International Journal of Osteopathic Medicine 53 (2024) 100725

Contents lists available at ScienceDirect

International Journal of Osteopathic Medicine

journal homepage: www.elsevier.com/locate/ijosm

Primary and secondary prevention of musculoskeletal pain and disability in chiropractic, osteopathy, and physiotherapy: A scoping review

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ARTICLE INFO

Keywords:
Musculoskeletal
Primary Prevention
Secondary Prevention
Chiropractic
Osteopathy
Physiotherapy
Public health

ABSTRACT

Background: Musculoskeletal prevention is a key priority in public health and for national health systems due to the increasing number of people living with persistent conditions, including musculoskeletal (MSK) complaints. There is no robust review of the evidence on COP interventions and MSK prevention, such as what the current state of conceptual debate is about a possible role of COP interventions in prevention, where and how this has been studied, and what the evidence for effectiveness is.

Objectives: A scoping review was conducted to chart and appraise the available evidence regarding primary and secondary prevention in MSK care in the chiropractic, osteopathic and physiotherapy (COP) professions.

Methods: The review was prospectively registered (https://osf.io/bqe5x/). Studies were eligible if they were primary quantitative research on COP interventions for primary and secondary prevention, delivered in clinical settings, and to patients of any age who were asymptomatic or had any MSK pain or disability. Screening, data extraction, and risk of bias assessment were conducted in duplicate by independent reviewers. The data was synthesised narratively.

Results: Twenty-one articles were included in the final synthesis: 17 randomized controlled trials, 3 cross sectional studies, and 1 experimental study. Studies were mostly moderate-quality clinical trials (n = 17) on manual therapy (n = 14) for low back pain (n = 10) that measured prevention by assessing healthcare use (n = 14) or symptom recurrence (n = 11). Heterogeneity of methods, low numbers, and mixed quality did not allow for conclusions about the effectiveness of COP interventions in preventing MSK complaints.

Conclusions: The evidence base is heterogeneous and of moderate quality making clinical recommendations challenging, but future research priorities have been identified, including a need for further research into primary, but mostly in secondary and tertiary prevention in COP; future research in COP should be designed in line with best practices and existing guidelines; and a need for the development and validation of reliable tools to stratify risks and management options.

Implications for practice

- Chiropractic, osteopathy, and physiotherapy (COP) professions may be well-placed to contribute to the prevention of musculoskeletal (MSK) conditions and their impact on patients' lives and on societies.
- This scoping review shows that prevention is infrequently studied in COP, for example by measuring patients' healthcare use or symptom recurrence, and that high-quality research endeavours are sparse.

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https://doi.org/10.1016/j.ijosm.2024.100725
Received 27 December 2023; Received in revised form 12 April 2024; Accepted 11 May 2024
Available online 14 May 2024

- Prioritising the rigorous study of COP interventions in the patient-centred prevention of MSK conditions and burden may be worthwhile and is aligned with a global need.

1. Introduction

Advances in public health interventions have contributed to better health worldwide. Although people live longer, this increases the pressure on health services who, with finite resources, must provide care for an increasing number of patients and an aging population, which is often accompanied by greater levels of multimorbidity [1]. According to a recent UK government report (2019), musculoskeletal (MSK) disorders are the leading cause of years lived with disability in England. In 2023, they affected around 20 million people in the UK (c. 1/3 of the population), the most common MSK conditions included osteoarthritis, back and neck pain [2,3]. These conditions are one of the most common reasons for working days lost in the UK [3]. Direct and indirect costs of MSK ill health were £2.58 billion in 2017 and are estimated to reach £3.43 billion by 2030 [3].

In the UK, MSK conditions account for one million hospital admissions a year (8,3 %) and in 2010 for 14 % (1 of every 7) of GP appointments [4]; which has steadily risen to between 20 and 30 % in recent years [5]. Whilst there is a shortage of GPs in the UK, it has long been suggested [6] that health professions such as Chiropractors, Osteopaths, and Physiotherapists (COP) are well-suited to address some of this burden due to the nature of their training and scope of practice [7].

The National Health Service (NHS) Long Term Plan [8] includes prevention in its 5 strategies, including MSK prevention [9]. Prevention is defined as: *primary* when the onset of disease or injury is avoided; *secondary* when conditions are detected and managed in their early stages to prevent deterioriation, and *tertiary* when the aim is to improve the quality of life for individuals with established health conditions [10–12].

COP professions vary in their nature and delivery [13,14] but their training and practice standards require qualified clinicians to be proficient in assessing and managing MSK conditions, employing similar manual, physical, and psychological interventions for commonly managed MSK conditions such as LBP [15]. Despite disparate educational and regulatory frameworks, there exists a noteworthy overlap in the scope of practice among COP with shared practices and values [15,16]. COP practitioners utilise management approaches which support disease prevention, for example facilitating patient self-management via pain education lifestyle advice, encouraging physical activity and wellbeing [14]. There is also significant overlap regarding conceptual and theoretical models to guide the clinical practice of COP, with the biopsychosocial model being an example of a shared framework between COP disciplines [16]. Recent qualitative research indicates that COP practitioners share some values and aspects of clinical care, whilst also highlighting and valuing professional differences [16].

To our knowledge, there is no robust review of the evidence on COP professions in MSK prevention, such as what the current state of conceptual debate is about a possible role for COP in prevention, where and how this has been studied, and what evidence for effectiveness there is. The main aim of this review was to chart and appraise the available evidence regarding prevention in MSK care in the COP professions. The research questions identified were.

- What is the extent and nature of existing evidence regarding primary and secondary prevention of musculoskeletal pain and disability in COP? What is the quality of the literature on primary and secondary prevention in COP? How is effectiveness of primary and secondary MSK prevention in COP measured?
- Are there any gaps within the evidence base which subsequent research can explore?

2. Methods

2.1. Protocol and registration

The review protocol was prospectively registered on the Open Science Framework website on May 12, 2022 (https://osf.io/bqe5x/), and this scoping review is reported following the Preferred Reporting Items for Systematic Reviews and Meta-analysis Protocols, Scoping Reviews extension (PRISMA-ScR) [17]. This systematic scoping review followed a 5-step framework consisting of identifying the research question; identifying relevant studies; study selection; charting the data; and collating, summarising and reporting the results [18].

2.2. Eligibility criteria

Studies were eligible if they were on COP interventions for primary and secondary prevention, delivered in clinical settings, in patients of any age, who were asymptomatic or had any MSK pain or disability. When the search strings were piloted, tertiary prevention yielded many results that were not labelled as such or could not be easily distinguished from effectiveness trials (e.g., using pain or disability outcomes instead of measuring quality of life outcomes in line with the scope of tertiary prevention [10–12]. Therefore, tertiary prevention was excluded from the review during the protocol development phase. Table 1 describes the full list of eligibility criteria and specifies how the identification of prevention-focused studies was operationalised. Articles had to be primary research, written in English or French.

Table 1
Eligibility criteria.

Inclusion Criteria	Exclusion Criteria
The objective is to find the available literature regarding prevention in musculoskeletal care in the chiropractic, osteopathic and physiotherapy (COP) professions. POPULATION - any age - with or without MSK pain or disability - with or without comorbidities (e.g., scoliosis). Clinical trials, observational studies, longitudinal studies, retrospective studies, prospective studies, case-control studies. CONCEPT COP interventions for prevention: - primary prevention, i.e., maintaining patients' wellbeing (e.g., reporting outcomes regarding diminution of risks of developing pain) - secondary prevention, i.e., preventing future episodes (e.g., reporting outcomes regarding decrease of number of episodes, work absenteeism, or healthcare use). CONTEXT - Interventions delivered in treatment room or at the patient's home but they should have been discussed directly between the patient and practitioner (e.g., online or leaflet campaigns excluded). - English or French publications only. - No geographical limitations.	POPULATION Papers that are not fully published (e.g., poster, conference presentations etc) Studies on animals CONCEPT - Not chiropractic, osteopathy or physiotherapy - Papers looking at tertiary prevention or effectiveness of interventions => e.g., a trial reporting patient having less pain but not looking at prevention, i.e., exclude if not stating explicitly prevention OR not mentioning decrease of "number" of pain episodes (rather than decrease of amount of pain), work absenteeism, or healthcare use. If unsure, include and we'll screen again at next stage. CONTEXT - not French or English - interventions delivered automatically (e.g., leaflet drop, interventions delivered by a website) i.e., not through patient-practitioner interactions

2.3. Information sources and search

The search strategy was developed and piloted by DHS and JDR, experts in systematic and scoping reviews, on MEDLINE (via Ovid) to identify relevant keywords and MeSH terms and was adapted to the other databases. The list of databases searched is MEDLINE, Allied and Complementary Medicine database (AMED), Index to Chiropractic Literature, and the Physio Evidence Database (PEDro) (search strings were registered on searchRxiv [19–22]. The literature search was conducted between April 25, 2022 and May 12, 2022, and was updated on September 04, 2023.

