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The effects of Osteopathic treatment on psychosocial factors in people with persistent pain: a systematic review

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Abstract

Persistent pain is considered a complex biopsychosocial phenomenon whose understanding and management is yet to be improved. The last decades have seen a shift in pain management, from the biomedical model to a biopsychosocial model. There is also a significant body of evidence emphasizing the effects of Osteopathy in chronic pain management. Given the relevance of psychosocial factors in aetiology and maintenance of long-term pain, it is essential to investigate whether Osteopathy has an influence on depression, anxiety, fear avoidance or pain catastrophizing. This review will identify and synthesize relevant primary research focused on the effects of osteopathic interventions on psychosocial factors in patients living with different persistent pain conditions. Studies were identified by searching seven databases (Medline complete, CINAHL, Cochrane Library, Psychinfo, Psycharticles, Web of Science and Scopus) between 1980 and 2017. Peer reviewed articles reporting effects of: Osteopathic manual therapy, Osteopathic Manipulation, Mobilization, Spinal manipulation, high velocity and low amplitude manipulation, massage and soft tissue treatment were extracted. A total of 16 RCTs were selected. Two out of five reported significant differences in depression; in regards to anxiety, all the four trials found significant effects; two out of three trials reported a significant reduction in fear avoidance while six out of seven trials found a significant enhancement of health status and three out of four found an increase in quality of life. The findings of this review are encouraging; suggesting that osteopathic treatment may have some effects on anxiety, fear avoidance, quality of life and general health status in populations living with persistent pain.

Keywords: persistent pain; Osteopathy; psychosocial factors; depression; anxiety; avoidance

Implications for practice

This systematic review contributes to the advancement of knowledge in regards to the role of Osteopathy in the management of persistent pain and it is one of the few to explore the effects of osteopathic interventions on psychosocial factors. There are important implications in terms of improving pain management by using a holistic approach, and also there is scope for pairing Osteopathic treatment with psychological interventions in order to enhance the health and wellbeing of people with long-term pain.

INTRODUCTION

Persistent pain[1] is recognised as one of the most pervasive and challenging problems that the medical community is facing nowadays. Persistent pain is regarded more as a complex pathophysiological, diagnostic and therapeutic situation rather than a persistent symptom. [1] Pain can have a highly destructive impact on the psychological and social wellbeing of individuals, who commonly experience high levels of stress and struggle to self-manage. [2] Persistent pain is known to affect the individuals' activity, social interactions and consequently their wellbeing. [3] Furthermore, there is a high rate of comorbidity in the occurrence of persistent pain and mental health. [4] The average percentage of patients living with persistent pain who also display symptoms of anxiety and depression is reported to be between 50% and 75%. [5, 6, 7] There is evidence revealing that the burden of persistent pain and its prevalence are underestimated and in addition, treatment is not always adequate. [8] Given the costs to the individuals and society, new research is needed to address the complex nature of persistent pain and its management.

For more than a century, the biomedical model has been dominant in Western medicine. [9] This approach postulates that pain originates through the physiological mechanisms in the human body. [10] By seeking to explain all disease in biological terms, this model is reductionist. This approach is currently the most commonly used in medical science, determining disease prevention, diagnosis and treatment. [11] Physicians are typically treating disease by identifying a single abnormality in isolation, much like mechanics locate the faulty part of a broken car. [12] While reductionism focuses on a treat-the-symptom process, holism takes into account cultural and existential dimensions and everything that affects

[1] the terms ''persistent pain'' and ''chronic pain'' are often used interchangeably, but the newer term, ''persistent pain,'' is preferred, because it is not associated with the negative attitudes and stereotypes that clinicians and patients often associate with the ''chronic pain'' label. (Weiner and Herr, 2002)

health by focusing on finding and treating the causes, rather than the symptoms. [13] One good example is idiopathic pain, which is under the label of medically unexplained symptoms (MUS). These symptoms or diseases cannot be explained in terms of organic pathology, which contributes to the patients being subject to stigma and marginalization. [14] A holistic approach may be more appropriate in understanding and managing this type of illness.

This is closely related to the Biopsychosocial model proposed by Engel that provides a holistic view of the human being, by defining the different hierarchically organised systems that interdependently constitute an individual. [15] For example, pain is regarded as an interactive psychophysiological phenomenon that cannot be separated into isolated, independent psychosocial and physical components. [16] This model is phenomenological, as it recognizes that the lived experience is filled with meaning and values. Bendelow suggested that the biomedical approach to pain is simplistic and unsophisticated, and it often results in physicians being frustrated due to the intractable nature of pain which then leads to doubting patients' reports of pain and labelling them as 'frequent fliers" or "heart sink" patients. Not only does the biopsychosocial model provide a better account of the underlying dynamics of persistent pain, but it also provides healthcare professionals a set of alternative tools to address not only the biological but also the psychosocial variables associated with this condition. Pain cannot be evaluated without an understanding of the person who perceives it. [17]

Osteopathy has been defined as a patient centred healthcare discipline, based on the principles of interrelatedness between the structure and the function of the body, the innate ability of the body for self-healing and on adopting a whole person approach to health mainly by practicing manual treatment. [18] Osteopathic philosophy and practice is congruent with the biopsychosocial model, by adopting a whole person approach to illness and by

acknowledging that psychological factors may have a profound effect on physiology and homeostasis.[2][19]

Osteopathic care is integrated into patient management in a unique way. The choice of technique, duration and frequency is also tailored for each individual patient and their needs. [20]

The results of a study commissioned by the General Osteopathic Council in 2014 show that the osteopathic patients report positive experiences. They suggest that osteopaths discuss the treatment options thoroughly with them and provide clear information about the costs. Other information regarding treatment risks, what treatment will involve and what an osteopath does is also shown to be highly valued by patients. Osteopathy provides patients a therapeutic option characterized by a low risk-to-benefit ratio and with an increasingly growing evidence base. [21]

