotherapy intervention for chronic pain with a matched intervention with an additional psychological therapy component.

All eligible studies were independently reviewed by two researchers and the strength of evidence and results evaluated. A meta-analysis was conducted on post-test mean data for physical functioning.

Results

Eight studies were identified for inclusion. Meta-analysis of the data showed combined treatments to be superior in modifying functional outcomes (standardised mean difference -1.12 95% confidence intervals -1.94 to -0.31). This was echoed in the narrative review of the quality of life evidence. Study quality was variable and thus the findings should be interpreted with caution.

Conclusions

There is evidence that combining physiotherapy and psychological approaches improves physical function in chronic pain in comparison to physiotherapy alone. Further examination of this field is required to inform changes in practice and to develop treatment methods.

Keywords: Psychological approaches; Physiotherapy; Chronic pain; Physical function; Quality of life

Background

Chronic pain is a widespread problem within healthcare with a reported 28 million people in the UK experiencing chronic pain condition of moderate to severe severity [1]. It is disabling and impacts on psychological functioning [1]. Pain is the second most common reason for claiming incapacity benefit with an annual cost of £3.8 billion; healthcare costs are unknown but general practitioner (GP) appointments for chronic pain have been estimated at £69 million per year [2]. The complex interaction between physical and emotional suffering makes management of chronic pain a challenge for the 21st century. Curative treatments can be ineffective, and when combined with unrealistic patient expectations this can lead to unhelpful patterns of investigation and treatment seeking, even where these efforts fail to reduce pain [3]. Chronic pain is a significant financial burden on health and social support systems and profoundly affects the lives of those living with it.

Physical rehabilitation strategies targeted at increasing functioning through exercise and/or manual therapy are common within physiotherapy for chronic pain. A recent review identified some evidence to support multidisciplinary treatments, education and exercise therapy but highlighted the need for further research [4].

Psychological approaches to pain management have been advocated for over 40 years [5] and the role of supporting patients with cognitive and emotional barriers to making changes in the presence of chronic pain is now common practice at a worldwide level. In the UK, pain clinics have adopted these approaches based on the best available evidence and national guidance is available to support this implementation [6]. The limited capacity of these specialised clinics mean that many patients fall between pain management services and more easily accessible outpatient physiotherapy services.

The experience of chronic pain is complex without simple linear relationships between tissue damage, the pain experience, and impact of pain and over the past 15 years physiotherapists have started to acknowledge the broader psychosocial impact of pain [7]. Cognitive behavioural approaches have been adopted within physiotherapy, particularly with a focus on the reduction of chronicity. The BeST trial and STarT Back trial provide examples of interventions combining physiotherapy and psychology which have been demonstrated to be effective in reducing chronicity in low back pain with longer lasting effects than physical treatment modalities alone [8,9].

A 2015 Cochrane review and meta-analysis concluded that multidisciplinary approaches are superior to physiotherapy alone for low back pain. The cost of these approaches however lead to a suggestion that they should be reserved for the most complex cases [10]. In a further review of physical and behavioural treatments for non-specific spinal pain small benefits were reported for pain and disability with no significant difference between interventions. No specific comparisons were made to explore the effectiveness of physiotherapy versus comparable physiotherapy in combination with another treatment [11].

Current understanding of psychologically informed physiotherapy approaches has been limited to low back pain with a specific focus on prevention of chronicity. There is however a much broader population of patients experiencing chronic pain and its debilitating impact. Both psychological and multidisciplinary approaches to chronic pain have been studied in some depth and appear both clinically and cost effective [12]. The large number of patients struggling with chronic pain cannot be managed in existing psychology and multidisciplinary pain management programmes hence alternative practical, cost-effective solutions are required. The enhancement of existing physiotherapy practice may be one possible solution to meet the needs of patients with chronic pain.

The aim of this systematic literature review was to evaluate the evidence regarding the addition of psychological treatment approaches to physiotherapy practice for patients with chronic pain. The specific focus was to determine the evidence for the impact of the addition of these approaches on physical function and quality of life. Pain was not selected as an outcome measure due to the lack of reliable link between reported pain levels and physical function [13].

Method

The review protocol was registered on PROSPERO (CRD42015026434) and conducted according to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines [14]. Articles were identified using an electronic search of Psychinfo, EMBASE, MEDLINE, Allied and Complementary Medicine Database (AMED) and Web of Science combined with hand searching of review paper reference lists. The search was updated on 14th September 2017. The search strategy, developed with a librarian, is included in figure 1.