In addition, twenty-seven subject experts in chiropractic, osteopathy and/or physiotherapy were contacted by email in May 2022, inviting them to propose relevant studies in the field of prevention. Finally, the reference lists of all included sources of evidence were screened for additional studies.

2.4. Selection of sources of evidence

All identified citations were uploaded into Endnote (version X8.2) and duplicates removed. They were then uploaded on Covidence (2.0: V2876). Titles and abstracts, and then full texts, were screened independently by two reviewers (drawn from WJ, AS, JS, TD and AMM).

2.5. Data charting process

Data were extracted independently in duplicate (by WJ, AS, JS, TD, OT and AMM), using a data extraction tool developed by the reviewers and piloted on two papers prior to the data extraction phase. Data extracted included: full list of authors, year of publication, article title, conflicts of interests reported, study aims, study design, number of patients per group, symptoms, patient demographics, profession delivering the intervention(s), settings, type of prevention, outcome measures used to assess prevention, and the key findings. Disagreements were resolved by the mediation of a third reviewer.

2.6. Data items

After extracting the data, reviewers categorised the types of intervention and the symptoms that were evaluated. These pre-defined categories were applied independently and in duplicate by two reviewers (TD and JDR), and disagreements were discussed in a meeting to reach consensus. Symptomatic body areas were classified as headaches, low back pain, low back pain and sciatica, neck pain, mixed spinal pain, knee pain, and asymptomatic; symptom duration was classified as acute (<6weeks), subacute (>6 weeks, <12 weeks), persistent (>12 weeks), mixed, recurrent, unclear, and not applicate; interventions were classified as manual therapy, rehabilitation, pharmacotherapy, usual care, primary care, self-management, education, psychologically-informed practice, and other; and prevention outcomes were categorised as symptom recurrence, symptom occurrence, healthcare utilisation and work absenteeism.

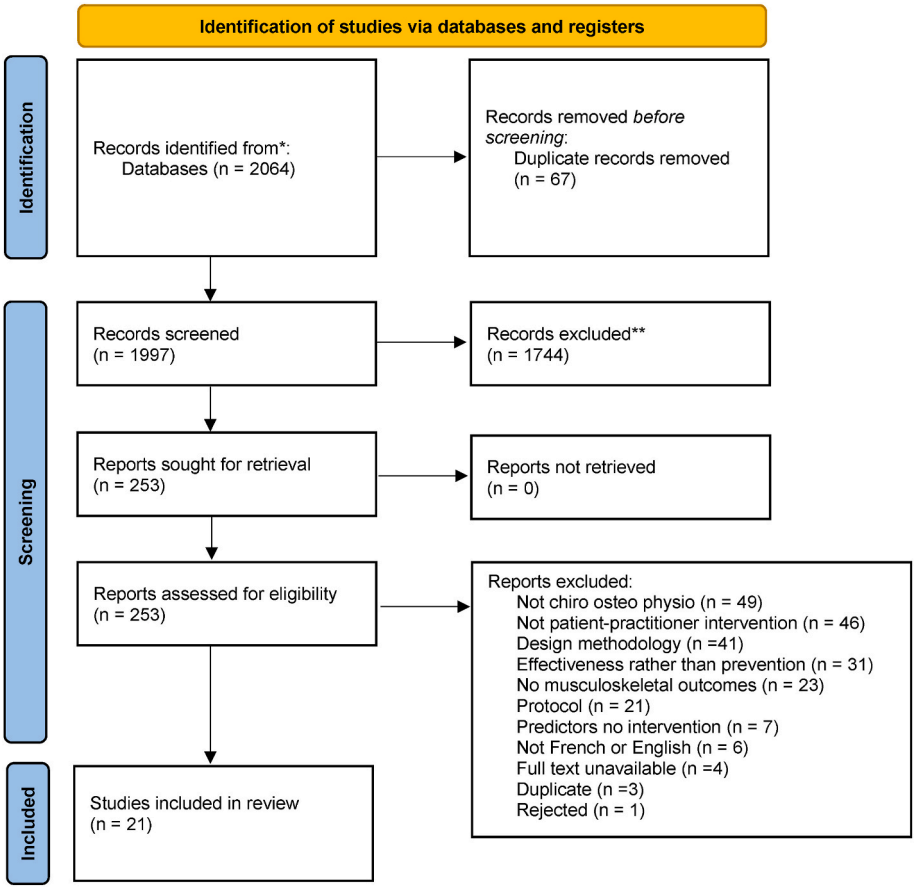

Fig. 1. PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only. *Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers). **If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools. *From:* Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021; 372:n71. https://doi.org/10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/.

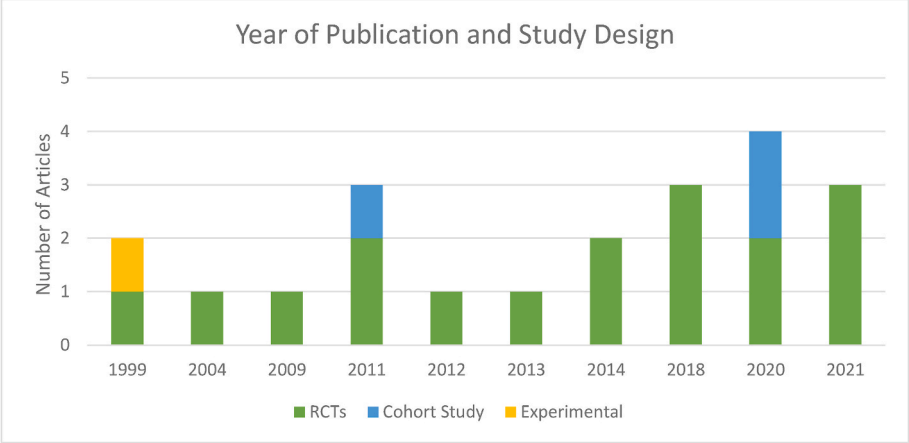

Fig. 2. Study designs of included articles.

Table 2
Risk of bias assessment of randomised clinical trials.

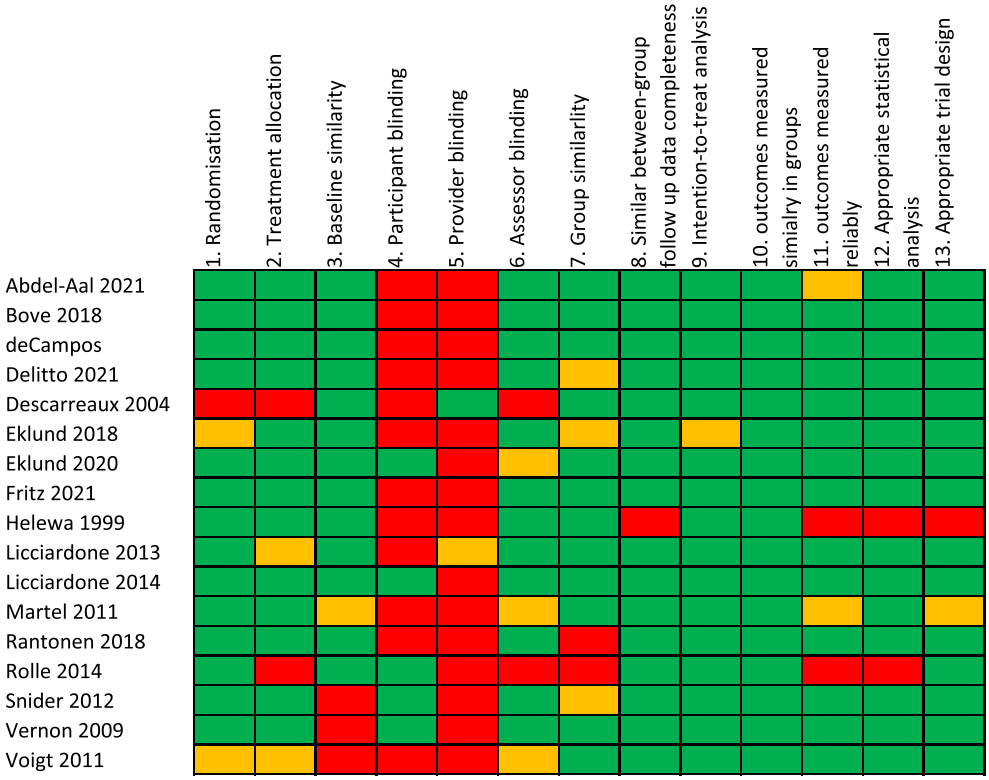

Table 3
Risk of bias assessment of non-randomised experimental clinical trials.