There is also a significant body of evidence emphasizing the effects of Osteopathic treatment in managing persistent pain. Licciardone and his colleagues performed a meta-analysis and concluded that OMT (Osteopathic Manipulative Treatment) significantly reduces back pain, compared to placebo. [22] This effect has been shown to persist at three-month follow-up. Furthermore, a randomized controlled trial funded by the Medical Research Council (UK BEAM trial) concluded that the combination programme of spinal manipulation and exercise was more beneficial than either of the treatments alone and when compared with ‘’best care’’[3]. [23] In addition, a health economic analysis conducted alongside this trial concluded that using spinal manipulation in addition to ‘best care’ is cost-effective in GP practices. Similar results were reported by Williams, who undertook a pragmatic trial for patients with neck or back pain in North Wales. [24] They reported that

[2] The concept of ‘’homeostasis’’ is seen as a balanced and effective integration of the physical, chemical and mental components of the body (Stone, 1999)

an Osteopathy primary care clinic improved short-term pain-related outcomes and long-term psychological outcomes. A cost-utility analysis performed for this trial suggested that a primary care Osteopathy clinic added to usual general practice might be cost-effective. [25]

Osteopathy demonstrates good outcomes when compared to other treatments for persistent pain. Chown and his colleagues investigated differences between group exercise, physiotherapy and Osteopathy for patients with back pain in a hospital setting and collected data at baseline, six weeks and twelve months after discharge. [26] There was a smaller dropout rate among the Osteopathy group than in the other groups due to patients' preference for hands-on treatment, a more flexible appointment schedule or past experience with private practice. Furthermore, research by Orrock et al. explored the experiences of people receiving osteopathic healthcare by conducting a quantitative survey of patients with persistent non-specific low back pain followed by qualitative semi-structured interviews. [27] The results indicated that common outcomes of Osteopathy were: a reduction in pain, increased flexibility, and improvements in posture and in the ability to complete daily tasks. The participants commonly engaged in autonomous decision-making, and regarded Osteopathy as being holistic while emphasizing the individualisation of the interventions and the collaborative relationship with the osteopaths, who heard their stories and consulted them in regards to treatment and outcome planning.

Despite the existent evidence, more health economic data is needed to investigate the cost-effectiveness and cost utility of Osteopathy. A systematic review and critical appraisal of the available health economic evidence for Osteopathy only resulted in sixteen studies of which the majority demonstrated a high risk of bias. The authors concluded that published comparative health economic studies of Osteopathy cannot inform policy and practice due

to their inadequate quality and quantity. [28]

This is consistent with the recommendations made by the Bevan Commission in Wales regarding prudent healthcare- a concept denoting the need to identify interventions and initiatives that are cost-effective and promoting healthcare that fits the needs and circumstances of the citizens by making most effective use of available resources. [29] Further health economic analyses are needed to establish the cost-effectiveness and cost-utility of Osteopathy and other holistic modalities employed in chronic pain management. There is a gap in the literature when it comes to comparisons with standard practice or the best-available alternative. [30]

Considerable efforts have been made to establish the role of psychosocial factors [3] in chronic pain. Burton et al. and Pincus et al. emphasized the need for awareness of the psychosocial factors and the way they influence chronic pain outcomes. [31, 32] A psychosocial factor strongly associated with disability and work loss is fear avoidance. [33] The authors suggested that 'fear of pain and what we do about it is more disabling than the pain itself'. Another relevant factor is 'pain catastrophizing', defined as a set of exaggerated and maladaptive cognitive and emotional responses during actual or anticipated painful stimulation. [34] The literature also points to robust associations between pain catastrophizing and an array of pain related outcomes such as: clinical pain severity, pain-related activity interference, disability and depression. [35, 36] There is also evidence linking psychosocial factors with the transition from acute to chronic pain. [37, 38, 39] Psychosocial factors are significantly related to the onset of back pain and they also play a role in the development of persistent pain. [40] Of these, pain-related cognitions, catastrophizing and fear-avoidance yielded the most empirical support. Moreover, psychosocial factors were shown to be more predictive than biomedical

[3] According to World Health Organization (WHO), 'psychosocial factors' are defined as factors determining how individuals ' deal with the demands and challenges of everyday life', maintain a state of wellbeing while interacting with others, their culture and environment' (WHO, 1993)

or biomechanical factors.

One of the most influential models trying to account for the role of psychological factors was adapted from Acceptance and Commitment Therapy and utilised specifically for chronic pain. [41] This model posits that individuals should reduce their attempts to avoid or control pain and instead focus on pursuing their personal goals and engaging in valued activities through acceptance. [42] Research has also shown that pain-related acceptance is associated with higher physical functioning and less emotional distress. [43] Similarly, preliminary findings from the OsteoMap program, an NHS funded initiative conducted at the British School of Osteopathy (BSO) have revealed a significant improvement in psychological flexibility (CI 95%, 4. 48:10.87, p<. 0001) but also in levels of pain, mood and coping (CI 95%, 11.54: 20.53, p<. 0001) in a cohort of patients living with persistent pain. [44] This was as a result of a six weeks intervention based on osteopathic treatment and mindfulness and acceptance-based pain management exercises as outlined in a text book –"ACT made simple". [45]

Aims

There is a plethora of evidence regarding the relevance and impact of psychosocial factors in the experience of persistent pain. It has been agreed that psychosocial factors contribute to the progression and maintenance of persistent pain. [46] There is also research emphasizing positive outcomes of Osteopathy in regards to different chronic pain conditions. Therefore, the aim of this review is to identify and synthesize relevant primary research in regards to the effects of osteopathic treatment on psychosocial factors. The review will focus on addressing a specific question ("What are the effects of Osteopathy on psychosocial factors of chronic pain?"). The evidence in this area is scarce; the number of osteopathic trials reporting psychosocial factors is fairly low. The review consists in an analysis of the relevant research evidence in this area and a systematic appraisal of quality by using Critical Appraisal Skills

Programme (CASP).

METHOD

Inclusion and exclusion criteria

Type of study. Published peer reviewed RCTs and controlled clinical trials.

Type of participants. Adults with chronic pain (including: back pain, lower back pain, neck pain, shoulder pain, chronic headache, pelvic pain, fibromyalgia, arthritis).

Type of intervention. Studies using different modalities within Osteopathic practice: Osteopathic manual therapy (OMT), Osteopathic Manipulation (OM), Mobilization, Manipulation, Spinal manipulation, high velocity and low amplitude manipulation, (HVLA), Myofascial release, Manual Therapy, Massage, Soft tissue treatment.