Figure 1 here

Both authors independently screened the titles, abstracts and full texts of the total search yield to identify potentially eligible articles in a staged process. The abstracts and then full texts were retrieved where either reviewer considered a citation potentially met the inclusion criteria. Inclusion criteria were that the trial was published in English, randomised and included a control arm, participants were adult patients with a minimum three-month history of non-malignant pain, the study described a physiotherapy intervention arm with a clear theoretical approach and an intervention arm combining an equivalent physiotherapy intervention with a theory driven psychological intervention and measured physical functioning using a standardised measure. Exclusion criteria were the inclusion of patients with recent surgery or with inflammatory, degenerative or life limiting conditions.

Limiting the review to randomised controlled trials (RCT) with comparable physiotherapy interventions eliminated the risk of differences in the physiotherapy component of treatment

influencing the study results. This allowed the impact of the additional psychology treatment to be independently assessed. The exclusion of degenerative and inflammatory conditions eliminated risk of outcomes being impacted by changes in a progressing underlying condition.

Both authors independently reviewed the full texts which met the inclusion criteria and used a piloted data extraction form to collect information including: publication details, study design, participants, exclusion criteria, overarching physiotherapy and psychological theories, interventions delivered, primary and secondary outcome measures, randomisation procedures, blinding, results, unreported data and adverse events. Disagreements were resolved through discussion. Study authors were contacted where further information was required to determine inclusion and Cochrane Risk of Bias assessments were completed for all included studies [15]. The outcome of the risk of bias assessment is included in table 1. The Scottish Intercollegiate Guidelines Network (SIGN) methodology checklist 2 for randomised controlled trials was used for each study to inform the narrative review [16]. Evidence tables were produced to summarize the studies.

If the data were available, and it was appropriate to do so, it was proposed that the studies would be combined in a meta-analysis. We proposed to calculate the mean difference in physical function between the intervention (physiotherapy plus psychological approach) and control (physiotherapy only) arms. If heterogeneity between studies was suspected, for example where outcome measures vary between studies, the possibility of utilising a random effects model of meta-analysis would be considered.

Results

The electronic database search yielded 1060 citations. Thirteen articles were included in the final analysis which reported the findings of eight studies. A flow diagram of the review process is included in figure 2. A narrative review of the studies is included below along with a meta-analysis for physical functioning using post-test means. Table 1 summarises the included studies and table 3 summarises the study results.

Figure 2 here

Table 1 here

Participants

All studies recruited patients with spinal pain which persisted three months following onset. Four studies included patients with low back pain [17,21,22,26] and four included patients with neck pain [18,20,23,28]. No information was provided in any of the studies about previous physiotherapy or psychology treatment input for the pain conditions. Only one study reported a significant difference between arms for age [23] with those in the combined treatment arm being older.

Interventions and training

The interventions included in the studies are detailed in table 2. Physiotherapy varied from a general exercise protocol including strengthening and cardiovascular exercise [17,26,18,20], manual therapy in combination with exercises for strengthening and postural control [21–23,28]. Psychological interventions were all based upon a cognitive behavioural model. Of the eight studies six described the model used as Cognitive Behavioural Therapy [17,21,22,26,20,23] one as a Functional Behavioural Analysis approach [28] and one as an operant behavioural approach [18]. There was overlap in the CBT methods with graded activity and problem solving being used in two studies [17,26], graded activity and modification of thoughts and pain behaviours being used in four studies [21,22,20,23].

All treatments were delivered by physiotherapists in four studies [17,18,23,28], other studies used clinical psychologists [21,22,20] or clinical psychologists and social workers [26]. It was difficult to determine the equivalence of training and experience across the studies; Smeets [26] described an extensive training package and provided a detailed account of the treatment delivered whereas Monticone [23] described the treating physiotherapists as having over 20 years' experience in delivering manual therapy, but the level of training in CBT was acknowledged to be low. One study reported the physiotherapist to be experienced but again gave no detail of their training in psychological approaches [18]. One study described the physiotherapists delivering the combined treatment receiving supervision from a clinical psychologist [23]. Two studies described the combined treatment being delivered by a multidisciplinary team of a doctor, psychologist, occupational therapist and physiotherapist [21,22]. Only one study measured treatment integrity, however the results were not included in the publication [28]. Smeets [26] reported that there were no statistically significant protocol deviations between arms and provided a level of detail which would be adequate for the trial to be reproduced. The lack of detailed protocols and details of training makes it impossible to determine the quality of these interventions.

