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Home-Based Health Care Interventions for People Aged 75 years and above with Chronic, Non-inflammatory Musculoskeletal Pain: A Scoping Review

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ABSTRACT

Background and Purpose:

Chronic non-inflammatory musculoskeletal pain is common in the aged population and management can be challenging for older people due to multi-morbidity, social isolation and physical frailty. The aim of this scoping review is to summarise and discuss the evidence related to home-based health care interventions for the older population, with chronic, musculoskeletal pain.

Methods:

A review of the literature using 8 electronic databases (EMBASE, MEDLINE, CINAHL PubMed, Cochrane Library, Physiotherapy Evidence Database (PEDro), Scopus and Web of Science) was performed, following the PRISMA-ScR guidelines. English-language published studies that assessed home-based health care intervention/s, in men and women aged ≥ 75 years, with chronic, non-inflammatory musculoskeletal pain where included. Two authors independently reviewed the articles and extracted data into a pre-formulated chart.

Results and Discussion:

The database search identified 4722 studies of which 7 studies met the inclusion criteria. Six of the seven studies were randomised controlled trials and five studies focused on a single site pain. The type of home-based interventions in the included studies were physical therapy (n=2), psychotherapy (n=3) and multimodal therapy (combination of multiple therapies) (n=2). Participation completion rate was >74% in 6 out of 7 studies. Most studies used pain and/or physical function as their primary outcome (n=6). Music therapy showed a statistically significant reduction in visual analogue score (VAS) for

pain, and there was a trend towards improvement of pain and function in the physical therapy studies. There were no significant differences in outcomes between intervention and control groups in the multimodal studies.

Conclusion:

This review highlights the scarcity of evidence related to home-based health interventions in older people aged ≥ 75 years, living with chronic non-inflammatory musculoskeletal pain. The findings were that physical, psychotherapeutic and multimodal interventions are usually well tolerated and can be delivered as a safe self-management option. There remains a substantial need for more high-quality research with wider range of home-based interventions and comprehensive assessment of outcomes for this age group

Key words: conservative, non-pharmacological, self-management, home-based rehabilitation, scoping review

BACKGROUND

The world population is steadily aging: population projections predict that by 2050 almost 16% of the world population and one in four people living in Europe and North America will be aged 65 or above.[1] Population census data from the US in 2016 shows nearly 49.2 million people are over the age of 65 years (predicted to be around 98.2 million by 2060), including almost 20.6 million people aged 75 and above.[2] While, in the UK, nearly 12 million people are over the age of 65 years; almost half of these (5.4 million) are over the age of 75 and this number is predicted to double in the next 20 years.[3]

Chronic musculoskeletal disease and pain are common in this population, with estimates ranging between 50-70% in those aged over 65 years.[4, 5] Over half of those aged over 75 years have two or more concurrent chronic health conditions (multimorbidity), with multimorbidity frequently being found in people with arthritis.[6-8] The average quality of life for adults who live with a long-term musculoskeletal condition is worse than that for chronic heart, lung or kidney disease.[9] Notably, chronic pain, one of the main symptoms of musculoskeletal condition, has been associated with a greater risk of loneliness,[10] impaired physical capacity for activities of daily living and increased risk of falls.[11, 12] Cost of care for musculoskeletal conditions is expensive; the direct cost of musculoskeletal conditions in the European Union (2007) and in the USA (2011) accounted for around 2% and 5.19% of the total annual gross domestic product (GDP), respectively.[13, 14] In the UK, musculoskeletal disease currently accounts for the third largest area of NHS spending at £4.7 billion each year.[15] In older adults, management of chronic musculoskeletal pain is even more expensive due to comorbidities and prolonged service

utilization over time. Therefore, provision of effective support and care for older people with chronic musculoskeletal pain is an important healthcare and socio-economic issue.

Current recommendations for the management of chronic musculoskeletal pain encompass self-management, physical aides, physical therapies and pharmacological treatment.[16, 17] However, there is a paucity of data for the management of musculoskeletal pain in people aged over 75 years of age, where management may be more complex. Pharmacological interventions are more likely to be contraindicated for older people due to their age, higher rate of renal, cardiac and hepatic comorbidities, and polypharmacy.[16] For older adults with chronic musculoskeletal conditions, the added challenge to this is limited social support and environmental factors such as difficulty parking, cost of transportation, bad weather and unfamiliar environment significantly impede patient motivation to attend physical therapy visits.[17, 18] In addition, group based exercise programmes, which are a popular intervention for painful musculoskeletal conditions like osteoarthritis, have been found not to be well received by less active adults as they have multiple perceived barriers to regular physical activity and believe they hinder the progress of the whole group.[19]

In the context of these potential barriers, home-based health interventions have become of increasing interest to care service providers.[20, 21] Home-based health care refers to a range of interventions delivered at home or in a residential care setting with the purpose of "promoting, maintaining, or restoring health along with maximising the level of independence, while minimising the effects of disability and illness".[20]

The importance of supporting care closer to home, enabling individuals to self-manage their long-term condition/s and remain independent has been highlighted, particularly for

the older population.[22] With growing pressures on healthcare systems, and long waiting lists for outpatient physiotherapy services, home-based healthcare has particular relevance for chronic conditions such as musculoskeletal disease, where pain is recurrent and conditions progress over time. Studies have found that home-based interventions for chronic musculoskeletal care are relatively cost-effective, generally acceptable and provide benefit to the patient.[23-26] However the age range of 75 and over is not well represented in many studies.

