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EFFECTIVENESS OF LIFESTYLE INTERVENTIONS IN MANAGING CHRONIC MUSCULOSKELETAL PAIN

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ABSTRACT

Introduction: Chronic musculoskeletal pain, particularly low back pain (LBP), is a major global health issue, leading to reduced quality of life, disability, and a significant economic burden on healthcare systems. Increasing evidence suggests that lifestyle-related factors—including physical inactivity, poor sleep, obesity, and psychosocial stress—play a key role in the persistence and severity of chronic pain. Lifestyle medicine, emphasizing behavioral and non-pharmacological interventions, may offer promising therapeutic alternatives.
Aim of the study: The aim of this review was to analyze the effectiveness of lifestyle-based interventions in the management of chronic musculoskeletal pain, focusing on non-pharmacological strategies and their clinical relevance in long-term pain modulation.
Materials and methods: A systematic literature review was conducted using PubMed, Web of Science, and Google Scholar databases. The search included original studies published in English or Polish after 2013, focusing on adult populations and lifestyle-related interventions for chronic musculoskeletal pain. Studies were selected based on methodological quality and clinical relevance, following PRISMA guidelines.
Results and conclusions: The analysis revealed that interventions such as cognitive functional therapy (CFT), occupational therapy, core stabilization exercises, aquatic therapy, abdominal drawing-in maneuver (ADIM), and telerehabilitation show positive effects on pain reduction, functional improvement, and patient engagement. Moreover, integrated healthy lifestyle behaviors—including physical activity, sleep hygiene, balanced diet, and weight management—were associated with reduced healthcare utilization and improved self-efficacy in pain management. Although current evidence supports the use of lifestyle interventions, further high-quality, long-term studies are needed to establish standardized clinical recommendations.

KEYWORDS

Chronic Pain, Pain Management, Non-Pharmacological Treatment, Physical Activity, Lifestyle Medicine

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1. Introduction

1.1 Epidemiological data and the burden on healthcare systems in Poland and worldwide

Chronic musculoskeletal pain syndromes—particularly those involving the spine—are a widespread and significant health issue globally. Dorsalgia, defined as spinal pain persisting for more than 12 weeks, most commonly affects the lumbosacral region (LBP, low back pain). The non-specific form of this condition is among the leading causes of visits to primary care physicians and significantly contributes to the burden on healthcare systems. It is estimated that the global prevalence of LBP is approximately 9.4%, making it the foremost cause of disability worldwide [1-3].

This issue affects people across all age groups. Studies show that over 80% of the working-age population will experience at least one episode of low back pain during their lifetime [4], with the highest incidence observed among young and middle-aged adults [5]. The etiology of LBP is varied and often associated with overload, prolonged sitting, or repetitive physical effort, such as heavy lifting or sedentary office work. Consequently, spinal pain syndromes are frequently classified as occupational diseases. Degenerative and overload-related changes, which lead to reduced mobility, weakened deep trunk muscles, and impaired central stability, are common mechanisms underlying these conditions [6,7].

A sedentary lifestyle contributes to a decline in muscle strength and endurance, which may predispose individuals to recurrent pain episodes [8]. Persistent pressure on intervertebral discs and disrupted disc metabolism exacerbate degenerative changes [9,10]. Additionally, weakness of both superficial and deep trunk muscles is considered a significant risk factor for disc dysfunction. Targeted strengthening of these muscle groups may help reduce symptoms and improve functional capacity [11-13].

Low back pain is a major contributor to years lived with disability (YLDs). The global burden increased from 58.2 million YLDs in 1990 to 83 million in 2010 [5]. These problems also impose substantial financial burdens on healthcare systems. Annual expenditures associated with LBP reach 9.2 billion AUD in Australia [14], 11 billion GBP in the United Kingdom [15], and as much as 90 billion USD in the United States [16]. The economic impact of LBP results from long-term functional impairment, reduced work capacity, direct treatment costs, and expenses related to disability benefits [17,18]. In Poland, according to data from the Social Insurance Institution (ZUS), in 2016 non-specific spinal pain syndromes accounted for nearly 19 million sick leave days, and the number of disability rulings due to LBP was in the tens of thousands annually [19].

1.2 Lifestyle medicine as a potential tool in the management of chronic musculoskeletal pain

Although the exact causes of chronic pain are often multifactorial and not always clearly defined, growing evidence highlights the significant role of psychological, behavioral, and environmental factors in its persistence. Lifestyle elements, including physical activity levels, sleep quality, body weight, and emotional aspects such as stress and depression, play a crucial role in modulating symptoms [20-22].

Lifestyle modifications—particularly increasing physical activity, improving dietary habits, reducing body weight, and enhancing sleep quality—are increasingly considered as complements to, or alternatives for, conventional pharmacological treatment. Particular attention has been given to the link between obesity and increased pain severity, which positions weight reduction as a key therapeutic target [20].

Lifestyle medicine is a rapidly evolving field focused on the prevention and treatment of chronic diseases through modification of daily habits. At its core remains patient education, the elimination of harmful behaviors, and sustainable health-promoting behaviors—also in the domain of chronic pain management. Moreover, it emphasizes the use of non-pharmacological, often behavioral, methods to support long-term health outcomes.