Withdrawal from study and adverse events

Rates of adverse effects were generally low across the studies. Smeets [26] reported six adverse events (2.64%) due to increased pain during the treatment phase and Monticone [20]

reported transient pain worsening and mood disorders in a total of 33 patients (19.41%) with neither study showing a difference between study arms. Details of these adverse events are included in table 1. Six studies did not report on adverse events so it is unclear whether these may have occurred [17,21–23,28] although some of the withdrawals reported by Ludvigsson [18] included increased pain indicating there may have been further unreported adverse events. Fifteen patients (6.61%) did not complete adequate treatment due to treatment rejection (four in the active physiotherapy arms and 11 in the combined treatment arm) in the study by Smeets [26]. Monticone [23] reported five dropouts in the physiotherapy only condition and Soderlund and Lindberg [28] reported one patient in the combined treatment who did not comply with treatment. The highest withdrawal rates were reported by Ludvigsson [18] with 11.27% in the combined physiotherapy and psychology arm and 23.68% in the physiotherapy only arm. With nearly a quarter of patients withdrawing between pre and post treatment questions are raised about acceptability.

Methodological quality

Table 2 summarises the Cochrane Risk of Bias findings for the eight studies included in the final analysis. Key weaknesses were the high risk of performance bias across all studies as it was not possible to blind participants to treatment. Risk of selection bias was also unclear for two studies due to inadequate description of concealment procedures [17,28].

Detection bias was affected by a lack of blinding in one study [28]. Two further studies did not report on blinding [17,26]. Attrition bias was high for one study due to the outcomes of a participant who did not comply with treatment being excluded [28]. A further four studies had participants withdraw, Smeets [26] performed an intention to treat analysis with baseline outcomes carried forward which minimised the risk of this affecting the findings. Three studies reported using an intention to treat analysis, however the methods for this were not reported [17,20,23].

One study did not report on treatment integrity, despite this being included in the method, putting it at high risk of reporting bias [26]. Risk of other biases included the lack of treatment fidelity testing across all studies aside from Smeets [26]. One study also offered acupuncture and heat based pain relieving modalities in the physiotherapy only arm, these were not measured and therefore their impact on the outcomes cannot be determined [28]

The small sample sizes in three of the studies makes it difficult to assess whether the findings are reliable or generalizable [17,21,28].

Table 2 here

Effect of treatment on quality of life

Quality of life was measured in four studies, each of these used the Short-Form Health Survey Questionnaire (SF36). Monticone [23] demonstrated non-significant difference in favour of the combined treatment whilst Monticone [21,22,20] showed statistically significant effects of time, group and time-by group interaction in favour of the combined physiotherapy and psychology treatment. Meta-analysis was not carried out on these data as only subscale scores for the physical and mental components of the SF36 were available.

Effect of treatment on physical function

Physical function was measured in all eight studies. Three studies showed statistically significant between group differences in favour of the combined treatment [21,22,20] and four [17,26,18,23] showed statistically significant differences from pre to post treatment with no significant difference between groups. Soderlund and Lindberg [28] did not demonstrate statistically significant changes in either group between pre and post treatment.

Table 3 here

Meta-analysis

Seven of the eight studies were included in the meta-analysis for physical function. The individual study results are presented in table 3. Smeets [26] were contacted for their post-test means which were not included in their publication, however these data were not provided. Data were pooled using a random effects model due to heterogeneity. Meta-analysis revealed a large effect size in favour of the physiotherapy combined with psychological approach (standardised mean difference: -1.12: 95% confidence intervals: -1.94 to 0.31, $p=0.007$). The full results are presented in figure 3 below.

Figure 3 here

Discussion

Eight studies were identified which compared physiotherapy only treatment with physiotherapy treatment plus a psychological intervention for chronic pain. These studies covered spinal pain, but none were found that included patients with localised pain away from the spine, widespread pain conditions, headache, or visceral pain. This may be due to

issues of heterogeneity around diagnosis of non-spinal pain conditions, spinal pain patients may also be more easily recruited from orthopaedic and musculoskeletal caseloads. There was a pattern of increase in number and quality of studies and reduction in risk of bias over time, however based on such a small number of studies it is difficult to infer whether this may be a pattern that will continue, particularly as 50% of the studies came from the same research group.