There is a clear need for the development of a home-based rehabilitation programme for older adults aged 75 and over with chronic musculoskeletal pain. To inform the development of an evidence-based intervention, it is essential to understand the current literature on home-based rehabilitation for this population. Therefore, the research question that guided this review was "What interventions exist in the literature that can be delivered partially or completely as part of a home-based rehabilitation programme to manage chronic musculoskeletal pain in older adults?"

METHODS

We selected to use scoping review methodology since we wanted to obtain a broad understanding of home-based care specifically in older adults. By using scoping review methodology we were able to firstly examine the extent, range and nature of research activity, secondly, determine the value of undertaking a systematic review; thirdly, summarize and disseminate research findings; and, finally identify research gaps in the existing literature.[27] The scoping review was based on a protocol which was developed in accordance with the recommendations from PRISMA-ScR guidelines,[28] as well as the

scoping review framework developed by Arksey and O'Malley,[29] and the Joanna Briggs Institute Reviewers' Manual 2015.[30]

Data source and search strategy

The following electronic databases were reviewed: EMBASE, Medline, PubMed, Cochrane Library, Physiotherapy Evidence Database (PEDro), Cumulative Index of Nursing and Allied Health Literature (CINAHL), Scopus and Web of Science between 1946 to October 2019. We also manually searched for additional studies by cross-checking the reference lists of included studies. A search strategy was developed for Medline (Supplementary File 1) and then modified for the different databases used. An electronic record of all search strategies and results was maintained in a Microsoft Excel spreadsheet.

Study eligibility criteria

Studies eligible for inclusion in the review were those that: (1) Recruited participants aged 75 years or older. Studies including younger age groups were included as long as subgroup data for those aged ≥ 75 years was provided. (2) Included non-traumatic and non-inflammatory musculoskeletal pain, labelled as chronic, without requirement for minimum duration of symptoms. (3) Involved (full or partial) home-based intervention for non-inflammatory musculoskeletal joint pain provided by a trained health professional. Interventions including and not limited to, physical therapy, occupational therapy, social support, medication reviews, motivational interviewing, psychological interventions, and nutritional support. (4) Were empirical studies including randomised controlled trials (RCTs), cohort studies, quasi-experimental studies or feasibility studies. Reviews, guidelines, commentaries and conference abstracts were excluded as they lack adequate

details related to intervention delivery methods. Studies published in languages other than English were excluded, due to resource limitations in conducting translation.

Study selection and data extraction

Results from the search were imported to an Endnote desktop reference manager where citations were collated and de-duplicated. The citations were then transferred into a spreadsheet for eligibility screening and charting of information. Two researchers (RTK and SC) independently reviewed all retrieved studies. Eligibility was determined by a two-stage process consisting of a title and abstract review, and then a full-text review if a home-based intervention was mentioned in the abstract and with no obvious exclusion criteria. If there was inadequate information in the abstract to determine if the intervention was home-based, the article was still included for full text review as long as no other exclusion criteria were met. Any ambiguities regarding the eligibility of an article were flagged and discussed together by both reviewers (RTK and SC). Discrepancies were resolved by the 3rd reviewer (SK). Articles for full text review were assessed independently (RTK and SC) and included in the final analysis if they met our study inclusion criteria and none of the exclusion criteria. Relevant information was extracted from included papers using an extraction table. We extracted study characteristics (e.g. study design, year of study, country of study, duration of study, type of intervention, outcome methods), and intervention details for home-based delivery.

Quality Appraisal

Although not imperative,[31] quality appraisal is recommended in scoping reviews.[32] In this scoping review we independently assessed the risk of bias issues among the included studies using the modified version of the Cochrane risk bias instrument.[33] Risk of bias

assessment included selection bias (random sequence generation; allocation concealment), performance bias (blinding of study participants and personnel), detection bias (blinding of outcome assessors), attrition bias (incomplete outcome data (≥20% missing data will be considered at high risk of bias)) and reporting bias (selective reporting). A validated method was used to assess the responses: 'definitely yes' or 'probably yes' (considered as low risk of bias), or 'definitely no' or 'probably no' (considered as high risk of bias). Any discrepancy in the assessment of risk of bias was resolved by discussion with the third reviewer if needed.

RESULTS

Literature search

The literature search results are presented in Figure 1. The database search identified 4950 articles. Six further records were identified through a reference search. After deduplication, there were 4772 records. Most of the studies did not pass the abstract review due to traumatic and inflammatory musculoskeletal pain being the primary focus of the study, not meeting the age criteria or non-interventional studies. Our search found 77 study protocols, and none meeting our inclusion criteria had results published at time of review. After title and abstract review, 18 records remained for full text analysis. Eleven records were excluded at this stage, mainly due to not meeting age criteria and non-home-based intervention in study. Following full text review, 7 studies were included in this review.[34-40]

Quality Appraisal

A summary of the results of the risk of bias assessment is presented in Supplementary Table 1. Only 1 study[40] was found to be of low risk for all assessed bias. One study[34],

being a single group study design, had the highest risk of bias. Most of the included studies showed low selection bias. The dropout rate of the study participants in the included studies were generally low and therefore attrition bias was considered at low risk. In 6 studies[34-39] blinding of participants and/or personnel were not possible which led to high risk of performance bias. Similarly, for 6 studies[34-39] the outcome assessment was performed by the same personnel who delivered the intervention leading to high risk of detection bias.