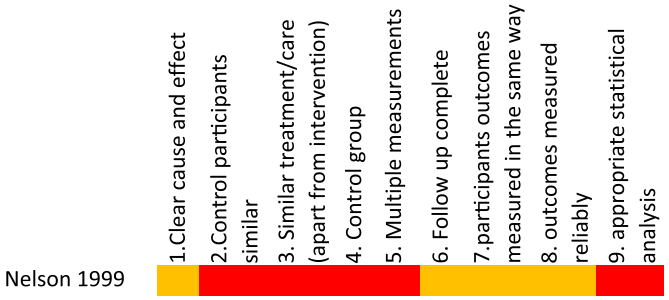

Table 4
Risk of bias assessment of cross-sectional studies.

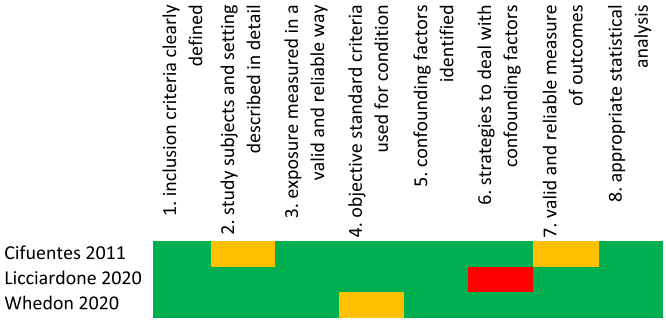

Table 5
Studies characteristics.

Authors	Year	Aims of study	Study design	Number of patients per group	Body area (spinal and axial, HA etc)	Symptom duration as per eligibility criteria (acute <4w, subacute 4-12w, persistent >12w, mixed, unclear)	Patient demographics	Profession	Intervention tested MT Rehab (SM: Self-management) PIP: psychologically-informed practice Pharmacotherapy	Control interventionPIP: MT Rehab (SM: Self-management) PIP: psychologically-informed practice Pharmacotherapy	Setting	Prevention	Categorisation of outcomes: symptom reduction symptom recurrence healthcare utilisation work absenteeism Other (specify)
James M Whedon, DC, MS, Andrew W J Toler, MS, Louis A Kazal, MD, Serena Bezdjian, PhD, Justin M Goehl, DC, MS, Jay Greenstein, DC	2020	The aim of this study was to evaluate data from three New England states for the impact of chiropractic utilisation upon use of prescription opioids among patients with spinal pain	Cohort study	Recipients (Primary care visit + Chiropractor): 34090 Non recipients (primary care visit): 67131	Mixed spinal	Mixed	Range 18–84 enrolled in a health plan (ie registered with MD or DC) and had continuous pharmacy coverage (insurance) and at least two visits associated with spinal pain between 7 and 90 days apart.	Mixed	MT Primary care	Usual care	private clinics	Secondary	healthcare utilisation
Karen Voigt, Jan Liebnitzky, Ute Burmeister, Henna Sihvonen-Riemenschneider, Matthias Beck, Roger Voigt, Antje Bergmann	2011	The present trial sought to investigate HRQoL, pain intensity, and the number of days with migraine as well as working disability as gauges.	Randomised controlled trial	OMT: 21 Control: 21	HA	Persistent	Female patients OMT: age mean: 47.7 Control: age mean 42.4	osteo	MT Primary care	Usual care	Other: Not specified	Secondary	symptom recurrence work absenteeism
HowardVernon, DC, PhD, GwenJansz, PhD, MD, Charles H.Goldsmith, PhD, Cameron McDermaid, DC	2009	Authors used a placebo-controlled factorial randomized controlled trial to investigate the individual and combined effects of chiropractic spinal manipulation and low-dose amitriptyline on headache frequency in patients with a diagnosis of tension type headache with between 10 and 25 days with headache per month.	Randomised controlled trial	4 groups 1) Amitriptyline + Chiro (n = 4) 2) Placebo amitriptyline + Chiro (n = 6) 3) Amitriptyline + sham chiro (n = 5) 4) Placebo amitriptyline + sham chiro (n = 5)	HA	Persistent	General population: amitriptyline + chiropractic: age mean: 29, F:3/M:1 placebo amitriptyline + chiropractic: age mean: 34, F:5/M:1 amitriptyline + sham chiropractic: age mean: 29.4, F:4/M:1 placebo amitriptyline + sham chiropractic: age mean: 43, F:4/M:1	chiro	MT Pharmaco	MT Sham mt Pharmaco Sham pharmaco	private clinics	Secondary	symptom recurrence
Karen T. Snider, Eric J. Snider, Jane C. Johnson, Celia	2012	The purpose of the current pilot study was to investigate the effects of	Randomised controlled trial	OMT (n = 8), LT (n = 6), TAU/ control (n = 7)	NA	NA	Elderly Nursing Home Residents, The mean (standard deviation [SD]) age	osteo	MT	Usual care Sham mt	Other: nursing homes	Primary	healthcare utilisation

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Table 5 (*continued*)

Authors	Year	Aims of study	Study design	Number of patients per group	Body area (spinal and axial, HA etc)	Symptom duration as per eligibility criteria (acute <4w, subacute 4-12w, persistent >12w, mixed, unclear)	Patient demographics	Profession	Intervention tested MT Rehab (SM: Self-management) PIP: psychologically-informed practice Pharmacotherapy	Control interventionPIP: MT Rehab (SM: Self-management) PIP: psychologically-informed practice Pharmacotherapy	Setting	Prevention	Categorisation of outcomes: symptom reduction symptom recurrence healthcare utilisation work absenteeism Other (specify)
Hagan and Conrad Schoenwald		preventative OMT on the health of elderly nursing home residents.					was 87 (7) years, ranging from 74 to 96 years. Of the 21 participants who completed the study, 18 (86 %) were women				Kirksville, Missouri		
Guido Rolle, Lucio Tremolizzo, Francesco Somalvico, Carlo Ferrarese and Livio C. Bressan	2014	OMTh for pain management, HA frequency and pain intensity (not prevention of HA specifically)	Randomised controlled trial	Osteopathy (n = 21); control (sham) (n = 19).	HA	Unclear	General population Osteopathy group mean age: 32.7, Male: 4; Female: 17 Control group mean age: 36.3, Male: 2, Female: 17	osteo	MT	Sham mt	Other: Not declared	Secondary	symptom recurrence healthcare utilisation
J Rantonen, J Karppinen, A Vehtari, S Luoto, E Viikari-Juntura, M Hupli, A Malmivaara, S Taimela	2018	In this study the authors wanted to assess and compare 3 intervention groups against a parrallel group. They were interested to see if the interventions were better to reduce low back pain symptoms, related disability and sickness absence in comparison to natural course of LBP among a cohort of worker from a forestry company experiencing moderate low back pain.	Randomised controlled trial	n = 126 rehab n = 43 progressive back exercises n = 43 Advice n = 40 Control n = 50 (random sample from previous sub-cohort)	LBP	Mixed	Employee from a forestry company Multidisciplinary rehab: mean age: 45, male: 65 % Physio: mean age: 44, male: 72 % Advice: mean age: 45, male 68 % Control: mean age: 46, male 60 %	Physio	Rehab	Rehab SM No treatment		Secondary	work absenteeism work absenteeism
B W Nelson, D M Carpenter, T E Dreisinger, M Mitchell, C E Kelly, J A Wegner	1999	Objective - to determine of patients recommended for spinal surgery can	Experimental study	n = 46	Mixed spinal	Persistent	Subjects candidates to spinal surgery Age mean: 42 years old	physio	Rehab	N/A	private clinics	Secondary	healthcare utilisation