1.3 Aim of the study

The primary objective of this review is to provide a comprehensive analysis of lifestyle medicine strategies and assess their effectiveness in the long-term modulation of chronic pain symptoms. A review of the current literature reveals a lack of consolidated resources focused on the management of chronic musculoskeletal pain through lifestyle interventions. Nevertheless, the abundance of research on this topic suggests a growing interest among clinicians and physiotherapists in identifying non-pharmacological methods to prevent and alleviate chronic pain.

It is also important to emphasize the significance of eliminating chronic musculoskeletal pain, which affects millions of individuals globally, severely impairing daily functioning and significantly reducing quality of life. Addressing this issue is therefore of utmost importance, and a meticulous exploration of the subject may support more informed clinical decision-making by orthopedic specialists and general practitioners in the effective management of their patients' pain.

2. Methodology

2.1 Inclusion and exclusion criteria

This review encompasses scientific studies that conformed to the specified inclusion criteria: i) original research articles published in Polish or English language; ii) related to lifestyle modification in the management of chronic musculoskeletal pain; iii) research based solely on studies conducted on humans; iv) published after 2013; v) articles published in 2013 or earlier could only be included if contain particularly relevant information; vi) case reports were excluded. Initial selection was conducted using keywords and accessible abstracts, followed by a detailed examination of the full-text articles.

2.2 Literature selection strategy and data collection process

The selection of appropriate studies according to eligibility criteria was conducted through a search of articles within the following databases: PubMed, Web of Science, and Google Scholar. The following keywords were used: chronic pain; pain management; non-pharmacological treatment; physical activity; lifestyle medicine. As a result, 847 articles were found, of which 770 were excluded after elimination of duplications and abstract analysis. Then, full-text papers were obtained, and eventually, 35 studies were accepted for this review with the following reference numbers: 23-57. To exclude possible mistakes, the

"ROBIS" algorithm was used. Figure 1 presents step-by-step the process of literature selection. In preparation of this review the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were taken into consideration. The papers selected for this review were chosen based on the quality of the conducted research, with preference given to investigations featuring robust methodologies and larger both study and control groups.

2.3 Outcome measures

Of the utmost importance for this review is a meticulous analysis of the tools used in lifestyle therapy and the effectiveness of their application in the long-term modulation of chronic pain conditions. This paper focuses on a description of existing recommendations for the management of chronic musculoskeletal pain. To uphold the highest standards in the selection process, special consideration was given to guidelines and recommendations with proven effectiveness and those issued by reputable institutions.

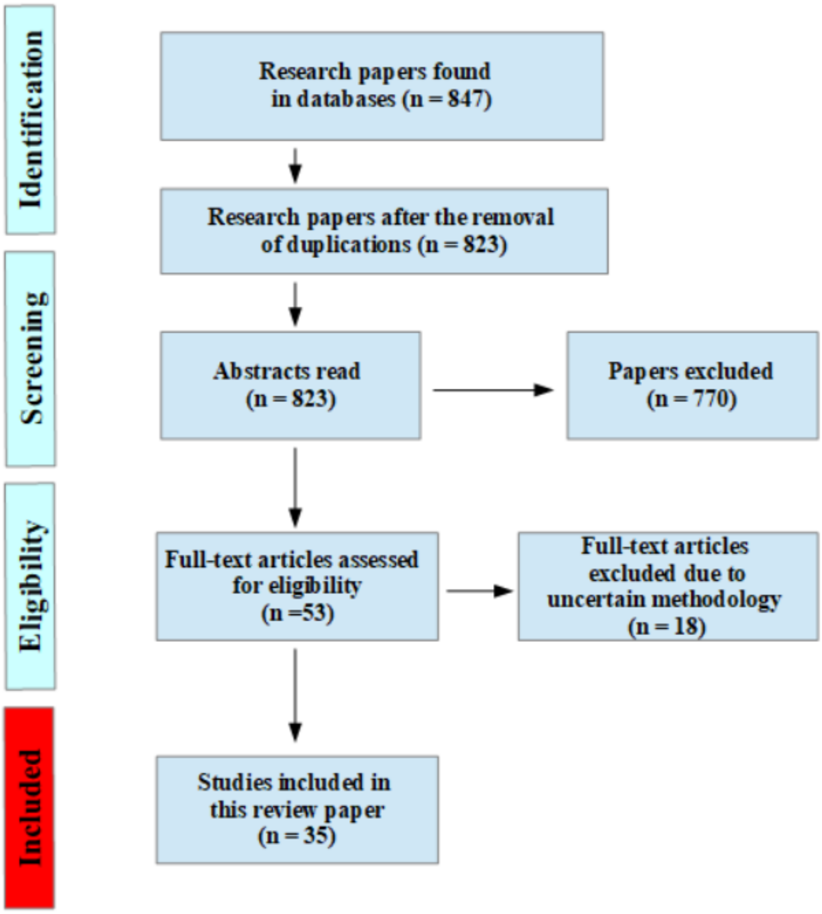

Fig. 1. *Process of study selection*

2.4 AI

In the process of preparing this manuscript, the authors utilized ChatGPT to assist with enhancing the clarity, coherence, and overall readability of the text. The tool was also employed to aid in refining sentence structure, grammar, and formatting consistency throughout the document. Following the use of ChatGPT, the authors carefully reviewed the AI-generated suggestions, made necessary revisions, and ensured that the final content accurately reflects their intended meaning.