Characteristics of included studies

Details of the seven studies included in the final analysis are presented in Table 1. All included studies were published in the last 18 years, between 2003 – 2018. The majority of the studies were conducted in the United States of America (n=4), with one study each in China, Malaysia and Sweden. Six of the seven studies used a randomised controlled trial design, while one study employed a mixed method single group pre - post study design.[34] The focus was generally on a single site of chronic musculoskeletal pain, including knee pain (n=2), low back pain (n=2) and hand pain (n =1), but two studies did not require a specific location of musculoskeletal pain.[36, 39] The sample size in the studies were relatively small, ranging between 22 – 76 participants. All studies had a majority of female participants, with one study restricted to female participants only.[39] The average age of participants in the intervention group in 6 out of 7 studies was above 75 years. One study[37] had participants of average age 74.1 years in the intervention group and 75.6 years in the control group. This study was included since the 'waiting-list' control group eventually received the intervention. Four studies did not provide data on ethnicity of participants. Two studies had a majority of white participants[37, 38] and one study had a

majority of Chinese participants.[40] In terms of cognitive impairment in participants, four studies excluded participants with a history of cognitive impairment and three reported a baseline Mini-Mental State Examination (MMSE) score. Four studies did not explicitly include cognition in their exclusion criteria (McCaffery 2003, Rogers 2009, Lee 2016, Mat 2018). Three studies restricted participation based on written and spoken language of study patients to English[37, 38] and Swedish.[39] Pain was assessed as an outcome measure for all studies, with physical function and disability assessed in six of seven studies. Physical assessment of function was assessed in five studies.

Description of intervention

Detailed descriptions of the home-based interventions for the included studies are shown in Table 2. The type of home-based interventions in the included studies were, physical therapy (n=2), psychotherapy (n=3) and multimodal (multimodal therapies combine different therapies including medical treatment, physiotherapy, behavioural therapy as well as health related education) (n=2). The interventions were led by trained medical professionals, physical therapists, meditation practitioners or nurses. The intervention session frequency was 6 to 7 days/week in 5 studies. The multimodal studies had lower intervention session frequency with only 3 and 5 days/week. The duration of each session ranged between 10 - 50 mins. Three of the seven studies were completely home-based and did not include any sessions outside the home. For three studies, weekly group meetings were scheduled in addition to the home-based sessions, whilst one study (Mat 2018) used monthly visits to the physiotherapist to assess outcome, followed by personalised prescription of a selection of exercises to the appropriate level of difficulty. All studies provided take home material for participants, which included printed notes,

tapes, and exercise equipment e.g., resistance bands and ankle weights and Nintendo DS Brain game. All studies used participant diaries to track adherence, during the intervention period.

Study outcomes

The outcome of adherence assessment of individual studies is reported in Table 3. The primary outcome of included studies that reported the numerical average values of the outcome at baseline and at follow-up are reported in Table 4. Three studies personalised the intervention based on participants' needs. Physical therapy and multimodal studies reported improvement in function assessed via physical assessment. However, no significant difference in pain and function was reported compared to the control group based on patient reported outcome measures (PROMs). None of the included studies reported any adverse effects of the interventions on the participants.

DISCUSSION

In this review we aimed to describe the available information on home-based management of non-inflammatory musculoskeletal pain in the older population. Our study included multiple electronic databases to perform a comprehensive literature search. Although 4722 studies were retrieved through the search, only 7 were included for final analysis, mainly due to the low mean age of participants (age <75 years) and absence of intervention for chronic non-inflammatory musculoskeletal pain. Overall, we found that home-based interventions are well tolerated by the older population and have a positive impact on pain reduction and improvement in physical function.

The health benefits of physical activity in the older population is well documented.[41] Good adherence to exercise programmes, and performance of exercises at near maximum capacity is important to induce positive physiological changes.[42] The two physical therapy intervention studies in this review meet the recommended exercise guidelines by the American College of Sports Medicine (ACSM) as well as Physical Activity guidelines in the UK, for adults over the age of 65 years with chronic conditions such as osteoarthritis. The guidelines recommend older people to perform 30 min/day of moderate-intensity aerobic exercise on at least five days/week for a total of ≥150 min/week, or 20 min of vigorous aerobic exercise on at least 3 days/week for a total of ≥75 min/week.[42, 43] The physical activity studies that recommended daily exercises, tailored the exercises to the maximum capacity of the participants and included planned progression. The outcome of physical assessment of function in these studies showed significant improvement post intervention in participants, when compared to controls. We noted that Lee et al[34] study did not have a control group for comparison while Roger et al[35] study had high dropout rate.