The treatments delivered in the physiotherapy arms varied including manual therapies, heat and acupuncture, as well as exercise therapies. These combined treatment approaches reflect the range of treatments applied in current physiotherapy practice for spinal pain conditions, however these modalities themselves do not have a strong evidence base [4]. Whilst it is difficult to extrapolate the potent elements of treatment the use of a control and intervention arm allows physiotherapy only treatment to be compared with physiotherapy treatment with an added component of psychological therapy. Further work is required to investigate which physiotherapy interventions are most effective for chronic pain conditions and cease delivery of treatments that are not found to be clinically and cost effective. For example both acupuncture and Transcutaneous Electrical Nerve Stimulation were not recommended for low back pain or sciatica in the most recent guidelines from the National Institute for Health and Care Excellence due to an absence of persuasive evidence [30].

Meta-analysis showed that combined physiotherapy and psychology treatment was statistically significantly superior in improving physical functioning over physiotherapy alone. Three of the four most recent studies indicate that the addition of a psychological intervention to physiotherapy resulted in better outcomes in physical functioning and quality of life, however in all of these studies the psychology component was delivered by clinical psychologists [21,22,20]. It is of note that one of these studies included an extensive year long period of intermittent treatment [22]. This appeared to be effective, however in the current healthcare climate of the United Kingdom it is unlikely that this approach would be feasible. The study sample sizes were small overall with between 10 and 85 participants in each arm. Six of the studies included power calculations and matched these with their recruitment [17,22,26,18,20,23]. Monticone [21] was only a small pilot study. Pilot studies are designed to test procedures of a larger RCT such as recruitment retention, appropriateness of measures and proof of concept and the results of this study in isolation should be interpreted with caution [31].

The three studies which showed an enhancing effect of the addition of a psychological approach to physiotherapy used experienced psychologists to deliver the psychological component of treatment [21,22,20]. The skill levels of psychologists to deliver psychological therapy is higher than physiotherapists due to their specificity in training and this may have impacted on the results. It is possible that where the addition of psychological approaches did not enhance treatment this may have been due to the skill level associated with the treatment delivery. Excluding studies which used healthcare professionals other than physiotherapists may have provided a clearer picture of the treatment outcomes achievable by psychologically

enhanced physiotherapy input. It is conceivable that attention to training needs of physiotherapists may enable them to deliver effective psychologically enhanced treatments.

Two studies were low quality [21,28]. One of these showed no statistically significant effect over time of either physiotherapy or combined physiotherapy and psychology interventions on physical functioning [28]. The other showed a statistically significant increase in physical functioning and quality of life for both groups over time with a combined physiotherapy and psychology treatment showing a statistically significantly greater effect [21]. The extension of the pilot study by Monticone [21] to a full RCT would provide more robust outcomes.

Six studies were of moderate quality [17,22,26,18,20,23]. Four showed significant improvements in physical functioning in both physiotherapy and combined treatment arms over time but no significant difference between arms [17,26,18,23]. Monticone [23] also showed quality of life to significantly improve over time but not between arms. Two moderate quality studies demonstrated statistically significant improvements in both physical functioning and quality of life with significant time-by-group differences in favour of the combined treatment, both studies employed highly intensive treatment which may not be cost effective or practical to implement [22,20].

Implications for practice

The addition of psychological approaches to physiotherapy interventions may provide some additional benefit, however these benefits must also be considered in the context of the cost of treatment enhancement. Health economic data is not available for the treatments included in this review, however the increased treatment time involved in the majority of studies indicated that treatment delivery costs could increase as well as there being training cost implications. These would need to be balanced by cost savings in areas such as medical consultations, medication use or unemployment costs to demonstrate value. Further work to distil the potent clinical methods may assist in the translation of highly intensive research treatment protocols to viable clinical protocols for care.

To ensure that psychological interventions could be implemented in physiotherapy settings a clear model for treatment is required and issues around training and treatment fidelity need to be addressed. A recent review of the behaviour change theories and techniques in physiotherapist led pain self-management programmes uncovered substantial problems, including inconsistency in theory implementation [32]. Further problems in implementation emerge in another recent review of physiotherapist's perceptions of practice which suggested that although physiotherapists are aware that psychological approaches may be beneficial, they do not feel competent to deliver them [33]. Concerningly a review by Synnott suggests that as well as not feeling prepared to treat chronic pain following under and post graduate training, that physiotherapists may only partially recognise the cognitive, emotional and social factors impacting in chronic pain and express a preference for biomedical treatments regarding complex factors as out of their scope of practice [34]. We are yet to fully understand whether training packages can address both therapist attitudes and perceptions of their skill levels and so change therapist behaviour resulting in improved patient outcomes.