Type of outcome. Trials reporting psychological outcomes including at least one of the following: depression, anxiety, avoidance, catastrophizing, acceptance and self-efficacy. Generic outcome measures with a psychological component (e.g. generic health status, quality of life) were also accepted.

Language. English.

Article exclusion criteria: reports or studies not published in English, no peer review, studies that are not RCTs or controlled clinical trials, studies that did not include adults, reports of asymptomatic adults, adults with acute pain, reports of pelvic post-partum pain or pain resulting from a different condition (e.g. chronic fatigue syndrome, IBS, Temporomandibular Joint Syndrome, Gout, Cancer etc.), reports of interventions other than Osteopathy, studies that did not report psychological outcomes (or generic outcomes with a psychological subcomponent).

Search strategy for identification of studies

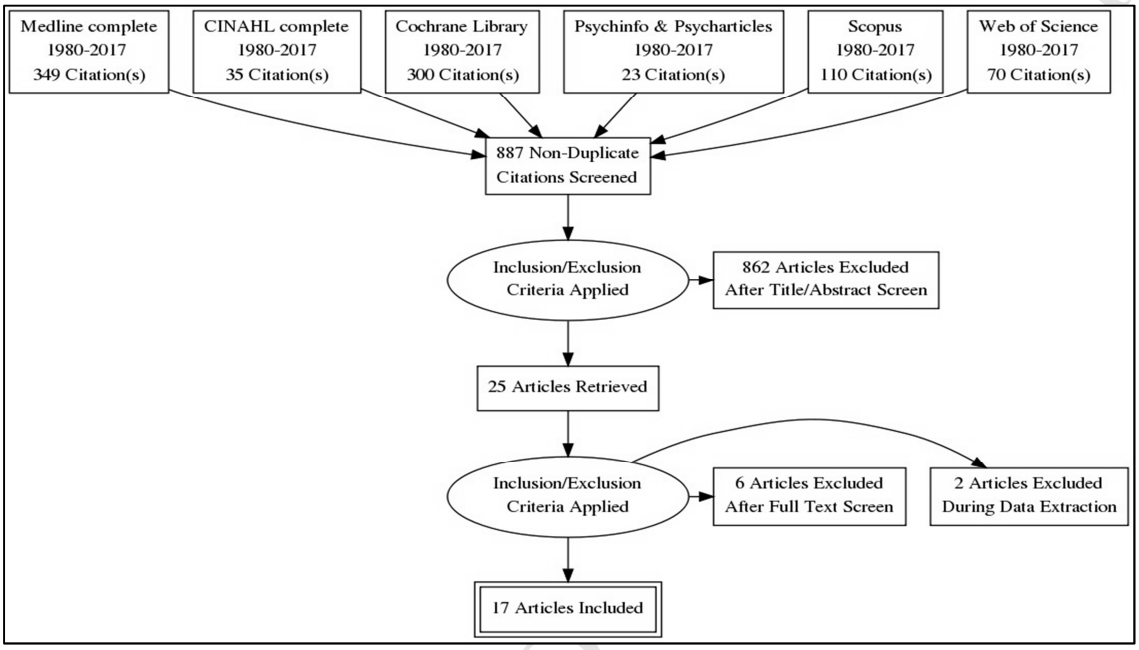
The electronic databases *Medline complete*, *CINAHL complete*, *Cochrane Library*, *Psychinfo*, *Psycharticles*, *Web of Science* and *Scopus* have been searched from 1980 to 2017, using a search strategy that used a combination of keywords (*Table 1).* Reference lists from were also screened, in addition to citation tracking and hand searching of key journals.

Table 1. Search terms and proximity operators[4]

''chronic pain'', ''persistent pain '', ''musculoskeletal pain'', ''nociceptive pain'', ''neuropathic pain'', ''chronic headache'', ''back pain'', ''fibromyalgia'', ''neck pain'', ''pelvic pain'', ''arthritis''
osteopath* n/3 manipulat* or "osteopathic intervention" or 'manipulative treatment" or "OMT" or "Spinal Manipulative Therapy" or "myofascial release" or "HVLA" or "Soft tissue mobilization" or 'muscle energy technique' or 'soft tissue treatment' or 'mobilization' or ''massage'' or ''soft tissue treatment''
'psychosocial factors'', ''psychosocial outcomes'', ''psychosocial health'', ''acceptance'', "catastrophizing, "avoidance", ''depression'', ''anxiety'', ''self-efficacy''

[4] **Proximity operators**
Proximity searching has been employed, to help refine the search. Proximity operators allow searching for two or more words that occur within a specific number of words from each other (e.g. osteopath* *n/3* manipulat*). The databases searched have different proximity operators (Medline, CINAHL, Psychinfo, Psycharticles use n/; Web of Science & Cochrane Reviews employ NEAR/ and Scopus uses w/).

Figure 1. Flow diagram of the selection process (PRISMA diagram adapted from Moher et al., 2009)



Data selection

Identification of studies

The search strategy identified 887 potentially relevant titles and abstracts that were screened for potential inclusion. After removing duplicates, 862 abstracts were reviewed. The inclusion and exclusion criteria were applied. Trials reporting outcomes from samples with pain resulting from other conditions, trials reporting interventions different than Osteopathy, trials of asymptomatic, acute or sub-acute samples and or trials published in a language different than English were excluded. 25 articles were retrieved and, after full text screening 6 were excluded for not fully meeting the inclusion criteria. 17 trials were included in the synthesis. Two of the reviewers have performed the search independently, and after applying

the exclusion and inclusion criteria, they reached an agreement in regards trials to be selected. A third reviewer validated the results.

Study characteristics

The selected studies used samples with: lower back pain (6), neck pain (5), fibromyalgia (2), back pain non-specific (2) and chronic migraine (1). The control groups received one of the following: standard care, placebo (e.g. sham OMT, sham Manual therapy, OMT with sham ultrasound physical therapy), specific manipulation or exercises (e.g. sling Neurac exercise, non-thrust manipulation, sustain appophyseal natural glide), nonspecific exercises or a multimodal programme (consisting of CBT, education – 'The Back book' and exercise). Study characteristics including sample size and type of pain condition, type of intervention and control group, outcome measures employed and results were extracted and presented in *Appendix 1*.