There is growing evidence of effectiveness of multimodal therapy for chronic musculoskeletal pain as physical, psychosocial and behavioural factors contribute towards the development of a chronic pain.[44] Multimodal therapy aims at targeting all of these factors with a well-rounded holistic approach.[45] However, there is a lack of consensus on the types of therapeutic interventions, method of assessment, duration and frequency of sessions and length of intervention.[46] The multimodal interventions in Mat et al study[40] included physical therapy, medical review and pharmacologic optimisation for fallers with knee osteoarthritis. The study showed improvement in pain and function, post

intervention, but these results were not statistically significant. Physical assessment reported significant reduction in postural sway and limits of stability which were the primary outcome of the study. The multimodal interventions in Cederbom et al[39] included a home-based exercise programme and behavioural interventions. Exercise dose was personalised for the participants based on the SMART (Specific, Measurable, Attainable, Realistic, and Time-bound) goal setting method.[47] There was no significant difference in pain-related disability or morale between control and intervention groups at the end of the 12 weeks follow up. However, there was a trend towards increased exercise adherence and exercise efficacy in the intervention group. Follow-up qualitative study assessing the perceptions of participants in the Cederbom et al study reported a positive and meaningful experience of the exercise programme including a behavioural approach.[48] This is in line with previous research suggesting that the psychosocial component of multimodal interventions can help in reducing health-related negative thoughts and can potentially help improve exercise adherence.[49] The exercise prescription in both multimodal studies did not fulfil the ACSM recommendations e.g. in Mat et al[40] study, participants exercised only 3 days a week for 30 mins, and in the Cederbom et al[39] study, the exercise difficulty was not based on a physical assessment of the participants' exercise capacity, but on the subjective assessment of participants' expectations and needs.

Psychological therapies play an important role in pain management and can improve emotional wellbeing and pain perception.[50] Techniques such as mindfulness, meditation and music therapy have been used for decades to help with chronic pain and anxiety.[51] [52] The most successful intervention in our scoping review was daily music therapy, by McCaffrey et al.[36] Both VAS and pain descriptor subscales were significantly improved in

the intervention group compared to the control group at day 1, 7 and 14 of the study. However, the study only reported the difference in pain at follow-up and baseline pain levels of participants were not reported. Furthermore, the study did not measure physical function in their participants. The two other psychotherapy studies[37, 38] offered a mind-body intervention via daily home meditation. One study used a waiting list control group who did not receive any intervention; however, they were offered to join the mindfulness meditation programme after completion of the study.[37] The SF36-Physical Function subscale outcome reported statistically significant difference between the two groups post intervention.[37] While in another study, the control group received health related education.[38] Both the control and trial groups reported improvement in pain and function scores during the study, but the difference was not statistically significant.[38]

RECOMMENDATIONS

The included studies in this scoping review suggest that home-based interventions are safe and can benefit the older population with chronic musculoskeletal pain. However, the included study sizes were small, and the results do not support an unequivocal prescription of home-based intervention in the older population with chronic musculoskeletal pain. Home-based interventions have become more popular in the last two decades but there is limited data on those aged >75 years. In this scoping review we found only 7 home-based intervention studies, two of them from the same research group testing the same intervention. Another issue is lack of testing of existing home-based interventions on older populations to assess safety, benefits, effectiveness and challenges of the intervention in the over 75 years population with musculoskeletal pain. For example the ESCAPE-pain programme for knee and hip OA,[53, 54] which include

home-based components, has been found to be safe and successful in reducing pain and improving function in patients but these self-management programmes are still not trialled in patients over the age of 75 years. Furthermore, there was a lack of consistent assessment of pain, physical function, physical activity and exercise capacity and therefore an inability to personalise the home-based intervention. In this scoping review we found only one study which used this method to develop a progression plan for participants.[40] It has been found that personalised home-based exercise interventions can improve physical function in older individuals.[43] Lastly, success of home-based interventions depends largely on patient adherence, which in turn relies on psychological and situational factors.[55, 56] A review study on musculoskeletal rehabilitation, in participants aged ≥45 years suggest that incorporating practices like motivational strategies, behavioural graded exercise and booster sessions with the health professional may be associated with increased treatment adherence.[57] Additionally, adherence assessment is also crucial in home-based self-care programs. In this review, only one study reported the number of diaries filled and returned at the end of the study. Due to a lack of a gold standard method for adherence assessment, utilising a combination of both subjective (self-reported) as well as objective (e.g. continuous motion tracking) methods to gain better insight into this issue should be considered.[58]

The studies included in this review were relatively homogeneous with respect to ethnicity which is not reflective of ethnic diversity. This may have implications in applicability of the interventions, e.g., the availability of multi-lingual take-home materials, interpreters for group meetings, goals and expectations of individuals. Strategies to improve the participation of older adults from different ethnic backgrounds in future studies should be

explored. Developing supporting materials in different languages would encourage participation from diverse ethnic groups.[59] It is also important to consider any sensory deficits (such as deafness and vision impairment) at the time of creating educational material with the interventions. Inclusion of both PROMs and physical assessment can help in better estimation of benefits of treatment and clinical significance. When including physical therapy as an intervention it is important to make the participants exercise near their maximal capacity for better health-related outcomes. Inclusion of psychosocial components in the intervention could help improve adherence and encourage positive health related behaviours in participants. Future studies are encouraged to undertake both theory and person-based approaches when developing and testing home-based interventions for older adults.[60, 61] Such an approach will encourage involvement of the target population in the process of intervention development and will help align evidence-based interventions along with their goals and perspectives. Furthermore, the intervention study design should be robust including larger sample size, long-term interventions as well as long term follow up to check for adherence and intervention efficacy.

CLINICAL IMPLICATIONS

Studies suggest that there are no significant differences in outcomes between home-based and clinic-based physiotherapy,[62-64] although whilst both delivery modes can provide equivalent exercise- and self-management-related treatment components, clinic-based care does provide access to additional modalities for pain management.[65] For chronic conditions such as osteoarthritis the importance of self-management has been highlighted, promoting confidence and independence of people to self-manage their own health and minimising dependency on health professionals.[66] The current review

indicates that home-based interventions are well tolerated by the older population and have a positive impact on pain reduction and improvement in physical function.