Recent reviews of the effectiveness of group self-management programmes for low back pain which included a wide range of physiotherapy only and multi-disciplinary programmes concluded that such interventions are as effective as individual physiotherapy or medical management, however limitations reported in the studies included too much focus on pain scores perhaps resulting in inadequate assessment of behaviour change [35]. Treatment fidelity has also been described as poor, although it is unclear whether this is due to lack of consistency between delivery and prescribed models or limited reporting of fidelity checks in published research [36]. This review highlights three areas for development in clinical practice; 1) clear definitions of the content of physiotherapy based self-management programmes; 2) determining acceptability of these programmes to physiotherapists and 3) training of physiotherapists in the effective delivery of the programmes.

Implications for research

As indicated above the clinically potent methods within both physiotherapy and psychology models are not apparent from the available research. Further work to extrapolate the important elements of treatment for spinal and other chronic pains is required, alongside the testing of brief interventions based upon the potent clinical components identified. Multicentre trials are also required to reduce the risk of type one error due to localised populations or treatment environments where findings may not generalise to broader clinical populations.

The small number of studies identified ranging over a 16-year period reflects a lack of research focused on the implementation of biopsychosocial treatments in physiotherapy for chronic pain. This mirrors a clinical environment where patients often transition from unidisciplinary primary care settings into specialised pain services where self-management programmes or psychologically based pain management programmes dominate practice. There are many studies of psychological treatments for chronic pain which include pain management programmes. These are summarised in Cochrane reviews [10,37]. The addition of psychological approaches to physiotherapy has not however been thoroughly studied. This may be due to a slow transition in practice which has not been tested using robust research methods. To ensure effective patient care further research in this field is required.

In terms of methodological quality, the design and treatment fidelity of the interventions requires greater attention. This is a longstanding challenge for a profession with treatment approaches as diverse as physiotherapy. The addition of methods traditionally seen as outside the scope of physiotherapy practice raises professional issues of competence and supervision on top of questions of efficacy.

The introduction of pain education and motivational interviewing approaches into physiotherapy highlights a change in clinical practice. Future research will need to determine how these approaches compare with more traditional physiotherapy approaches and psychological interventions combined with physiotherapy. When treatments are combined it

is possible that an interaction effect occurs. This was beyond the scope of this review; however further study of the impact of physiotherapy and psychological approaches being delivered separately or in combination may assist in understanding the mechanisms which influence this.

Limitations

The strength of evidence provided by this review is constrained by quality and volume of the available studies. The review question was narrow to ensure relevance of the findings, however a broader review of biopsychosocial approaches used in chronic pain may enhance understanding of the treatment approaches utilised and their impact on function. Long-term follow-up of outcomes was insufficient to enable a meta-analysis leaving questions about the lasting effects of treatments.

Pain intensity was not scrutinised as a part of this review which focused on patient functioning. Whilst clinically and socially patient functioning appear important, the outcomes desired by patients may differ and pain intensity may be an important variable in determining treatment efficacy. Repetition of this review with pain as the primary outcome may add to the understanding of patient reported outcomes and the interaction between pain levels and physical functioning.

Conclusion

Overall there is evidence that combined physiotherapy and psychology interventions to enhance physical functioning are superior to physiotherapy alone for patients with chronic spinal pain. Combined interventions may also lead to greater improvements in quality of life in the presence of chronic spinal pain. Resulting clinical changes remain to be weighed against a potential increase in cost of treatment. Further work is indicated to enhance understanding of both treatment efficacy and the health and social economics involved in these treatment approaches.

Conflicts of interest

No conflicts of interest.