Quality assessment

CASP (Critical Skills Appraisal Programme) for Randomized Controlled Trials was preferred for quality appraisal. This tool is widely used in health research, valid, user-friendly, accessible and appropriate to the topic of this review. CASP was designed to address the trials' validity, results and the relevance to practice. [47] The tool comprised eleven different questions and assessed criteria related to the internal and external validity of the trials (Did the trial address a clearly focused issue? Were patients, health workers and study personnel blinded; was the assignment of patients to treatments randomised?) but also evaluating the results (How large was the treatment effect?) and the applicability and relevance of the studies (Can the results be applied in your context or to the local population?). [48] Scores

ranging from 0- 2 were assigned to each question (e.g. were patients, health workers and study personnel blinded? 0-no blinding, 1-single blinded/ partially blinded, 2-double blinded). The 17 Rates have been ranked according to their total score (ranging from 14- 22) and divided into quartiles (Table).

The first quartile (lower quartile) contains the 25th percentile of the data-in this case the trial with the lowest score. The majority of the Rates in this review (eleven) fell into the second quartile. They all obtained a total score of 15 or 16 and were considered to have a medium quality. The third quartile, also called upper quartile (the 75th percentile of the data) was comprised of the four trials with the highest quality (scored 19, 20 or 22). The reviewers agreed that the trial in the lower quartile (considered to have a low quality due to insufficient randomization, selection bias and a high attrition rate) should be excluded from the final analysis.

Table 2. Quality assessment

Quartiles	CASP ratings	Trial name
First quartile (Lower quartile) Low quality	14	Hough et al.[73]
Second quartile (Median) Medium quality	15-16	Sung et al.[55] Williams et al.[61] Voigt et al.[58] van Dongen et al.[60] UK BEAM trial [23] Chown et al. [26] Cleland et al. [56] Castro-Sanchez et al. [51] Cheung-Lau et al. [57] Gamber et al. [53] Niemistö et al. [59]
Third quartile (Upper quartile) High quality	17-22	Bialowski et al. [54] Licciardone et al. [50] Lopez-Lopez et al. [52] Moustafa and Diab [49]

RESULTS

There were sixteen RCTs selected for full analysis. Psychological and generic health outcomes were extracted and are discussed below.

Depression and Anxiety

Five trials assessed effects on depression. Of these, two found significant differences in depression scores. Moustafa and Diab found significant differences between the experimental and control groups for BDI scores ($p < .0005$) at 1-year follow-up. [49] Licciardone et al. reported a significant interaction between OMT and comorbid depression ($p= .02$) indicating that patients with comorbid depression did not respond favorably to OMT in their study. [50] Three other reports found no significant effects of Osteopathy on depression (Castro-Sanchez et al, Lopez-Lopez et al. and Gamber et al.). [51,52,53] Although the RCT conducted by Gamber and his colleagues did not report significant effects, the authors reported that the two OMT groups were less frequently depressed, had less frequent losses of energy were less often lonely.

In regards to anxiety, four studies reported effects. Bialowski et al. found that state anxiety was significantly associated with changes in pain sensitivity in participants who received spinal Manipulative Therapy ($r= .62$, $p= .04$). Similarly, Castro-Sanchez et al. reported that a 20-week massage-myofascial release program significantly improved anxiety but also quality of sleep and quality of life in patients with fibromyalgia. The experimental group experienced an improvement in regards to anxiety compared to baseline and also against placebo ($p<. 041$). Lopez-Lopez et al. reported that only trait anxiety interacted with manual therapy while Moustafa and Diab revealed a statistically significant change favouring the experimental group in terms of all the outcome variables including anxiety ($F = 2560.6$ $p < .0005$)

Table 3. Trials reporting effects on Depression and Anxiety

Trial name	Depression	Anxiety
Castro-Sanchez et al.	No sig. effect	Sig. increase in trait anxiety (p<. 041) compared to baseline and placebo; Sig. improvement in trait anxiety (p < .043) at 1 month follow-up
Gamber et al.	No sig. main effect	
Lopez-Lopez et al.	No sig. effects	Treatment x time x anxiety interaction F (2, 24) = 6.65, p<. 005, np_2=0.36
Moustafa and Diab	Sig. group × time effect group BDI F = 872.9 (p< .0005)	Sig. group × time effects BAI (F = 2560.6 p < .0005)
Licciardone et al.	OMT × comorbid depression Interaction effects (p=. 02)	
Bialowsky et al.		state anxiety (r=. 62, p=. 04) sig.associated with changes in A fiber–mediated pain sensitivity (SMT group)

Fear avoidance and pain catastrophizing

There were three studies reporting effects on fear avoidance. The UK Beam trial found that the manipulation package alone did not produce significant changes while manipulation followed by exercise produced significant improvements in fear avoidance beliefs both at three and twelve months. Equally, Sung et al. found a significant decrease in fear avoidance in the thoracic manipulation group (Group B). [55] Cleland et al. reported that there were not any significant effects on fear avoidance. [56] In what concerns pain catastrophizing,

Bialowski et al. reported a significant association with pain sensitivity in patients who received Spinal Manual Therapy (r=. 67, p<. 02). The authors suggested that the changes in temporal summation related to SMT were only minimally influenced by psychological factors.