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Authors	Year	Aims of study	Study design	Number of patients per group	Body area (spinal and axial, HA etc)	Symptom duration as per eligibility criteria (acute <4w, subacute 4-12w, persistent >12w, mixed, unclear)	Patient demographics	Profession	Intervention tested MT Rehab (SM: Self-management) PIP: psychologically-informed practice Pharmacotherapy	Control interventionPIP: MT Rehab (SM: Self-management) PIP: psychologically-informed practice Pharmacotherapy	Setting	Prevention	Categorisation of outcomes: symptom reduction symptom recurrence healthcare utilisation work absenteeism Other (specify)
		avoid surgery through an aggressive strengthening programme					28 men (60.9 %) 18 women (39.1 %)						
Johanne Martel, Claude Dugas, Jean-Daniel Dubois, and Martin Descarreaux	2011	The objective of the study is to investigate the efficacy of preventive SMT compared to a no treatment group in NCNP patients. Another objective is to assess the efficacy of SMT with and without a home exercise program.	Randomised controlled trial	3 groups: SMT (Chiro) n = 36 (4 drop out, so 32 received intervention) SMT (Chiro) + exercise n = 33 Control (attention) n = 29 (2 dropped out so 27 received intervention)	Neck	Persistent	General Population SMT: mean age: 36.8, male: 39.4 % SMT + Exx: mean age: 43.3, male 42.4 % Attention-Control: mean age: 43.3, male 20.7 %	chiro	MT	No treatment	educational institutions	Secondary	healthcare utilisation
John C. Licciardone and Robert J. Gatchel	2020	To assess osteopathic medical care and the effectiveness of OMT for chronic low back pain in a real-world setting without the constraints of a rigid research protocol.	Cohort study	DO who used OMT: 79 DO who did not use OMT: 48 Medical Doctor: 318	LBP	Persistent	Patients ranged from 21 to 79 years of age, with a mean (SD) age of 54.0 (12.0) years. There were 308 (69.2 %) female patients. The mean (SD) low backpain intensity reported by patients was 6.1 (2.0) and themean (SD) Roland-Morris Disability score was 14.1(5.9).	Osteo	MT	Usual care	Other: It is unclear -seems like settings will be diverse as the article states patients are 'community-based'	Secondary	healthcare use
John C.Licciardone, Subhash Aryal	2014	To study clinical response to OMT and relapse within the short-term endpoint of 12 weeks.	Randomised controlled trial	Osteopathy Manipulative Treatment: 95 Sham OMT: 91	LBP	Persistent	General population, naive to osteopathy or who had not received regular manual therapy in the last 12 months (no quantitative description given). OMT: Median age: 43, female 62 % (65)	osteo	MT	Sham mt	Other: Dallas-Fort Worth metroplex (not sure what it is, not stated in the article)	Secondary	symptom recurrence

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Table 5 (*continued*)

Authors	Year	Aims of study	Study design	Number of patients per group	Body area (spinal and axial, HA etc)	Symptom duration as per eligibility criteria (acute <4w, subacute 4-12w, persistent >12w, mixed, unclear)	Patient demographics	Profession	Intervention tested MT Rehab (SM: Self-management) PIP: psychologically-informed practice Pharmacotherapy	Control interventionPIP: MT Rehab (SM: Self-management) PIP: psychologically-informed practice Pharmacotherapy	Setting	Prevention	Categorisation of outcomes: symptom reduction symptom recurrence healthcare utilisation work absenteeism Other (specify)
							Sham OMT: Median age: 42, female 53 % (58)						
John C. Licciardone and Subhash Aryal	2013	To measure the treatment effects of OMT in preventing progressive back-specific dysfunction during the third trimester of pregnancy using criteria established by the Cochrane Back Review Group	Randomised controlled trial	(1) UOBC + OMT: 49 (2) UOBC + SUT: 48 (3) UOBC: 49 Key: UOBC = usual obstretric care SUT = sham ultrasound therapy	LBP	Unclear	3rd semester pregnant women. Pregnant women enrolled the study between week 28 and week 30 of pregnancy. OMT + UOBC age mean 23.8 SUT + UOBC age mean 23.7 UOBC age mean 23.8	Osteo	MT Usual care	Ultrasound Usual care	educational institutions	Secondary	symptom recurrence
Helewa, A., Goldsmith, C.H., Lee, P., Smythe, H. A. & Forwell, L.	1999	To determine whether an increase in abdominal muscle strength exercise and back education reduces the rate of LBP among individuals with weak abdominal muscle strentgh (AMS) over 2 years.	Randomised controlled trial	Abdominal exercises and back classes: 203 Back classes: 199	LBP	NA	general population between 23 and 57 years old Experimental group (abdominal strengthening): age mean: 38.3, male: 94 (46.3 %) Control (back education): age mean: 38.4, male: 93 (46.7 %)	physio	Rehab Education	Education	Other: Not stated	Primary	symptom occurrence
Fritz, J.M., Lane, E., McFadden, M., Brennan, G., Magel, J.S., Thackeray, A., Minick, K., Meier, W. and Greene, T.,	2021	Early Referral to physical therapy vs usual care in an unblinded RCT. Aim was reduced disability.	Randomised controlled trial	110 UC were provided 1 session of education. 110 participants randomly assigned to early physical therapy (EPT) were provided 1 education session and then referred for 4 weeks of physical therapy, including exercise and manual therapy	LBP + sciatica	Mixed	adults aged 18 to 60. age UC 37.9 (11.2) EPT 40.0 (11.2) Female UC 59 (53.6) EPT 48 (43.6) Oswestry Disability Index (OSW) score of 20 or more, current symptoms present for 90 days or less, symptoms extending below the knee in the past 72 h, and examination signs consistent with sciatica	physio	MT Rehab Usual care	Usual care	educational institutions; hospitals	Secondary	healthcare utilisation work absenteeism

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Table 5 (*continued*)

Authors	Year	Aims of study	Study design	Number of patients per group	Body area (spinal and axial, HA etc)	Symptom duration as per eligibility criteria (acute <4w, subacute 4-12w, persistent >12w, mixed, unclear)	Patient demographics	Profession	Intervention tested MT Rehab (SM: Self-management) PIP: psychologically-informed practice Pharmacotherapy	Control interventionPIP: MT Rehab (SM: Self-management) PIP: psychologically-informed practice Pharmacotherapy	Setting	Prevention	Categorisation of outcomes: symptom reduction symptom recurrence healthcare utilisation work absenteeism Other (specify)
							(positive result on straight leg raise test or sensory or motor deficit in a pattern consistent with a lumbar nerve root).						
Andreas Eklund, Irene Jensen, Malin Lohela-Karlsson, Jan Hagberg, Charlotte Leboeuf-Yde, Alice Kongsted, Lennart Bodin, Iben Axe	2018	The objectives of the study were to compare maintenance care to symptom-guided care with regard to the total number of days with bothersome LBP over 52 weeks, the prevalence of days with pain per week over time as trajectories, and the total number of treatments.	Randomised controlled trial	maintenance care: 164 (chiropractor-preventative); control: 160 (patient - symptom guided)	LBP	Recurrent	Both groups: mean age 43 years; roughly 60 % female; majority of participants have a light kind of work (not too physical)	chiro	MT	MT	private clinics	Secondary	symptom recurrence healthcare utilisation work asbenteeism
Andreas Eklund, Jan Hagberg, Irene Jensen, Charlotte Leboeuf-Yde, Alice Kongsted, Peter Lövgren, Mattias Jonsson, Jakob Petersen-Klingberg, Christian Calvert, Iben Axén	2020	The overall aim of this project was to explore how MC affects the bothersome (activity-limiting) LBP around treatment periods, new episodes of LBP and pain-free periods between episodes as compared to patients receiving care when experiencing a symptomatic relapse. The specific objectives were to compare the	Other: Secondary analysis of an RCT	Maintenance Care: 161 Control: 158	LBP	Recurrent	General population Maintenance care, age mean: 43.4, Female: 63.5 % (94) Control, age mean: 43.1, Female: 60.3 % (85)	chiro	MT	MT	private clinics	Secondary	symptom recurrence symptom recurrence