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Figure 1 Search Strategy

"chronic pain" OR "long term pain" or "persistent pain" OR "arthritis pain"

AND

physiotherap* OR "physical therap*"

AND

psycholo* OR "cognitive behavioural therap*" OR "psychosocial approach" OR
"motivational interviewing" OR "acceptance and commitment therapy"

Figure 2 Flow Diagram of the Review Process

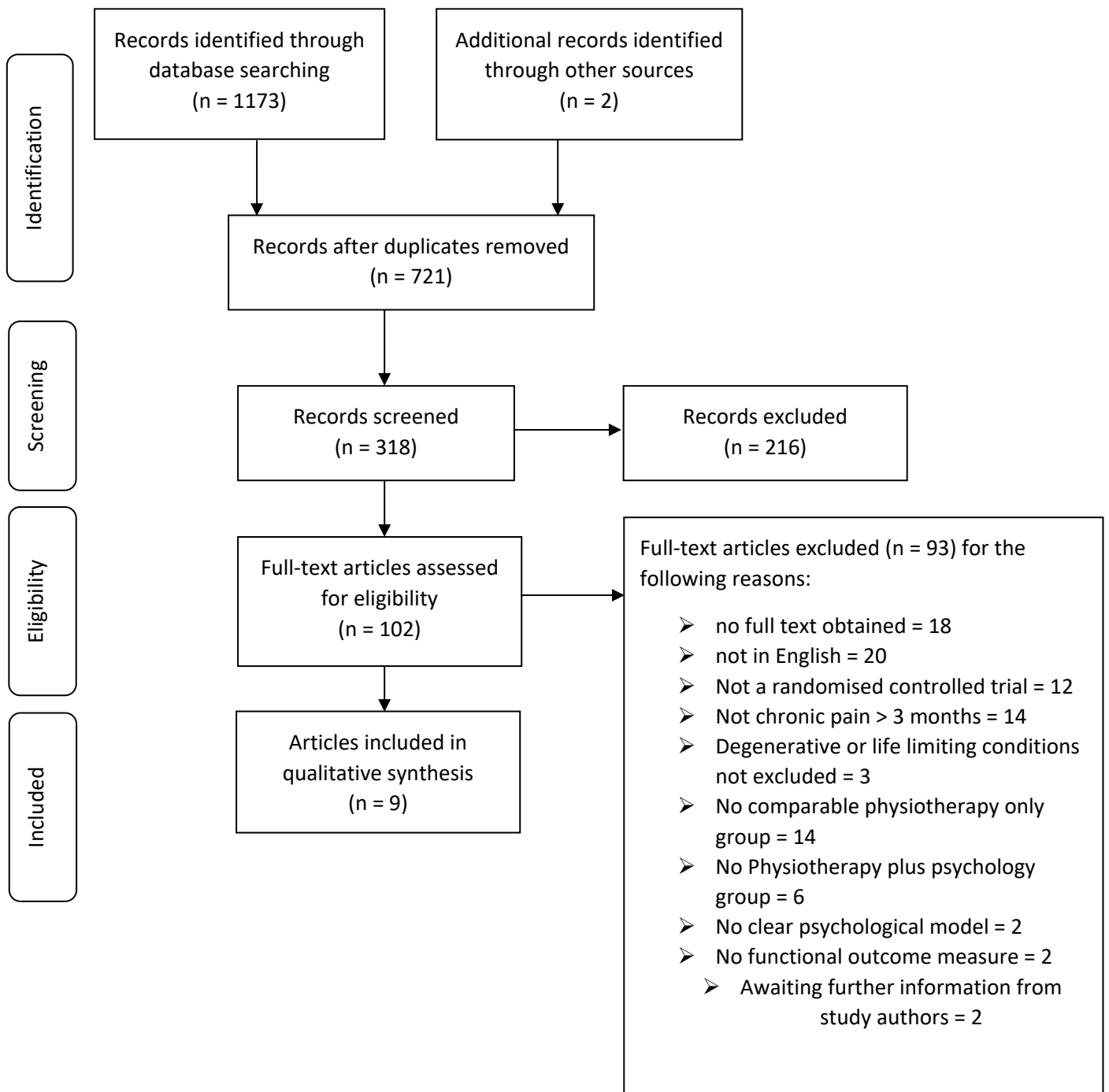


Table 1 Description of Studies

Study	Condition and physical functioning outcome measure	Recruitment	Total entered into study (% female)	Age range (mean±SD) years	Physiotherapy intervention	Physiotherapy plus psychological intervention	Withdrawals	Adverse events
Khan et al [17]	NSLBP 3-24 months RMDQ	Via two clinics in Pakistan	N=54 (54%)	29-50 (39.61 ± 5.3)	General exercise: range of movement and aerobic training. 3 supervised sessions/week plus 2xdaily home exercise on 5 days/week for 12 weeks.	General exercise as physiotherapy only group plus CBT: operant behavioural graded activity and problem-solving training.	None	Not reported
Ludvigsson et al [18-19]	Chronic whiplash disorder NDI	Patients identified from healthcare registers in 6 Swedish counties	N=216	PTcb (n=71) 40±11.6 PT (n=76) 38± 11.3	Supervised exercise and basic information. 2 sessions weekly plus home exercises. Unrestricted isometric exercise	As physiotherapy only but progressed more slowly with patients encouraged to be responsible for progression, plus pain education, activities aimed at pain management and problem	None	Not reported