Table 4. Trials reporting effects on fear avoidance and catastrophizing

Trial name	Fear avoidance
Cleland et al.	No differences in fear avoidance
UK BEAM trial	Manipulation followed by exercise at 3 & 12 months Mean=2.40 (1.41 to 3.39) p< .001; Mean= 1.24 (0.07 to 2.41) p< .5
Sung et al.	Sig. change in FABQ only in manipulation group (pre-test 73.6±7.3, post-test 87.9±4.2)
Trial name	**Pain catastrophizing**
Bialowsky et al.	Pain catastrophizing (r = -.67, p = .02) associated with changes in A fiber–mediated pain sensitivity in lower extremity in SMT participants

Health related quality of life and generic health status

There were seven studies reporting changes in health related quality of life. Cheung –Lau et al. found a significant improvement in the Physical component of the SF-36 for the Thoracic Manipulation group compared to control post-intervention and at 6 months follow-up (41.24, 8.40, p = 0.002). [57] Similarly, Castro-Sanchez et al. reported significant improvements post-intervention in several dimensions of the SF-36: physical function (p<0.007), physical role (p<0.039), body pain (p< .043) and social function (p<0.48) compared to baseline. Findings from the UK Beam trial also indicated significant improvements for the participants in the

spinal manipulation package in regards to pain, back beliefs and general physical health. Moreover, they showed improved mental health at three months post intervention and improved disability at 12 months. Voigt et al. investigated the effects of OMT on pain and health related quality of life in patients with migraine and found significant improvements in the intervention group concerning the number of days lost due to migraine but also in physical role functioning, mental health, vitality and body pain. [58]

Improvements have been reported also in the ROMANS trial. At two months post-intervention, the osteopathic treatment group showed greater improvement than the usual care group on SF-12 mental score. After 6 months, the improvements remained significantly greater for the mental health score of the SF-12 for the Osteopathy group.

However, there were studies reporting similar outcomes in both the experimental and control groups. Niemistö et al. found that for patients with chronic lower back pain, both a manipulative treatment program with exercises and a physician's examination with information and advice enhanced health related quality of life and reduced healthcare utilization and costs. [59] Van Dogen et al. also reported that there were no significant differences between groups. [60] Despite that, the healthcare costs were found to be significantly lower in the manual therapy group compared to the physiotherapy group, the maximum probability of manual therapy being cost-effective was found to be low. Last but not least, Licciardone and his colleagues found medium effect sizes for OMT in improving general health, decreasing healthcare utilization and work disability in patients with lower back pain; however, none of these results were statistically significant.

In regards to quality of life, there were four trials reporting effects. Chown et al. found a significant increase in EQ-5D scores for all the groups (exercise, Physiotherapy and Osteopathy) at 6 weeks follow up. However, the authors suggested that attendance was

significantly lower for the group exercise patients and those one-to-one therapies had better patient satisfaction. Similar results were reported in the UK BEAM trial. All three packages (spinal manipulation, exercise classes, or manipulation followed by exercise) increased patients' QALYs when compared to standard care alone. The authors suggested that adding spinal manipulation to 'best care' for back pain is cost-effective and that manipulation alone gives better value for money than the combined package (manipulation followed by exercise). Moreover, Williams et al. reached similar conclusions. The ROMANS trial showed significant improvements in EQ-5D scores of people with spinal pain both at 2 and 6 months. Williams and his colleagues suggested that a primary care osteopathic clinic yielded long-term psychological improvements at little additional cost. The only trial reporting no significant differences was conducted by van Dongen et al. The MTU and PT groups had similar results in what concerns functional status and QALYs.

Table 5. Trials reporting effects on quality of life and health status

Trial name	Quality of life and health status
Castro- Sanchez et al.	Sig. improvements post-intervention SF-36: physical function ($p<0.007$), physical role ($p<0.039$), body pain ($p< .043$) and social function ($p<0.48$) compared to baseline.
Cheung Lau et al.	Int. group – sig. greater improvement in the Physical Component (PCS) of the SF36 (41.24, 8.40, $p = 0.002$) immediately post-intervention and at 6 months follow-up.
Chown et al.	Increase in EQ-5D scores of 0.1 for all groups at 6 weeks follow- up (Osteopathy -0.11 (0.02 to 0.19), $p< .5$)
Niemistö et al.	Both Manipulative treatment and Consultation groups had a sig. improvement in HRQoL ($p< .001$, ANOVA). No differences at 12 months follow up ($p= .93$, ANOVA)
ROMANS trial Williams et al.	Osteopathic group – sig. improvement in SF-12 mental score (95% CI 2.7–10.7) at 2 months, 6 months- improvement in osteopathy group remained sig. >for SF-12 mental score (95% CI 1.0–9.9)
UK BEAM trial	Manipulation –sig. improvement of SF-36 physical score at both 3 and 12 months; Manipulation & exercise sig. effect on fear avoidance at 3 & 12 months Mean=2.40 (1.41 to 3.39) $p< .001$; Mean= 1.24 (0.07 to 2.41) $p< .5$
Van Dogen et al.	No sig. dif. between the MTU and PT group in functional status $\beta= -1.03$; 95 %CI: -2.55–0.48), and QALYs ($\beta = -0.01$; 95 %CI: -0.04–0.03)
Voigt et al.	4 /8 HRQoL domains of SF-36 in the OMT group showed sig. improvement (vitality, $p< .01$; mental health, $p= .05$; bodily pain, $p= .05$ and physical role functioning, $p< .01$)

DISCUSSION

This review aimed to determine whether Osteopathy has an impact on psychosocial factors in populations living with persistent pain. Studies considered within the review have revealed some effects of osteopathic treatment, particularly on anxiety and fear avoidance (patients undergoing osteopathic manipulation showed decreased anxiety and fear avoidance). Additionally, several studies reported significant improvements in health status (six out of seven) and quality of life (three out of four). Despite that, more research needs to be done to further investigate these effects.

The current body of literature looking at the effects of Osteopathy on psychosocial factors associated chronic pain is limited. This review was one of the few to investigate whether osteopathic interventions affect psychosocial factors relevant in chronic pain.

The results of this review are similar to those obtained by Williams et al. who conducted the first systematic review of spinal manipulation to examine psychological outcomes. [61] In this study, twelve studies reporting psychological outcomes were selected, six of which had a verbal comparator. The results showed a small benefit of spinal manipulation over verbal interventions (mean benefit of spinal manipulation equivalent to 0.34% of the population standard deviation [95% confidence interval (CI) 0.23—0.45] at 1—5 months; 0.27 of the SD [95% CI 0.14—0.40] at 6—12 months). They also reported a small benefit of spinal manipulation compared to physical treatment comparators (e.g. exercise programs).

However, it is unclear if these improvements were due to the distinctive characteristics of the compared interventions or due to incidental placebo effects. The authors argued that the psychological effects are due to the characteristics of treatment (reducing distressing symptoms as fear and pain). Our review found similar effects, for example one of the studies reported significant improvements in fear avoidance beliefs as a result of a treatment package consisting of manipulation and exercise (UK BEAM trial).