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		following for i) all participants in the trial as well as the ii) psychological subgroups defined by the MPI-S instrument: 1.The pain trajectory before and after a single visit or the first visit in every new treatment period. 2.The time to and risk of a new episode following the first recovery period. 3.The length of consecutive pain-free periods and total number of pain-free weeks during the study period.											
Descarreaux, M., Blouin, J.S., Drolet, M., Papadimitriou, S. and Teasdale, N.,	2004	The goal of this study was to explore the common assertion that maintenance spinal manipulation therapy (SMT) can help reduce overall pain and disability levels associated with chronic low-back conditions after an initial phase of intensive chiropractic treatments and to determine the efficacy of	Randomised controlled trial	(N = 30) 15 LBP-1 (Control/usual care) 15 LBP 2 (maintenance)	LBP	Persistent	General population, mean age: 42.1, men:24, women:6	chiro	MT	MT	private clinics	Secondary	healthcare utilisation healthcare use work absenteeism

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Table 5 (*continued*)

Authors	Year	Aims of study	Study design	Number of patients per group	Body area (spinal and axial, HA etc)	Symptom duration as per eligibility criteria (acute <4w, subacute 4-12w, persistent >12w, mixed, unclear)	Patient demographics	Profession	Intervention tested MT Rehab (SM: Self-management) PIP: psychologically-informed practice Pharmacotherapy	Control interventionPIP: MT Rehab (SM: Self-management) PIP: psychologically-informed practice Pharmacotherapy	Setting	Prevention	Categorisation of outcomes: symptom reduction symptom recurrence healthcare utilisation work absenteeism Other (specify)
		maintenance chiropractic SMT.											
Anthony Delitto, Charity G. Patterson, Joel M. Stevans, Janet K. Freburger, Samannaaz S. Khoja, Michael J. Schneider, Carol M. Greco, Jennifer A. Freel, Gwendolyn A. Sowa, Ajay D. Wasan, Gerard P. Brennan, Stephen J. Hunter, Kate I. Minick, Stephen T. Wegener, Patti L. Ephraim, Jason M. Beneciuk, Steven Z. George, Robert B. Sap	2021	To test if implementation of a risk-stratified approach to care would result in lower rates of chronic LBP and improved self-reported disability.	Randomised controlled trial	Usual care + psychologically informed physical therapy (PIPT): 1207 Usual care: 1093	Mixed spinal	acute	General Population, Usual care + PIPT; age mean: 49.3; Female: 721 (60 %) Usual Care; age mean: 50.6; Female 635 (58 %)	physio	Usual care PIP	Usual care	private clinics; educational institutions; hospitals	Secondary	healthcare utilisation
Tarcisio F de Campos, Natasha C Pocovi, Chris G Maher, Helen A Clare, Tatiane M da Silva, Mark J Hancock	2020	To investigate whether a McKenzie-based self-management exercise and educational approach, compared with a minimal-intervention control, prevents recurrences of LBP over 1 year and future care seeking in people who have recently recovered from an episode of non-specific LBP.	Randomised controlled trial	n = 262 randomised, 133 in intervention group (132 analysed at the end); 129 in control group (129 analysed at the end)	LBP	NA	General Population. Mean age 42 years (SD 13) 49 % female median of previous episodes of back pain: 6 (IQR 3 to 15)	physio	SM	Education	private clinics	Secondary	symptom recurrence healthcare utilisation
Manuel Cifuentes, Joanna Willetts,	2011	To study the association between provider type	Cohort study	Chiropractor: Disability Period: 242. Health Care	LBP	Persistent	Cohort consisted of 894 cases with a median age of 41	Mixed (Physio	MT Rehab Primary care	N/A	Other: Not specified	Secondary	symptom recurrence

(*continued on next page*)

Table 5 (*continued*)

Authors	Year	Aims of study	Study design	Number of patients per group	Body area (spinal and axial, HA etc)	Symptom duration as per eligibility criteria (acute <4w, subacute 4-12w, persistent >12w, mixed, unclear)	Patient demographics	Profession	Intervention tested MT Rehab (SM: Self-management) PIP: psychologically-informed practice Pharmacotherapy	Control interventionPIP: MT Rehab (SM: Self-management) PIP: psychologically-informed practice Pharmacotherapy	Setting	Prevention	Categorisation of outcomes: symptom reduction symptom recurrence healthcare utilisation work absenteeism Other (specify)
and Radoslaw Wasiak		during the initial period of return to work and risk of recurrence of disability due to work-related LBP.		Maintenance: 184 Physical Therapist: Disability Period: 428. Health Care Maintenance: 213			years (interquartile range [IQR] = 33 to 49), among whom 32 % were women. Jobs were transportation and material moving (29.1 %), production (12.8 %), office and administrative support (9.6 %), and building and ground cleaning (6.0 %). New York(27.0 %), Texas (20.4 %), and Illinois (18.1 %) were the states with the largest contribution to the sample	and Chiro)					
Allyn M Bove, Kenneth J Smith, Christopher G Bise, Julie M Fritz, John D Childs, Gerard P Brennan, J Haxby Abbott, G Kelley Fitzgerald	2018	To compare the relative cost-effectiveness of 4 different physical therapy strategies for individuals with knee OA over a 2-year period. The economic evaluation was conducted alongside an RCT investigating the clinical effectiveness of the 4 physical therapy strategies. Data were collected from 300 RCT participants who were 40 years old or older and who met American College of Rheumatology	Randomised controlled trial	Exercise (Ex) (n = 75) Exercise + Booster EX + B (n = 76). Exercise + Manual Therapy EX + MT(n = 75), Ex + MT + B (n = 74)	Knee	Persistent	General population aged over 40 Age mean and gender per group Exx: 58.3, M: 23, W: 52 Exx + B: 58.4, M: 25, F: 51 Exx + MT: 58, M: 26, F: 49 Exx + MT + B: 58.5, M 27, F: 47	physio	Rehab	Rehab MT	private clinics	Secondary	healthcare use

(*continued on next page*)

Table 5 (*continued*)

Authors	Year	Aims of study	Study design	Number of patients per group	Body area (spinal and axial, HA etc)	Symptom duration as per eligibility criteria (acute <4w, subacute 4-12w, persistent >12w, mixed, unclear)	Patient demographics	Profession	Intervention tested MT Rehab (SM: Self-management) PIP: psychologically-informed practice Pharmacotherapy	Control interventionPIP: MT Rehab (SM: Self-management) PIP: psychologically-informed practice Pharmacotherapy	Setting	Prevention	Categorisation of outcomes: symptom reduction symptom recurrence healthcare utilisation work absenteeism Other (specify)
		criteria for knee OA. Participants were randomized into 4 physical therapy treatment groups: exercise only (EX), exercise plus booster sessions (EX + B), exercise plus manual therapy (EX + MT), and exercise plus manual therapy and booster sessions (EX + MT + B). All groups received similar exercise interventions focusing on strength and flexibility of hip and knee musculature. The manual therapy groups additionally received stretching and nonthrust knee joint mobilizations											

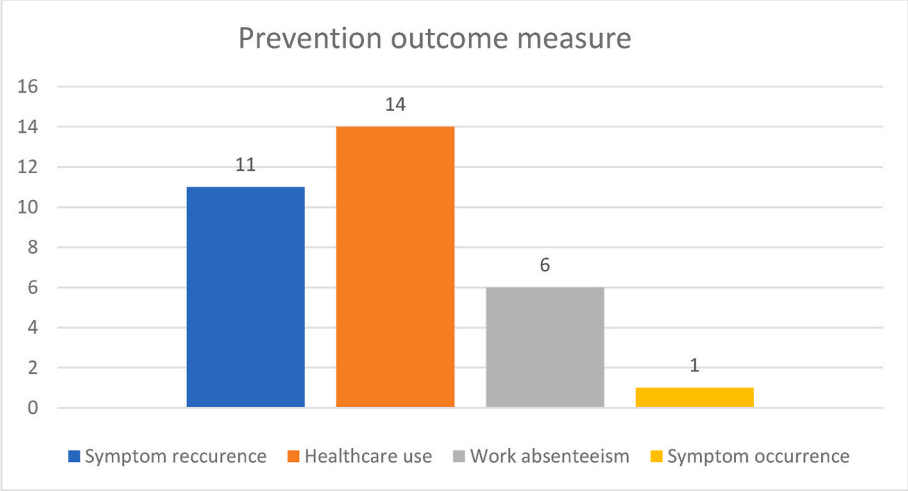

Fig. 3. Prevention outcome measures used in included articles.