					progressing to low isometric resistance and resistance training.	solving, relaxation and home practice.		
Monticone et al [20]	Chronic neck pain >3 months NDI	Via 1 hospital outpatient clinic	N=170 (71.2%)	PTcb (n=85) 53.8±13.3 PT (n= 85) 52.0± 12.1	Exercises for strengthening, regional stretching and spinal mobilization. Ergonomic advice booklet. One session per week for 10 weeks in groups of 5 patients.	Exercise introduced by means of graded exposure for cervical mobility, postural control, stretching and strengthening plus group-based CBT. 1 hour per week of exercise and CBT for 10 weeks.	PT only n=6 did not start intervention, n=4 lack of time, n=1 increased pain, n=3 other disease, unknown n=4	Transient pain worsening (combined group n=8, physio only n=12) Mood disorders (combined group n=5, physio only n=8)
Monticone et al [21]	NSLBP > 3 months duration ODQ	Via outpatient department	N=20 (55%)	(57.75)	Passive spinal mobilisation, stretching, muscle strengthening and postural control Individual 60 minute motor training sessions 2x/	CBT and spinal stabilisation exercises in addition to physiotherapy only treatment programme. Clinical psychologist delivered CBT: modification of fear of movement	None	Not reported

					week for 8 weeks	beliefs, catastrophizing and negative feelings and ensuring gradual reactions to illness behaviours. Cognitive reconditioning and graded exposure. Additional 60 minutes once/ week for 8 weeks.		
Monticone et al [22]	NSLBP > 3 months duration RMDQ	Via research hospital outpatient department	N=90 (57.78%)	(49.34)	Multimodal motor programme: active and passive spinal mobilisations, exercises aimed at stretching and strengthening muscles and improving postural control Individual programme followed by the patient. 10 x 60 minute sessions	Physiotherapy intervention plus CBT: modification of fear of movement beliefs, catastrophic thinking and negative feelings and ensuring gradual reactions to illness behaviours, graded exposure and acquisition and development of neglected coping strategies through communication, motivation and goal sharing.	None	Not reported

					2x a week for 5 weeks then 2x weekly 60 minute home exercise sessions for 1 year with telephone reminders	60 minute individual sessions once/ week for 5 weeks then 1 hour once/ month for 1 year		
Monticone et al [23]	Non-specific neck pain >3 months duration NPDS	Outpatient department	N=80 (75%)	PTcb (n=40) 54.97±13.83 PT 44.20±11.44 (p<0.001)	Manual Therapy and exercise including active and passive neck mobilisation, postural and motor control work for deep muscles of the neck. Up to 12 sessions, 45-50 minutes each, 1-2x a week. Discharge when pain free for 15 days minimum and Cx spine	Physiotherapy programme as for physiotherapy only group psychology consisted of graded activities, pain education, modification of fear-avoidance and catastrophisation, modification of pain experience, inappropriate thinking and pain behaviours. Up to 12 sessions, 45-50 minutes each 1-2x a week. Discharge when pain	5 withdrawals reported in the PT group. Data included in the ITT analysis	Not reported

					function normal.	free for 15 days minimum and Cx spine function normal.		
Smeets et al [24-27]	NSLBP >3months Functional limitation (RMDQ >3) RMDQ	Via 3 outpatient rehabilitation clinics	N=227 (45.9%)	(41.91 ± 9.65)	APT including CV and dynamic strengthening 1.75 hours 3x/ week for 10 weeks.	APT, as physiotherapy group plus CBT: operant behavioural graded activity training. 11.5 hours treatment primarily individually and problem solving 10 x 1.5 hour sessions with clinical psychologist in groups of up to 4.	6 withdrawals during treatment, data were included in ITT analysis.	6 patients. 3/group. 1x herniated disc requiring surgery, 1x knee complaint and 1x vascular problems requiring surgery.
Söderlund & Lindberg [28-29]	Whiplash injury with continuous symptoms at >3 months post injury. PDI	Via an orthopaedic clinic	N=33 (57.58%)	(40.69)	Exercises for neck stabilisation, neck and shoulder mobility, posture and arm strength. Relaxation, TENS, acupuncture and heat.	Basic skills included relaxation training and postural re-education, exercises for neck mobility and muscular coordination and endurance and re-education of normal humeroscapular rhythm	One patient in combined intervention did not comply with treatment and was excluded from the analysis	Not reported