Significance and implications

First of all, it is essential to acknowledge that psychosocial factors play an important role in the development and maintenance of different chronic pain conditions.[62, 63] More efforts are needed to establish the specific relevance and role of each of these factors in the aetiology and progression of different types of persistent pain. Furthermore, action needs to be taken to modify these factors with the help of psychological interventions. More research is needed in this area, particularly randomized controlled trials that report not only measures of pain and physical functioning but also psychosocial outcome measures.

Secondly, it is imperative to elucidate the underlying mechanisms through which osteopathic manipulation affects psychosocial factors of chronic pain. The dynamics of this process are still to be understood. The effects of Osteopathic treatment might be due to a reduction in fear followed by an improvement in pain beliefs. They might also be attributed to the collaborative nature of the patient-practitioner relationship or to the placebo effect. Further research needs to address this question and establish potential models of change. Process studies are needed to shed light on the effects of the individual components of Osteopathic care on patient outcomes.

Although Osteopathy itself is not a psychosocial intervention, it might be worth combining

Osteopathic treatment with brief psychological packages. Integrating concepts and principles from third wave therapies like Acceptance and Commitment Therapy (ACT) could lead to an increase in the effectiveness osteopathic care, and moderate the impact of comorbidities. This type of pairing might have a strong synergistic effect, compared to standard care alone. In fact there are recommendations to combine different types of treatment (physical, psychological, rehabilitative) in order to match patients' characteristics and individual needs. [64] It is already known that psychological process influence the experience of pain and also the treatment outcomes; therefore there is a chance that integrating psychological approaches into physical therapy could potentially enhance outcomes. [65] In addition, health economic evidence could be valuable in determining the cost-effectiveness of such combined packages.

In the future, osteopaths might benefit from a better awareness of the way in which their intervention influences patients' psychosocial outcomes. Different aspects of care such as the rapport with the patient, providing relevant information and encouraging self-management, showing empathy may all contribute to enhance patient outcomes. Osteopaths are ideally positioned to educate patients in regards to how certain factors as depression, anxiety or fear avoidance contribute to the onset and maintenance of persistent pain. Being aware of psychosocial factors might also signify a better understanding of the pain experience and the context in which chronic pain occurs. Additional training could be made available to provide Osteopaths with an extra set of skills and knowledge that will not only help their professional development but also enable them to support patients with chronic pain more effectively.

Osteopathy is a type of Complimentary therapy. The integration of Complementary and alternative medicine (CAM) and holistic modalities with conventional healthcare has the potential to yield significant health improvements. Osteopathy is increasingly provided in primary care settings; however more research is needed to explore the potential benefits and

cost- effectiveness of this type of provision. The economic burden of chronic pain and the overwhelming impact of pain on individuals' physical, psychological and social wellbeing make research in this domain a priority. Including and reporting this type of evidence is needed in order to inform and facilitate evidence-based decision making among policy makers but also health practitioners and patients. [66]

Limitations

It is important to acknowledge some limitations of this review. First of all, the samples investigated in the selected studies were heterogeneous (patients with different chronic pain conditions such as lower back pain, neck pain, fibromyalgia etc.). Pain is a very complex and subjective experience and there are marked differences in regards to causes and contributing from time to time and then subside, only to come back again subsequently. [67] For example, in fibromyalgia, the pain is widespread and flares are associated with prolonged activity, soft tissue injuries, poor sleep, and exposure to cold and psychological stressors). [68] Patients with chronic migraine experience headache episodes daily or near daily; there is also a tendency for these episodes to increase in frequency over time. [69] As a result, the findings of this review cannot be generalizable across specific types of persistent pain. However, this review is insightful because it emphasizes some particular effects that could potentially be valid across different persistent pain conditions.

In addition, there were a variety of manipulation techniques delivered by different health practitioners. There is often an overlap of techniques with other practitioners like Chiropractors or Physiotherapists, who use manipulative techniques similar to those of Osteopaths. The main difference between Osteopaths and Chiropractors consists in that while Chiropractors tend to focus mainly on the alignment of the spine as the means to relieve pain, Osteopaths look at the body as whole and consider the overall structure. Despite the

differences, it is important to point out that all these practitioners employ manual, hands-on techniques and a similar approach to delivering treatment. [70] The similarities between these approaches might prove useful in undertaking collaborative research (e.g. UK BEAM trial).

Moreover, it is important to mention that the majority of the trials analysed in this review were not blinded (seven out of seventeen). The remaining RCTs were either single-blinded (five) or double-blinded (two). While blinding or 'masking' is the cornerstone of treatment evaluation, it is difficult to obtain in trials assessing non-pharmacological interventions [71] It is very challenging to blind the participants and the treatment provider, it is feasible to blind the researchers involved in data collection and analysis to group allocation or baseline assessments.

Another common limitation in trials of this type consists in high drop out rates. It is known that high attrition may produce bias. The results might not be due to the effects of the intervention but to a loss of participants who were unresponsive or more or less symptomatic than the others. [72] It is also possible that some participants might fear adverse events or have concerns regarding being assigned to a placebo group. One of the trials initially selected for this review was excluded from the final analysis due to high attrition (23.5%) and insufficient randomization. Hough et al. reported that younger, unemployed people with lower back pain who had higher psychosocial risk scores tended to 'drop out' of treatment. [73] They also indicated that there might have been potential selection bias.

Other possible sources of bias of the analyzed trials include: long-term follow-up periods, selection bias (differences in baseline characteristics) and the possibility that the therapist was also the principal investigator (which might have resulted in more favorable responses).

Despite this, all of the sixteen analyzed RCTs had sound randomization (computer generated, block randomization, precoded cards). Furthermore, the majority of the trials obtained a

scored of 15 or more according to the appraisal using CASP (indicating medium to high quality). In order to increase the validity of the results, two authors conducted separate analysis and compared their conclusions, reaching an agreement in regards to the selection of trials and the quality appraisal. A third author validated the results.

Conclusions

The findings of this review are encouraging, suggesting that osteopathic treatment may have some effects on psychological factors such as anxiety and fear avoidance but also on the health status and overall quality of live of people living with persistent pain. Further research is needed to further investigate these effects and to evaluate the effectiveness of integrating psychological principles and interventions into Osteopathic practice. Only then will a fuller understanding of the role of Osteopathy in chronic pain management be achieved.