2.7. Critical appraisal of individual sources of evidence

Risk of bias assessment was conducted independently in duplicate on all included papers (by; WJ, AS, JS, TD, OT and AMM), using the suitable Joanna Briggs checklists for each individual study design [23].

2.8. Synthesis of results

The content of eligible studies was presented in tables for study characteristics, results, and risk of bias. Data were synthesised and reported in a narrative fashion. The final synthesis was agreed by all members of the research team.

3. Results

3.1. Screening process

The article selection process is shown in the PRISMA-ScR flow chart (Fig. 1). A total of 2064 articles were identified in the database search. Sixty-seven duplicates were removed, 1997 titles and abstracts were screened, and 253 full articles (see supplementary material 1 for the list of articles excluded during full text screening). Twenty-one articles were included in the final synthesis [24–44]. Among these, 17 were randomized controlled trials (RCTs), 3 cross sectional studies, and 1 cohort (self-identified as experimental) study (Fig. 2). Included studies were published between 1999 and up to 2021, with most articles being published after 2010.

3.2. ROB assessment

The overall quality of the included papers was mixed. In RCTs, the main source of potential bias was the absence of participant and provider blinding. In general, the RCTs and cohort studies had a medium ROB. The experimental study was of poor methodological quality (see tables 2, 3 and 4).

3.3. Interventions and symptoms

Secondary prevention was tested in 19 studies: spinal pain (15 out of 21) and headaches (4 out of 21) were the most evaluated symptoms. Primary prevention was assessed in one study, with asymptomatic population. The interventions tested included manual therapy (n = 14), rehabilitation (n = 7), Usual care/Primary care (n = 6), self-management (n = 1), pharmacology (n = 1), education (n = 1), psychologically informed practice (n = 1), instrument-based soft tissue technique (n = 1). Table 5 summarises the types of interventions and symptoms evaluated. A full description of the interventions and symptoms can be found as Supplementary Material.

3.4. Prevention outcome measures

Four types of outcome measures were used that were deemed relevant for demonstrating prevention (Fig. 3): healthcare use (n = 14), symptom recurrence (n = 11), work absenteeism (n = 6), and symptom occurrence (n = 1). Healthcare use included medication intake or visits to another healthcare provider. Symptom recurrence was commonly used to measure secondary prevention and included the number of days with an episode of pain or disability. Work absenteeism was defined as sickness-related absence from work per time period. Symptom occurrence described the appearance of a first episode of low back pain in an originally asymptomatic population, and was evaluated in only one article. A detailed description of prevention outcome measures is found in as supplementary material, and studies results are summarised in Table 6.

4. Discussion

This scoping review aimed to chart and critically appraise the available evidence regarding prevention in MSK care in the chiropractic, osteopathic and physiotherapy (COP) professions.; and to identify gaps within the evidence. Only 21 studies retrieved; they included a total of 107,546 participants, with a median (IQR) of 203 (278). They were mostly moderate-quality clinical trials (n = 17) on manual therapy (n = 14) for low back pain (n = 10) that measured prevention by looking at healthcare use (n = 14) and symptom recurrence (n = 11). The results regarding the preventative effects of COP interventions were mixed, and possibly confounded by the heterogeneity of study methods, and small samples in some studies. Work absenteeism was found not to be influenced by COP preventative interventions in any trial.

Considering current and future healthcare challenges, prevention must become a pan-professional priority, which it currently is not: Only 21 primary research studies were found in COP, searching four databases from inception. People are living longer, and with more persistent conditions and multiple morbidities. The rates of multimorbidity and complex multimorbidity have almost doubled in the last 15 years [1]; posing serious challenges at both societal and personal levels. This has led health organisations to include prevention as a key strategic objective (e.g., prevention is one of the 13 areas of work in the NHS Long Term Plan in the UK), but the COP professions have not been able to position themselves as key healthcare actors in the management of these

Table 6
Studies results.

#	Mixed Spinal Pain			Prevention Outcome
Delitto et al., 2021	Psychologically Informed Practice + UC	not better	UC alone	healthcare utilisation
Whedon et al., 2020	MT + Primary Care	>	UC alone	healthcare utilisation
Nelson et al., 1999	Rehab	+	(cohort)	healthcare utilisation
	LBP			
Cifuentes et al., 2011	MT	>	Rehab or UC	symptom recurrence
Eklund et al., 2018 + Eklund et al., 2020	MT clinician-induced	>	MT symptom-induced	symptom recurrence
		not better		work absenteeism
		not better		healthcare utilisation
Licciardone & Aryal. 2014	MT	>	Sham MT	symptom recurrence
Licciardone & Gatchel. 2020	MT	>	UC	healthcare utilisation
Licciardone & Aryal. 2013	MT + UC	(>)	US + UC	symptom recurrence
Descarreaux et al., 2004	Long-term MT	not better	Short term MT	healthcare utilisation
				work absenteeism
Rantonen et al., 2018	Rehab	not better	rehab or Self-management or no treatment	work absenteeism
De Campos et al., 2020	Self-management	>	Education	healthcare utilisation
	Self-management	not better	Education	symptom reccurence
	LBP & sciatica			
Fritz et al., 2021	MT + rehab + UC	not better	UC alone	healthcare utilisation
				work absenteeism
	Neck			
Martel et al., 2011	MT	>	No treatment	healthcare utilisation
	Headaches			
Voigt et al., 2011	MT + Primary Care	not better	UC	symptom recurrence
				work absenteeism
Vernon et al., 2009	MT + Pharmacology	>?	MT sham + Pharma or MT Sham and Pharma sham	symptom recurrence
Rolle et al., 2014	MT	>	Sham MT	healthcare utilisation
				symptom reccurence
Abdel-Aal et al., 2021	Rehab + device	>?	Rehab alone	healthcare utilisation
				symptom reccurence
	Knee			
Bove et al., 2018	Booster sessions to rehab alone or MT + rehab	>	Rehab alone or MT + rehab	healthcare utilisation
	Asymptomatic			
Snider et al., 2012	MT or Sham MT	>	UC	healthcare utilisation
Helewa et al., 1999	Rehab + Educ	not better	Education alone	symptom occurrence

conditions. There is more evidence about group interventions rather than one-to-one interventions [45–48] which may seem at odds with the fact that most COP clinicians see patients with musculoskeletal complaints that are recurrent in nature [49]; suggesting that they are likely to be striving for secondary prevention with their patients on a regular basis. There is a direct need for further research into primary, but mostly in secondary and tertiary prevention in COP to ensure that the best care is provided to patients and that the professions can support national health policies for population health. This scoping review identified 15 studies in spinal pain that future research should consider meta-analysis of the data, but the impact of the quality of the studies would need to be considered first to decide whether this would be appropriate.

An implication of the results of this present scoping review is that higher quality research is required to generate more reliable evidence about the possible role of COP in the prevention of MSK pain. While clinical trials of COP interventions face methodological challenges in

both pragmatic [50] and explanatory design features [51,52], guidelines are now available to support researchers in developing and reporting control interventions for non-pharmacological interventions [53] and in designing high-quality pragmatic trials [54]. Especially pragmatic approaches to trial design appear relevant to elucidate prevention-related questions, with their focus on research questions that can directly change clinical practice and healthcare policy, as well as their potential alignment with routine clinical practice in intervention delivery, follow-up duration, and choice of outcome measures. Future prevention research in COP should build on the existing evidence described in this review, with studies designed in line with best practices and existing guidelines.

Understanding which patient groups are likely to benefit from COP management in relation to preventing musculoskeletal pain and disability is lacking. Developing robust ways to identify patient phenotypes has been one area of interests in the musculoskeletal field [55,56]. Development of classification tools that can be replicated for reliability is currently lacking [57,58]. A secondary analysis of one of the included trials [44]suggests that investigating subgroups of patients, e.g., patients with poor prognosis, would be a useful avenue for research, but this requires the development and validation of reliable tools to stratify risks and management options.