In this scoping review, exercises were found to be beneficial in reducing pain and stiffness and improving function. However, in the included studies, exercise programs differed in terms of the number of exercises, variety of exercises, dosage and frequency. From a clinical perspective, the optimal dosage of exercise cannot be recommended due to the limited number of included studies. However, the review does suggest that exercise programs including stretching, strengthening and range of motion exercises may produce better results. As mobility is an issue in older adults, use of functional exercises can be beneficial and help promote functional independence.

Based on the findings in this scoping review, there are a number of important considerations for the successful implementation of a home-based intervention. Firstly, the trained health care professional should ensure that instructions are provided in simple, clear language and in multiple formats (spoken, written, pictorial and/or recorded videos) so that the patient can refer to the materials when required and perform the exercises correctly in the long-term without continuous contact with the healthcare provider. For optimal clinical benefit, exercise programs should be tailored according to the patient's physical capacity and general health. To provide an optimal exercise progression plan, physiotherapists should perform physical assessment using both objective and subjective assessment methods, in regular follow-up appointments, to record functional outcome and prescribe changes in exercise dosage accordingly. Furthermore, assessment of, exercise performance at each visit would be beneficial, to determine whether the patient is mastering the exercise movements and providing evidence of adherence to the home-

based exercise protocol. This scoping review found that patient's adherence to home-based interventions declines over time, hence incorporation of behavioural therapy including SMART goal setting, incentives, and coping strategies, may be beneficial to positively encourage patients to self-manage their condition. Finally, training should be considered to support healthcare professionals to provide cognitive behavioural therapy to help their patients stay motivated and continue to exercise regularly in long-term.

LIMITATIONS

One of the limitations of this review is the methodology used. However, the decision to perform a scoping review was made as it allows the investigators to obtain a broad overview of a topic, where there isn't a focused clinical question, in a reasonable time frame compared to systematic reviews or meta-analysis.[31] Another limitation of this review was inclusion of studies only published in English language. In doing so, we could have lost studies published in different languages fulfilling the inclusion criteria. The third limitation of this review was the inclusion of a non-randomised single group pilot study. However, as this study is a scoping review and there is scarcity of publications on the topic, it is valid to include low quality studies to map the available literature on the topic.[67]

CONCLUSION

A variety of home-based health interventions have been trialled in the older population with chronic non-inflammatory musculoskeletal disease. Physical, psychotherapeutic and multimodal interventions are generally well tolerated and acceptable. This scoping review indicates that home-based interventions could be a promising method of delivering care in older populations with chronic musculoskeletal pain. There is overall a scarcity of evidence on home-based interventions in older populations (>75 years) and there is an

urgent need for future research to inform design and implementation for improved rehabilitation interventions. Future studies should consider a more holistic approach to treatment to improve the quality of life of older people with chronic musculoskeletal pain by achieving both physical and psychological benefits.

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ETHICS and DISSEMINATION

Research ethics approval was not required for this scoping review. None of the authors reported any conflicts of interest.

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Figure Legends

Figure 1: Prisma flowchart illustrating the study selection process.