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Author	Type of pain	Intervention	Duration	Control group	Outcome measures	Results
Bialowski et al., 2009	LBP (N=36) average age=32.3	Spinal manipulative therapy (SMT)	4 manipulations 5min; QST protocol (thermal pain sensitivity)	Nonspecific activity (Stationary bicycle) Specific activity (Lumbar extension exercise)	Fear of Pain Questionnaire (FPQ-III); The Tampa Scale Kinesiophobia (TSK) Coping Strategies Questionnaire (CSQ-R); State-Trait Anxiety Inventory (STAI); Anxiety Sensitivity Index (ASI)	Catastrophizing (r =. 67, p= .02) and state anxiety (r =. 62, p= .04) sig. associated with changes in A fiber–mediated pain sensitivity in lower extremity SMT group
Castro-Sanchez et al., 2011	Fibromyalgia (N=74)	Massage-myofascial Release therapy	90 min session/ Week for 20 weeks	Placebo (sham treatment)	State-Trait Anxiety Inventory (STAI); Beck Depression Inventory (BDI); SF-36	Int. group sig. improvement in trait anxiety (p < .041) vs. baseline and placebo; sig. improvements in physical function, physical role, body pain, social function
Cheung Lau et al., 2010	Neck pain (N=120, 18-55)	Thoracic manipulation (TM) Infrared radiation therapy (IRR) and educational material	8 sessions (twice / week)	Infrared radiation therapy (IRR) and educational material only	SF-36	TM group –sig. improvement in Physical Component Score (PCS) of SF36 (p=. 002) post-intervention and at 6-months follow-up.
Chown et al., 2008	LBP (N=239, 18-65)	Manipulative physiotherapy Osteopathy	5 treatment sessions (30 min. each)	Group exercise with physiotherapist	EQ-5D	Mean EQ-5D scores increased by around 0.1 in all groups (p< .5)
Cleland et al., 2007	Neck pain (N=60, age 18-60)	Thoracic spine thrust mobilization/manipulation	Single session	Nonthrust mobilization/ manipulation	Fear-Avoidance Beliefs Questionnaire (FABQ)	No sig. difference in side effects experienced by subjects in both groups or in FABQ
Gamber et al., 2002	Fibromyalgia (N=24)	G1-Osteopathic Manipulation in addition to current medication; G2-Osteopathic Manipulation, Teaching group & current medication	23 weeks	Current medication alone	Centre for Epidemiological Studies Depression Scale Depression	G1, G2-less bothered, less frequently depressed, less frequent losses of energy, less often restless, less often lonely No sig. main effect on Depression

Hough et al., 2007	Non-specific low back pain (N=39)	Manual therapy	8 treatments over 4 weeks	Active rehabilitation (progressive exercise and education programme)	Linton & Hallden Questionnaire (Psychosocial factors linked to development of chronic non-specific low back pain)	LH score not sig. for any variables (p = 0.699 for RMQ, 0.611 for PRI, p = 0.405 for VAS); None of the interaction effects were sig.
Licciardone et al., 2015	LBP (N=455)	Osteopathic Manipulative treatment (OMT) Ultrasound physical therapy (UPT)	One hour /week 12 weeks	OMT with sham UPT UPT with sham OMT Sham OMT with sham UPT	SF-36	OMT× comorbid depression Interaction effects (*p*=. 02) Patients without depression more likely to recover from chronic LBP with OMT (RR, 3.21; 95% CI, 1.59-6.50; *p*<. 001)
Lopez-Lopez et al., 2015	Neck pain (N=48)	HVLA (high velocity and low amplitude manipulation) Posteroanterior mobilization	Single session	Sustain appophyseal natural glide (SANG)	State Trait Anxiety Inventory (STAI); Beck Depression Inventory (BDI –II) Spanish version; Tampa Scale for Kinesiophobia; Pain Catastrophysing Scale (PCS)	Sig. three-way treatment x anxiety x time interaction, with respect to VAS F (2, 24)=6.65, p=0.005, η_p^2=0.36 ; High anxiety interacts with mobilization and SNAG effects
Moustafa & Diab, 2015	Fibromyalgia (N=120)	Multimodal program (education, exercise & CBT) and upper cervical manipulative Therapy	12-week program plus 12 sessions of cervical manipulative therapy (3/week)	Multimodal program alone	Beck Anxiety Inventory (BAI) Beck Depression Inventory (BDI) Pain Catastrophizing Scale (PCS)	1-year follow-up, sig. differences between the experimental and control groups for all variables (FIQ, PCS, PSQI, BAI, and BDI (*p* < .0005)
Niemistö et al., 2003	LBP (N=204)	Manipulative Treatment with stabilizing Exercises	60-minute evaluation, treatment, 4 exercise sessions and education Booklet	Physician's Consultation and educational booklet	Health-related quality of life (15D)	No sig. differences between the groups in health-related quality of life or in costs
UK BEAM trial, 2004	Back pain (N= 1334)	G1-Spinal manipulation; (Techniques representative of UK chiropractic, osteopathic & physiotherapy) G2-Spinal Manipulation and exercise	8 x 60 minute sessions over 4-8 weeks & "refresher" class in week 12	G3-Best care in General Practice and ''The Back Book''	Fear avoidance beliefs Questionnaire (FABQ) SF-36 (health status) EuroQol (EQ-5D)	Manipulation –sig. improvement of SF-36 physical score at both 3 and 12 months; Manipulation & exercise sig. effect on fear avoidance at 3 & 12 months Mean=2.40 (1.41 to 3.39) p< .001; Mean= 1.24 (0.07 to 2.41) p< .5