4.1. Limitations

To our knowledge, this review is the first one that scoped the evidence for COP in the field of musculoskeletal pain and disability prevention. Best-practice guidance was used for its conduct, for example conducting screening, data extraction and quality assessment in duplicate and independently. The review did not include articles in tertiary prevention as the literature currently does not clearly differentiate tertiary prevention from effectiveness studies. A better labelling of studies in prevention would support future reviews. The search included only studies in French and English, which may have excluded studies published in other languages. Grey literature was not retrieved by our search and protocol registrations were not sought out; therefore, publication bias may have impacted this review with negative trials not being published or retrieved. However, experts were contacted to retrieve any relevant articles which may have been omitted from the systematic search with no additional inclusions suggested. Due to the heterogeneity and quality of included material, unpublished sources may not have significantly altered our findings or recommendations.

5. Conclusion

This was the first review in primary and secondary prevention for chiropractic, osteopathy, and physiotherapy. The evidence base is heterogeneous and of moderate quality making clinical recommendations challenging, but future research priorities have been identified, including a need for further research into primary, but mostly in secondary and tertiary prevention in COP; future research in COP should be designed in line with best practices and existing guidelines; and a need for the development and validation of reliable tools to stratify risks and management options.

Funding Sources

Internal funding was received to pay for the reviewers' time from the Enhanced Research Culture grant received by the University College of Osteopathy from UK Research and Innovation. The funding body had no role in the design of the study and collection, analysis, and interpretation of data and in writing the manuscript.

Ethical approval

Not applicable.

CRediT authorship contribution statement

Jerry Draper-Rodi: Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Tristan Delion:** Writing – original draft, Investigation, Formal analysis, Data curation. **Andrew MacMillan:** Writing – original draft, Investigation, Formal analysis, Data curation. **Alexander I. Storey:** Writing – original draft, Formal analysis, Data curation. **Jonathan Spadaccini:** Writing – original draft, Formal analysis, Data curation. **Wahida Jebi:** Writing – original draft, Formal analysis, Data curation. **Oliver P. Thomson:** Writing – original draft, Formal analysis, Data curation, Conceptualization. **David Hohenschurz-Schmidt:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

Competing interests: JDR receives fees for delivering pain management courses; DHS works at several osteopathic education institutions and has received consultancy fees from Altern Health Ltd., an enterprise developing digital therapeutics for pain management. OT receives fees for delivering courses on low back pain communication and podcasting. At the time of conducting this review Andrew MacMillan was the deputy course leader at an Osteopathic Education Institution, he maintains an unpaid role as a senior research fellow and delivers CPD to allied health professionals The other authors declare that they have no competing interests.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijosm.2024.100725.

References

[1] Head A, Fleming K, Kypridemos C, Schofield P, Pearson-Stuttard J, O'Flaherty M. Inequalities in incident and prevalent multimorbidity in England, 2004–19: a population-based, descriptive study. Lancet Healthy Longev 2021;2(8):e489–97. Aug.
[2] Ferreira ML, de Luca K, Haile LM, Steinmetz JD, Culbreth GT, Cross M, et al. Global, regional, and national burden of low back pain, 1990–2020, its attributable risk factors, and projections to 2050: a systematic analysis of the Global Burden of Disease Study 2021. Lancet Rheumatol 2023;5(6):e316–29. Jun.
[3] Versus Arthritis. The state of musculoskeletal health. Chesterfield; 2023.
[4] Jordan KP, Kadam UT, Hayward R, Porcheret M, Young C, Croft P. Annual consultation prevalence of regional musculoskeletal problems in primary care: an observational study. BMC Musculoskelet Disord 2010;11(1):144. Dec 2.
[5] Keavy R. The prevalence of musculoskeletal presentations in general practice: an epidemiological study. Br J Gen Pract 2020;70(suppl 1):bjgp20X711497. Jun.
[6] Hartvigsen J, Foster NE, Croft PR. We need to rethink front line care for back pain. May 25 BMJ 2011;342(may25 1). d3260–d3260.
[7] First contact practitioners and advanced practitioners in primary care: (Musculoskeletal): a roadmap to practice. 2021.
[8] The NHS long term plan. 2019.
[9] Rashbrook E. Health matters: prevention–A life course approach. 2019.
[10] Kisling LA, Das JM. Prevention strategies. StatPearls Publishing; 2022.
[11] Meyer C, Denis CM, Berquin AD. Secondary prevention of chronic musculoskeletal pain: a systematic review of clinical trials. Ann Phys Rehabil Med 2018;61(5):323–38. Sep.
[12] Baumann LC, Ylinen A. Prevention: primary, secondary, tertiary. In: Encyclopedia of behavioral medicine. Cham: Springer International Publishing; 2020. p. 1738–40.
[13] Stochkendahl MJ, Rezai M, Torres P, Sutton D, Tuchin P, Brown R, et al. The chiropractic workforce: a global review. Chiropr Man Therap 2019;27(1):36. Dec 24.
[14] Ellwood J, Carnes D. An international profile of the practice of osteopaths: a systematic review of surveys. Int J Osteopath Med 2021;40:14–21. Jun.
[15] Toloui-Wallace J, Forbes R, Thomson OP, Costa N. Fluid professional boundaries: ethnographic observations of co-located chiropractors, osteopaths and physiotherapists. BMC Health Serv Res 2024;24(1):344. Mar 15.
[16] Toloui-Wallace J, Forbes R, Thomson OP, Setchell J. When worlds collide: experiences of physiotherapists, chiropractors, and osteopaths working together. Musculoskelet Sci Pract 2022 Aug;60:102564.