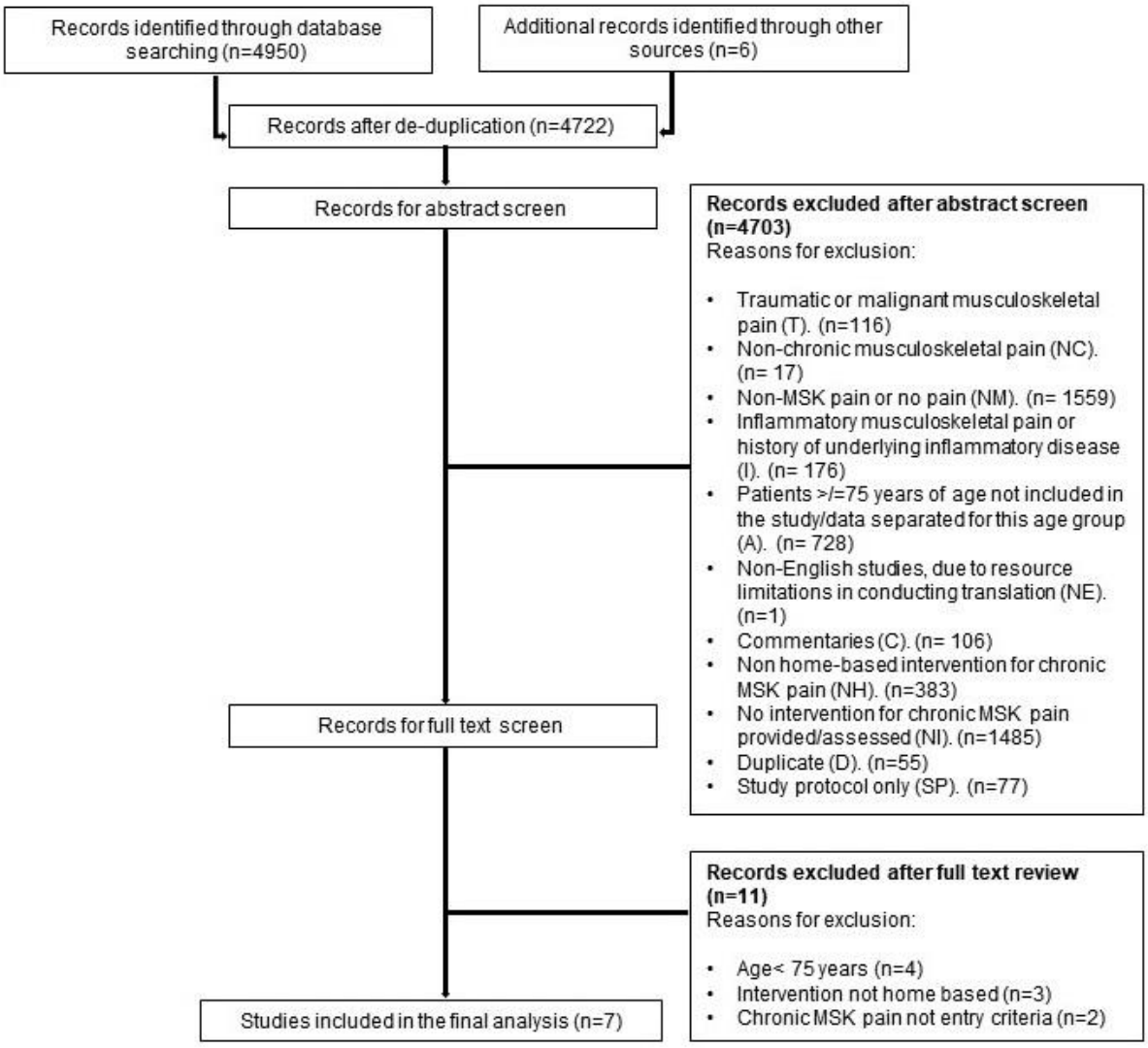

Figure 1: Prisma flowchart illustrating the study selection process

Table 1: Study Characteristics

Study	Country	Study design	Funding body	Average age of participants (years)	Total sample size, (CG), (Female%)	Cognition as inclusion criteria	Type of interventions	MSK chronic pain	Primary outcome	
									Pain	Function
Lee 2016[34]	China	Mixed method single group pilot study	Not mentioned	IG: 75.3	33 (CG:0) (F:84.8%)	No	Physical therapy	Knee OA	Yes	Yes
Rogers 2009[35]	USA	Controlled Crossover	Not mentioned	IG: 75 CG: 74	46 (F:90.9%)	No	Physical therapy	Hand OA	Yes	Yes
McCaffery 2003[36]	USA	RCT	Not mentioned	IG: 76.58 CG: 75.61	66 (CG:33) (F:66.6%)	No	Psychotherapy	OA any site	Yes	No
Morone 2008[37]	USA	RCT	NIH, USA	IG: 74.1 CG: 75.6	39 (CG:18) (F:53.8%)	Yes	Psychotherapy	LBP	Yes	Yes
Morone 2009[38]	USA	RCT	NIH, USA	IG: 78 CG: 73	40 (CG:20) (F:55%)	Yes	Psychotherapy	LBP	Yes	Yes
Cederbom 2014[39]	Sweden	RCT	Ragnhild and Einar Lundström Memorial Foundation	IG: 84.5 CG: 83.8	23 (CG:11) (F:100%)	Yes	Multimodal therapy	MSK pain	Yes	Yes
Mat 2018[40]	Malaysia	RCT	University of Malaya	IG: 76.29 CG: 71.96	50 (CG:28) (F:82%)	No	Multimodal therapy	Knee OA	Yes	Yes

IG: intervention group, CG: control group, RCT: randomised controlled trial, F: female, OA: osteoarthritis, LBP: low back pain, MSK: musculoskeletal

Table 2: Description of study interventions

Study	Intervention arm	Control arm	Study Period (week)	Intervention		Follow up period (week)	Intervention personalised	Mode of contact to promote adherence	Outcomes	
				Home-based	Added visits				PROMs	Physical Assessment
Lee 2016[34]	7 exercises (2 Range of motion, 2 stretching and 3 strengthening) + education related to knee OA	no control group	4	40-50 mins/ day	4 sessions (1 session/ week)	16	No	weekly group meetings	WOMAC, SF-12	RoM, TST
Rogers 2009[35]	9 exercises (3 using resistance band)	sham hand cream	16	10-15 mins/ day	1 session	16, 32 and 48	Four different difficulty resistance bands	monthly phone/ email/ letters	AUSCAN	Grip and pinch strength, hand dexterity
McCaffery 2003[36]	listen to provided music selection with a tempo of 60 and 72 beats/min	sit in a quiet room	2	20 mins/ day	-	2	No	-	SF-MPQ	-

Morone 2008[37]	mindfulness meditation	wait-list	8	50 mins/ 6 days/ week	8 sessions (1 session/ week)	8 and 12	No	weekly group meetings	SF-MPQ, SF-36, RMDQ, MAAS, FFMQ	SPPB (standing balance, gait speed, ability to rise from a chair)
Morone 2009[38]	mindfulness meditation	health education	8	50 mins/ 6 days/ week	8 sessions (1 session/ week)	8 and 24	No	weekly group meetings	SF-MPQ, SF-36, RMDQ	-
Cederbom 2014[39]	Goal behaviour, SMART goal setting + exercise	physical activity advice	12	30 mins/ 5 days/ week	-	12 and 24	Goal setting	weekly phone call	CPGQ	30-sec chair stand test, 2.4 m gait test
Mat 2018[40]	Fall education, home hazards intervention, CVS intervention, visual intervention, medication review, Otago Exercise Program	general health advice, conventional treatment	24	30 mins/ 3 days/ week	3 sessions (1 session/ month for 1st 3 months)	24	Exercise progression	monthly phone call	KOOS	mCTSIB,

WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index; SF: Short form survey; RoM: Range of motion; AUSCAN: AUStralian CANadian Osteoarthritis Hand Index; SF-MPQ: Short form McGill Pain Questionnaire; RMDQ: Roland-Morris Disability *Questionnaire;* SPPB: Short Physical Performance Battery; CPGQ: Chronic Pain Grade *Questionnaire;* KOOS: Knee Injury and Osteoarthritis Outcome Score; mCTSIB: Modified Clinical *Test* of Sensory Interaction in Balance

Table 3: Summary of individual study adherence outcome

Study	Adherence assessment method	Adherence Outcome
Lee 2016[34]	Activity diary as well as participant's performance in return-demonstration of the exercises	– Average exercise frequency 91.04% (SD 14.54) (range 39.4% - 100%) – Majority of participants (n=29) reported >75% adherence – 51.5% (n=17) participants fully adhered to the recommended exercise frequency – All 7 exercises reported high frequency of practice (range 89% - 92%)
Rogers 2009[35]	Activity diary	– High dropout rate in intervention group (n=18) compare to control/ placebo group (n=7) – Intervention group drop out reason related to the study: n=4 participants reported increased hand symptoms n=3 participants lost interest or could not remember to do intervention – Daily home exercise adherence not reported
McCaffery 2003[36]	Activity diary	– Outcome not reported
Morone 2008[37]	Attendance in weekly group session and daily diary	– 68% participants completed the meditation programme (13/19) – Average number of classes attended: 6.7 (5 - 8) – Average number of days/ week meditated: 4.3 (0 - 7) – Average minutes/ day meditated: 31.6 (0 – 52)

Morone 2009[38]	Attendance in weekly group session and daily diary	– 80% participants completed the meditation programme (16/20) – Average number of classes attended: 7.5 (6 - 8) – Average number of days/ week meditated: 5 (1 - 7) – Average minutes/ day meditated: 31 (22– 48)
Cederbom 2014[39]	Activity diary	– All participants in the control and the intervention group reported physical activity at least 5 of 7 days – Participants in intervention group on average reached the recommendation of at least 30 mins of physical activity/ day. – 3 participants had problem filling out the activity diary
Mat 2018[40]	Activity diary	– n=16 diaries returned (72.7 %), all 16 participants reported exercising at least a median of 1 exercise session per week. – 68.8% exercised at least a median of 2 times per week. – 56.3% exercised at least a median of 3 times per week. – 31.3% exercised at least a median of 5 times per week.

Table 4: Individual study assessment outcomes

Study	Assessment	Study group		Control group		Significant difference between groups
		Pre Mean	Post Mean	Pre Mean	Post Mean	
Lee 2016[34]	WOMAC-Pain	35.16	19.97 *	N/A	N/A	-
	WOMAC-Stiffness	26.98	15.22 *	N/A	N/A	-
	WOMAC-Function	35.12	17.55 *	N/A	N/A	-
	WOMAC-total	33.43	18.08 *	N/A	N/A	-
	SF-12 - Physical	30.41	36.36	N/A	N/A	-
	SF-12 - Mental	47.21	54.46 *	N/A	N/A	-
	Knee RoM (◦)	93.27	105.91 *	N/A	N/A	-
	Times-stands test	48.82	41.09 *	N/A	N/A	-
Rogers 2009[35]	AUSCAN-Pain	225	190*	230	190*	No
	AUSCAN-Stiffness	47	38*	47	41*	No
	AUSCAN- Function	476	460	473	433	No
	Max grip strength (Kg) (R)	42.53	44.50*	43.28	43.78	Yes
	Max key pinch strength (Kg) (R)	10.88	11.78*	11.05	11.01	Yes
	Max three-point pinch strength (Kg) (R)	10.04	10.60	9.56	9.85	Yes
	Peg board score (R)	12.88	13.40*	13.18	13.83	No
McCaffery 2003[36]	SF-MPQ	Mean not reported	Mean not reported	Mean not reported	Mean not reported	Yes

Morone 2008[37]	SF-MPQ	15.5	13.7	15.2	15.7	No
	SF-36 Pain	35.5	39.9	35.7	38.8	No
	SF-36 Function	42	45.7 *	45.1	44.5	Yes
	RMDQ	11.5	9.4	11.8	10.6	No
	SPPB	Mean not reported	Mean not reported	Mean not reported	Mean not reported	No
Morone 2009[38]	SF-MPQ, SF-36, and RMDQ	Mean not reported	Mean not reported	Mean not reported	Mean not reported	No
Cederbom 2014[39]	CPGQ Pain	46.1	64.8	50.6	49.7	No
	CPGQ Disability	30.3	43.4	15.9	19.9	No
	30 sec Chair stand test	3.5	2.2	1.6	0	No
	2.4 m Gait test	12.2	17.9	7.5	6.8	No
Mat 2018[40]	KOOS Pain	73.29	80.25	81.18	79.95	No
	KOOS Function	65.07	75.00	79.67	80.44	No
	mCTSIB	1.30	1.00 *	1.20	1.20	Yes

WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index; SF: Short form survey; RoM: Range of motion; AUSCAN: AUStralian CANadian Osteoarthritis Hand Index; SF-MPQ: Short form McGill Pain Questionnaire; RMDQ: Roland-Morris Disability *Questionnaire*; SPPB: Short Physical Performance Battery; CPGQ: Chronic Pain Grade *Questionnaire;* KOOS: Knee Injury and Osteoarthritis Outcome Score; mCTSIB: Modified Clinical *Test* of Sensory Interaction in Balance. * $p<0.05$ pre vs post comparison same group.