					Maximum 12 individual sessions	Functional behavioural analysis approach including goal setting, learning of basic physical and psychological skills, application and generalisation of skills targeting pain coping and self-efficacy. Maximum 12 individual sessions		
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APT= active physical treatment; CBT = Cognitive Behavioural Therapy; CT = combined treatment; CV = cardiovascular; Cx = cervical; ITT = intention to treat; NDI=Neck Disability Index; NPDS = Neck Pain and Disability Score; NSLBP= Non-specific low back pain; ODQ=Oswestry Disability Questionnaire; PDI=Pain Disability Index; PT = physiotherapy; RMDQ = Roland Morris Disability Questionnaire; TENS = Transcutaneous Electrical Nerve Stimulation.

Table 2 Cochrane Risk of Bias Ratings

	Random sequence allocation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other bias
Khan 2014 [17]	?	?	-	?	+	+	?
Ludvigsson 2015 [18]	+	+	-	+	+	+	?
Monticone 2017 [20]	+	+	-	+	+	+	+
Monticone 2014 [21]	+	+	-	+	+	+	?
Monticone 2013 [22]	+	+	-	+	+	+	?
Monticone 2012 [23]	+	+	-	+	+	+	?
Smeets 2006 [26]	+	+	-	?	+	+	?
Soderlund & Lindberg 2001 [28]	+	?	-	-	-	-	-
	-	High risk of bias					
	+	Low risk of bias					
	?	Risk of bias cannot be ascertained					

Table 3 Summary of Study Results

Study	Physical functioning	Quality of life
Khan (2014) [17]	RMDQ: statistically significant difference**** in both groups over time. No statistically significant difference between groups.	Not measured
Ludvigsson (2015) [18]	NDI: statistically significant difference in both groups over time (pt only**, combined treatment***). No statistically significant difference between groups.	Not measured
Monticone (2017) [20]	NDI: statistically significant difference within groups over time*** and between groups ***.	SF36: statistically significant difference within groups over time*** and between groups ***.
Monticone 2014) [21]	Oswestry Disability Questionnaire: improved by about 25% in the physiotherapy only group and 61% in the physiotherapy plus psychology group, indicating significant effects of time***, group* and time-by-group*** interaction in favour of the combined treatment group.	SF36: improved across most subscales indicating statistically significant effects of time**, group* and time-by-group interaction* in favour of the combined treatment group. The items which did not show statistically significant effects of time-by-group were physical role and bodily pain.
Monticone (2013) [22]	RMDQ: progressively reduced between pre and 2 year follow-up	SF36: decreased statistically significantly between pre-treatment

	in the combined treatment group with repeated measure linear mixed model showing significant main effects for group and time in favour of the combined treatment group***	and 1 year follow-up showing statistically significant effects of time, group and time-by-group interaction*** in favour of the combined treatment group.
Monticone (2012) [23]	NPDS: both groups showed improvement but no statistical difference between groups	SF36: both groups showed improvement but no statistical difference between groups
Smeets (2006) [26]	RMDQ: statistically significant difference** in both groups over time. No statistically significant difference between groups	Not measured
Soderlund and Lindberg [28]	PDI: no significant difference over time in disability for either group at post treatment, 3 or 6 month follow-up. Combined group analysis showed a statistically significant improvement** in disability at 6 months post treatment	Not measured

*p<0.05; **p<0.01; ***p<0.001; ****p=0.000; NDI=Neck Disability Index; NPDS = Neck

Pain and Disability Score; PDI = Pain Disability Index; RMDQ = Roland Morris Disability

Questionnaire; SF36 = Short-Form Health Survey Questionnaire; WL=waiting list

Figure 3 Effects of Physiotherapy plus psychology intervention compared with physiotherapy alone on physical functioning