Van Dongen et al., 2015	Ns neck pain (N=180)	Manual therapy	6 sessions (30-60 min each)	Physical therapy (standard care, active exercise)	SF-36 EQ-5D	No sig. dif. between the MTU and PT group in functional status β= -1.03; 95 %CI: -2.55–0.48), and QALYs (β = -0.01; 95 %CI: -0.04–0.03)
Voigt et al., 2011	Migraine (N=42, all female)	Osteopathic manipulative treatments (OMT)	5 x50-minute osteopathic manipulative treatments	No OMT/sham/physical therapy Only filled in questionnaires	SF-36	4 /8 HRQoL domains of SF-36 in the OMT group showed sig. improvement (vitality, p< .01; mental health, p= .05; bodily pain, p= .05 and physical role functioning, p< .01)
Williams et al., 2013 (ROMANS)	Neck or back pain (N=201)	GP care and 3 Osteopathic Manipulation sessions	3 or 4 sessions Every week x 1–2 weeks.	GP care alone	SF-12 health status EuroQol (EQ-5D)	Osteopathic group – sig. improvement in SF-12 mental score (95% CI 2.7–10.7) at 2 months, 6 months- improvement in osteopathy group remained sig. >for SF-12 mental score (95% CI 1.0–9.9)
Youn-Bum Sung et al., 2014	LBP (N=36)	Mobilization (trunk mobilization after sling Neurac exercise) Manipulation (trunk Manipulation after sling Neurac exercise)	Single Session	Control group (Sling Neurac exercise)	Fear-avoidance beliefs questionnaire (FABQ)	Sig. change in FABQ only in manipulation group (pre-test 73.6±7.3, post-test 87.9±4.2)

RANDOMISED CONTROLLED TRIAL

		(A) Are the results of the review valid?												(B) What are the results?				(C) Will the results help locally?						
		Question 1		Question 2			Question 3		Question 4		Question 5		Question 6		Question 7		Question 8		Question 9		Question 10		Question 11		
	NAME	Did the trial address a clearly focused issue?		Was the assignment of patients to treatments randomised?		IS WORTH TO CONTINUING?	Were patients, health workers and study personnel blinded?		Were the groups similar at the start of the trial?		Aside from the experimental intervention, were the groups		Were all of the patients who entered the trial properly accounted for at its		How large was the treatment effect?		How precise was the estimate of the treatment effect?		Can the results be applied in your context? (or to the local population?)		Were all clinically important outcomes considered?		Are the benefits worth the harms and costs?		
		Score	Description	Score	Description		Score	Description	Score	Description	Score	Description	Score	Description	Score	Description	Score	Description	Score	Description	Score	Description	Score	Description	Total score
1	**Bialowski et al., 2009**	2	YES	2	YES- computer generated	YES	0	NO	2	YES	2	YES	2	YES	1	small to medium effect size	2	p< .5, 95% CI	2	YES	2	YES	2	YES	19
2	**Castro- Sanchez et al., 2011**	2	YES	2	YES	YES	1	Partially- only the pla	2	YES	2	YES	2	YES	0	no effect sizes re	0		1	to some extent	2	YES	2	YES	16
3	**Cheung Lau et al., 2011**	2	YES	2	YES- computer generated	YES	1	Single -blinded	2	YES	2	YES	2	YES	0	no effect sizes rep	0		1	to some extent	2	YES	2	YES	16
4	**Chown et al., 2008**	2	YES	2	YES-block randomization	YES	1	Single-blinded	2	YES	2	YES	1	2	0	no effect sizes rep	0		1	to some extent	2	YES	2	YES	15
5	**Cleland et al., 2007**	2	YES	2	YES-computer generated	YES	0	NO	2	YES	2	YES	2	YES	0	no significant diff	0		1	to some extent	2	YES	2	YES	15
6	**Gamber et al., 2002**	2	YES	2	YES-precoded cards	YES	1	Single-blinded (obse	2	YES	2	YES	2	YES	0	no significant effe	0		1	to some extent	2	YES	2	YES	16
7	**Hough et al., 2007**	2	YES	1	Insufficient randomizatio	YES	1	Single-blinded	2	YES	2	YES	1	high attrition	0	no significant effe	0		1	to some extent	2	YES	2	YES	14
8	**Licciardone et al., 2015**	2	YES	2	YES-computer generated	YES	2	Double-blinded	2	YES	2	YES	2	YES	2	large treatment e	2	p< .5, 95% CI	2	YES	2	YES	2	YES	22
9	**Lopez-Lopez et al., 2015**	2	YES	2	YES-computer generated	YES	2	Double blinded	2	YES	2	YES	2	YES	2	large effect size	2	P< .5, 95% CI	2	YES	2	YES	2	YES	22
10	**Moustafa and Diab, 2015**	2	YES	2	YES-balanced stratified assignment	YES	1	Single-blinded	2	YES	2	YES	2	YES	2	large effect sizes	2	p< .5, 95% CI	1	to some extent	2	YES	2	YES	20
11	**Niemistö et al., 2003**	2	YES	2	YES	YES	1	Partial (blinded clinic	2	YES	2	YES	2	YES	0	No effect sizes.	0		1	to some extent	2	YES	2	YES	16
12	**UK BEAM Trial, 2004**	2	YES	2	YES-block randomization	YES	0	NO	2	YES	2	YES	2	YES	0	no effect sizes rep	0		1	to some extent	2	YES	2	YES	15
13	**van Dongen et al., 2015**	2	YES	2	YES-computer generated	YES	0	NO	2	YES	2	YES	2	YES	0	no differences	0		1	to some extent	2	YES	2	YES	15
14	**Voigt et al., 2009**	2	YES	2	YES	YES	0	NO	2	YES	2	YES	2	YES	0	no effect size reported	0		1	to some extent	2	YES	2	YES	15
15	**Williams et al.,2003**	2	YES	2	YES	YES	0	NO	2	YES	2	YES	2	YES	0	no effect sizes rep	0		1	to some extent	2	YES	2	YES	15
16	**Youn-Bum Sung et al.,2014**	2	YES	2	YES	YES	0	NO	2	YES	2	YES	2	YES	0	no effect sizes reported	0		1	to some extent	2	YES	2	YES	15
		0	no/can't tell	0	no randomization		0	no blinding	0	no	0	no	0	no	0	no effect size rep	0	can't tell	0	no	0	no	0	no	
		1	partially	1	partial/ inssuficient randomization		1	single-blinded	1	to some extent	1	to some	1	to some extent	1	small to medium	1		1	to some extent	1	partially	1	partially	
		2	yes	2	randomized		2	Double-blinded	2	yes	2	yes	2	yes	2	moderate to large	2	p<.5, 95% CI	2	yes	2	yes	2	yes	