Appendix 1

Supplementary Material

Database: Ovid MEDLINE(R)
Search Strategy:

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1 "Aged, 80 and over"/ or Aged/ (2134775)
2 exp Pain/di [Diagnosis] (37778)
3 exp Pain/pa, px, rh [Pathology, Psychology, Rehabilitation] (35046)
4 exp Arthritis/di, pa, rh, th [Diagnosis, Pathology, Rehabilitation, Therapy] (53884)
5 exp Knee Joint/pa [Pathology] (6915)
6 exp Osteoarthritis/cl, di, dh, dt, nu, pa, px, rh, th [Classification, Diagnosis, Diet Therapy, Drug Therapy, Nursing, Pathology, Psychology, Rehabilitation, Therapy] (21858)
7 exp Musculoskeletal Pain/cl, di, dh, dt, pa, px, rh, th [Classification, Diagnosis, Diet Therapy, Drug Therapy, Pathology, Psychology, Rehabilitation, Therapy] (1839)
8 exp Chronic Pain/cl, di, dh, dt, pa, px, rh, th [Classification, Diagnosis, Diet Therapy, Drug Therapy, Pathology, Psychology, Rehabilitation, Therapy] (8862)
9 exp Injections/ (152845)
10 exp Arthroplasty/ (59034)
11 exp Platelet-Rich Plasma/ (3560)
12 exp Arthrodesis/ (23680)
13 2 or 3 or 4 or 5 or 6 or 7 or 8 (134192)
14 9 or 10 or 11 or 12 (236332)
15 1 and 13 (37498)
16 15 not 14 (33651)
17 home.mp. (155091)
18 community.mp. (360834)
19 17 or 18 (492249)
20 16 and 19 (1877)
21 limit 20 to english language (1808)

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Database: Embase Classic+Embase <1947 to 2019 November 04>, Ovid MEDLINE(R) <1946 to October Week 4 2019>
Search Strategy:

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1 "Aged, 80 and over"/ or Aged/ (6047526)
2 exp Pain/di [Diagnosis] (112083)
3 exp Pain/pa, px, rh [Pathology, Psychology, Rehabilitation] (42899)

4 exp Arthritis/di, pa, rh, th [Diagnosis, Pathology, Rehabilitation, Therapy] (147942)
5 exp Knee Joint/pa (8821)
6 exp Osteoarthritis/cl, di, dh, dt, nu, pa, px, rh, th [Classification, Diagnosis, Diet Therapy, Drug Therapy, Nursing, Pathology, Psychology, Rehabilitation, Therapy] (27741)
7 exp Musculoskeletal Pain/cl, di, dh, dt, pa, px, rh, th [Classification, Diagnosis, Diet Therapy, Drug Therapy, Pathology, Psychology, Rehabilitation, Therapy] (1947)
8 exp Chronic Pain/cl, di, dh, dt, pa, px, rh, th [Classification, Diagnosis, Diet Therapy, Drug Therapy, Pathology, Psychology, Rehabilitation, Therapy] (9434)
9 Tendinopathy/di, rh, th [Diagnosis, Rehabilitation, Therapy] (4185)
10 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 (314227)
11 exp Injections/ (529934)
12 exp Arthroplasty/ (137628)
13 exp Platelet-Rich Plasma/ (15841)
14 exp Arthrodesis/ (80499)
15 fracture.mp. (557385)
16 Gout/ or Arthritis, Rheumatoid/ or Arthritis, Psoriatic/ (188311)
17 11 or 12 or 13 or 14 or 15 or 16 (1454517)
18 home.mp. (583699)
19 community.mp. (1140393)
20 home health nursing/ or community mental health services/ or counselling/ or home care services/ or occupational health services/ or health services for the aged/ (332382)
21 18 or 19 or 20 (1825941)
22 1 and 10 and 21 (3488)
23 22 not 17 (3040)
24 limit 23 to english language (2888)
25 limit 24 to yr="1998 -Current" (2557)
26 limit 25 to humans (2557)
27 Middle Aged/ (5845263)
28 26 not 27 (1178)

Supplementary Table 1: Risk of Bias Assessment of Studies included in the Scoping Review

Reference	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete Outcome data
Lee 2016[34]	-	-	-	-	+
Rogers 2009[35]	+	+	-	-	+
McCaffery 2003[36]	+	-	-	-	+
Morone 2008[37]	+	-	-	-	-
Morone 2009[38]	+	+	-	-	+
Cederbom 2014[39]	+	+	-	-	-
Mat 2018[40]	+	+	+	+	+

(+) = low risk of bias, (-) = high risk of bias, (?) = unknown risk of bias

Clinical Implications

1. Home-based rehabilitation for chronic musculoskeletal conditions is safe and effective among older adults.

2. Rehabilitation programs that include stretching, strengthening and range of motion exercises, with progression of exercises, may support better outcomes for patients.

3. Incorporation of behavior change techniques, education and self-management support may help to improve adherence to home-based exercise programs.