[17] Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med 2018;169(7):467–73. Oct 2.
[18] Arksey H, O'Malley L. Scoping studies: towards a methodological framework. Int J Soc Res Methodol 2005;8(1):19–32. Feb.
[19] Draper-Rodi J, Hohenschurz-Schmidt D, MacMillan A, Fawkes C, Thomson O, Storey S, et al. Prevention of musculoskeletal pain and disability in chiropractic, osteopathy, and physiotherapy (AMED). searchRxiv; 2023. Jan 6;2023.
[20] Draper-Rodi J, Hohenschurz-Schmidt D, MacMillan A, Fawkes C, Thomson O, Storey S, et al. Prevention of musculoskeletal pain and disability in chiropractic, osteopathy, and physiotherapy (chiro Index). searchRxiv; 2023. Jan 6;2023.
[21] Draper-Rodi J, Hohenschurz-Schmidt D, MacMillan A, Fawkes C, Thomson O, Storey S, et al. Prevention of musculoskeletal pain and disability in chiropractic, osteopathy, and physiotherapy (Ovid MEDLINE R). searchRxiv; 2023. Jan 6;2023.
[22] Draper-Rodi J, Hohenschurz-Schmidt D, MacMillan A, Fawkes C, Thomson O, Storey S, et al. Prevention of musculoskeletal pain and disability in chiropractic, osteopathy, and physiotherapy (PEDro). searchRxiv; 2023. Jan 6;2023.
[23] Barker TH, Stone JC, Sears K, Klugar M, Leonardi-Bee J, Tufanaru C, et al. Revising the JBI quantitative critical appraisal tools to improve their applicability: an overview of methods and the development process. JBI Evid Synth 2023;21(3):478–93. Mar.
[24] Abdel-Aal NM, Elsayyad MM, Megahed AA. Short-term effect of adding Graston technique to exercise program in treatment of patients with cervicogenic headache: a single-blinded, randomized controlled trial. Eur J Phys Rehabil Med 2021;57(5). Nov.
[25] Bove AM, Smith KJ, Bise CG, Fritz JM, Childs JD, Brennan GP, et al. Exercise, manual therapy, and booster sessions in knee osteoarthritis: cost-effectiveness analysis from a multicenter randomized controlled trial. Phys Ther 2018;98(1):16–27. Jan 1.
[26] Cifuentes M, Willetts J, Wasiak R. Health maintenance care in work-related low back pain and its association with disability recurrence. J Occup Environ Med 2011;53(4):396–404. Apr.
[27] de Campos TF, Pocovi NC, Maher CG, Clare HA, da Silva TM, Hancock MJ. An individualised self-management exercise and education program did not prevent recurrence of low back pain but may reduce care seeking: a randomised trial. J Physiother 2020;66(3):166–73. Jul.
[28] Delitto A, Patterson CG, Stevans JM, Freburger JK, Khoja SS, Schneider MJ, et al. Stratified care to prevent chronic low back pain in high-risk patients: the TARGET trial. A multi-site pragmatic cluster randomized trial. EClinicalMedicine 2021;34:100795. Apr.
[29] Descarreaux M, Blouin JS, Drolet M, Papadimitriou S, Teasdale N. Efficacy of preventive spinal manipulation for chronic low-back pain and related disabilities: a preliminary study. J Manip Physiol Ther 2004;27(8):509–14. Oct.
[30] Eklund A, Jensen I, Lohela-Karlsson M, Hagberg J, Leboeuf-Yde C, Kongsted A, et al. The Nordic Maintenance Care program: effectiveness of chiropractic maintenance care versus symptom-guided treatment for recurrent and persistent low back pain—a pragmatic randomized controlled trial. PLoS One 2018;13(9):e0203029. Sep. 12.
[31] Fritz JM, Lane E, McFadden M, Brennan G, Magel JS, Thackeray A, et al. Physical therapy referral from primary care for acute back pain with sciatica. Ann Intern Med 2021;174(1):8–17. Jan.
[32] Helewa A, Goldsmith C, Lee P, Smythe H, Forwell L. Does strengthening the abdominal muscles prevent low back pain–a randomized controlled trial. J Rheumatol 1999;26(8):1808–15.
[33] Licciardone JC, Aryal S. Prevention of progressive back-specific dysfunction during pregnancy: an assessment of osteopathic manual treatment based on cochrane back review group criteria. J Osteopath Med 2013;113(10):728–36. Oct 1.
[34] Licciardone JC, Aryal S. Clinical response and relapse in patients with chronic low back pain following osteopathic manual treatment: results from the OSTEOPATHIC Trial. Man Ther 2014;19(6):541–8. Dec.
[35] Licciardone JC, Gatchel RJ. Osteopathic medical care with and without osteopathic manipulative treatment in patients with chronic low back pain: a pain registry–based study. J Osteopath Med 2020;120(2):64–73. Feb 1.
[36] Martel J, Dugas C, Dubois JD, Descarreaux M. A randomised controlled trial of preventive spinal manipulation with and without a home exercise program for patients with chronic neck pain. BMC Musculoskelet Disord 2011;12(1):41. Dec 8.
[37] Nelson BW, Carpenter DM, Dreisinger TE, Mitchell M, Kelly CE, Wegner JA. Can spinal surgery be prevented by aggressive strengthening exercises? A prospective study of cervical and lumbar patients. Arch Phys Med Rehabil 1999;80(1):20–5. Jan.
[38] Rantonen J, Karppinen J, Vehtari A, Luoto S, Viikari-Juntura E, Hupli M, et al. Effectiveness of three interventions for secondary prevention of low back pain in the occupational health setting - a randomised controlled trial with a natural course control. BMC Publ Health 2018;18(1):598. Dec 8.
[39] Rolle G, Tremolizzo L, Somalvico F, Ferrarese C, Bressan LC. Pilot trial of osteopathic manipulative therapy for patients with frequent episodic tension-type headache. J Osteopath Med 2014;114(9):678–85. Sep. 1.
[40] Snider KT, Snider EJ, Johnson JC, Hagan C, Schoenwald C. Preventative osteopathic manipulative treatment and the elderly nursing home resident: a pilot study. J Osteopath Med 2012;112(8):489–501.
[41] Vernon H, Jansz G, Goldsmith CH, McDermaid C. A randomized, placebo-controlled clinical trial of chiropractic and medical prophylactic treatment of adults with tension-type headache: results from a stopped trial. J Manip Physiol Ther 2009;32(5):344–51. Jun.
[42] Voigt K, Liebnitzky J, Burmeister U, Sihvonen-Riemenschneider H, Beck M, Voigt R, et al. Efficacy of osteopathic manipulative treatment of female patients with migraine: results of a randomized controlled trial. J Alternative Compl Med 2011;17(3):225–30. Mar.
[43] Whedon JM, Toler AWJ, Kazal LA, Bezdjian S, Goehl JM, Greenstein J. Impact of chiropractic care on use of prescription opioids in patients with spinal pain. Pain Med 2020;21(12):3567–73. Dec 25.
[44] Eklund A, Hagberg J, Jensen I, Leboeuf-Yde C, Kongsted A, Lövgren P, et al. The Nordic maintenance care program: maintenance care reduces the number of days with pain in acute episodes and increases the length of pain free periods for dysfunctional patients with recurrent and persistent low back pain - a secondary analysis of a pragmatic randomized controlled trial. Chiropr Man Therap 2020;28(1):19. Dec 21.
[45] Steffens D, Maher CG, Pereira LSM, Stevens ML, Oliveira VC, Chapple M, et al. Prevention of low back pain: a systematic review and meta-analysis. JAMA Intern Med 2016;176(2):199–208. Feb.
[46] Bell JA, Burnett A. Exercise for the primary, secondary and tertiary prevention of low back pain in the workplace: a systematic review. J Occup Rehabil 2009;19(1):8–24. Mar 14.
[47] de Campos TF, Maher CG, Fuller JT, Steffens D, Attwell S, Hancock MJ. Prevention strategies to reduce future impact of low back pain: a systematic review and meta-analysis. Br J Sports Med 2021;55(9):468–76. May.
[48] Huang R, Ning J, Chuter VH, Taylor JB, Christophe D, Meng Z, et al. Exercise alone and exercise combined with education both prevent episodes of low back pain and related absenteeism: systematic review and network meta-analysis of randomised controlled trials (RCTs) aimed at preventing back pain. Br J Sports Med 2020;54(13):766–70. Jul.
[49] Ferreira G, Hancock M. Recommendations for shaping the future of low back pain prevention research. Br J Sports Med 2021;55(16):886–7. Aug.
[50] Hohenschurz-Schmidt D, Kleykamp BA, Draper-Rodi J, Vollert J, Chan J, Ferguson M, et al. Pragmatic trials of pain therapies: a systematic review of methods. Pain 2022;163(1):21–46. Jan.
[51] Hohenschurz-Schmidt D, Draper-Rodi J, Vase L, Scott W, McGregor A, Soliman N, et al. Blinding and sham control methods in trials of physical, psychological, and self-management interventions for pain (article I): a systematic review and description of methods. Pain 2023;164(3):469–84. Mar.
[52] Hohenschurz-Schmidt D, Draper-Rodi J, Vase L, Scott W, McGregor A, Soliman N, et al. Blinding and sham control methods in trials of physical, psychological, and self-management interventions for pain (article II): a meta-analysis relating methods to trial results. Pain 2023;164(3):509–33. Mar.
[53] Hohenschurz-Schmidt D, Vase L, Scott W, Annoni M, Ajayi OK, Barth J, et al. Recommendations for the development, implementation, and reporting of control interventions in efficacy and mechanistic trials of physical, psychological, and self-management therapies: the CoPPS Statement. BMJ 2023:e072108. May 25.
[54] Hohenschurz-Schmidt DJ, Cherkin D, Rice ASC, Dworkin RH, Turk DC, McDermott MP, et al. Research objectives and general considerations for pragmatic clinical trials of pain treatments: IMMPACT statement. Pain 2023;164(7):1457–72. Jul.
[55] Draper-Rodi J, Vogel S, Bishop A. Identification of prognostic factors and assessment methods on the evaluation of non-specific low back pain in a biopsychosocial environment: a scoping review. Int J Osteopath Med 2018;30:25–34. Dec.
[56] Tousignant-Laflamme Y, Houle C, Cook C, Naye F, LeBlanc A, Décary S. Mastering prognostic tools: an opportunity to enhance personalized care and to optimize clinical outcomes in physical therapy. Phys Ther 2022;102(5). May 5.
[57] Tagliaferri SD, Mitchell UH, Saueressig T, Owen PJ, Miller CT, Belavy DL. Classification approaches for treating low back pain have small effects that are not clinically meaningful: a systematic review with meta-analysis. J Orthop Sports Phys Ther 2022;52(2):67–84. Feb.
[58] Koppenaal T, Pisters MF, Kloek CJ, Arensman RM, Ostelo RW, Veenhof C. The 3-month effectiveness of a stratified blended physiotherapy intervention in patients with nonspecific low back pain: cluster randomized controlled trial. J Med Internet Res 2022;24(2):e31675. Feb 25.