3. Overview of lifestyle interventions in the management of chronic musculoskeletal pain

3.1 Cognitive Functional Therapy (CFT)

Cognitive Functional Therapy (CFT) represents an integrative therapeutic approach to LBP, combining education, graduated movement exposure, and the modification of beliefs and coping strategies related to pain. It was developed in response to the limitations of traditional treatment methods, which often overlook the psychological and social dimensions of chronic pain. CFT is grounded in the biopsychosocial model of pain, which posits that chronic pain does not arise solely from anatomical damage but is also maintained by maladaptive beliefs, fear of movement (kinesiophobia), activity avoidance, depression, and stress [23]. The therapy includes: i) patient education – reinterpreting beliefs about pain (e.g. moving away from the "pain = injury" narrative); ii) movement exposure and motor retraining – gradual return to normal movement patterns; iii) lifestyle modification – such as increasing physical activity, reducing stress, and improving sleep quality.

In a randomized controlled trial by Fersum et al., CFT demonstrated significant superiority over conventional exercise-based therapy—showing greater reductions in pain, improved physical function, and reduced fear of movement [24]. A three-year follow-up of the same cohort provided valuable insights into the durability of these effects [25]. Although a statistically significant long-term reduction in pain was not observed, positive outcomes in functioning persisted—including reductions in disability, pain-related activity avoidance, anxiety, depression, and negative beliefs and emotions about pain. These results emphasize that the effectiveness of CFT goes beyond temporary pain relief, focusing instead on sustainable changes in behavior and attitude, which may be key to preventing relapses and improving quality of life [24, 25].

Additional evidence on the efficacy of CFT comes from a study by Khodadad et al., which compared CFT with lumbar stabilization therapy (LST) [26]. After 8 weeks of intervention, both groups showed significant improvement in movement control and pain reduction. However, the differences between groups were not statistically significant, indicating comparable efficacy. Still, it's worth noting that CFT offers a broader approach that includes psychological components, which may be particularly beneficial for patients with prominent psychosocial factors [26].

A systematic review and meta-analysis by Zhang et al. suggested that Cognitive Functional Therapy (CFT) may provide short-term benefits in pain reduction, functional improvement, and reduction of fear-avoidance beliefs. However, the evidence quality was rated low to very low, and no definitive conclusions about its superiority over other treatments could be drawn, highlighting the need for further rigorous clinical trials [27].

In summary, CFT presents a promising strategy for managing chronic low back pain, especially when considered through the lens of the biopsychosocial model. Its efficacy has been documented in comparison with conventional therapies, though not all studies have demonstrated a clear advantage. The individualized patient-centered approach, which addresses psychological and behavioral aspects of pain, aligns well with lifestyle-based treatment strategies for chronic pain.

3.2 Occupational Therapy (OT) in the management of chronic musculoskeletal pain

In recent years, the growing interest in occupational therapy (OT) as a vital component of comprehensive care for individuals with chronic musculoskeletal pain (CMP), including chronic low back pain, has been observed. By focusing on the meaning and structure of everyday activities, OT can support patients in improving their functional abilities, enhancing their sense of agency, and adapting to life with persistent pain.

One promising approach in this area involves the implementation of personalized, lifestyle-based OT interventions within multidisciplinary treatment settings. In a qualitative study by Nielsen et al., researchers evaluated such an intervention in a Danish pain management clinic [28]. The program included components such as activity planning, energy conservation, time management, and emotional regulation. Both patients and therapists perceived the intervention as useful, relevant, and empowering. Participants reported improved daily functioning, better understanding of their limitations, and increased readiness to manage their pain actively [28].

A Swedish longitudinal study by Persson et al. assessed the effectiveness of a multidisciplinary pain rehabilitation program on occupational performance and satisfaction. Using the Canadian Occupational Performance Measure (COPM), researchers found significant improvements in both performance and satisfaction at one-year follow-up. The program, which included occupational therapy components such as activity training and time-use strategies, demonstrated that clients with higher life control and less disability experienced greater improvements. These findings provide robust evidence for the value of OT-informed, client-centered rehabilitation in chronic pain management [29].

Additional insight into current OT practices in chronic pain management—particularly musculoskeletal pain—comes from a descriptive cross-sectional study by Slee et al. [30]. This survey-based research explored the experiences of 26 UK-based occupational therapists working with individuals experiencing persistent pain. The study highlighted the breadth of interventions employed in OT, including activity pacing, energy conservation, cognitive-behavioral strategies, and client education. Therapists also emphasized ongoing systemic challenges, such as limited referral pathways, insufficient resources, and a lack of awareness regarding the role of OT within pain services. These findings underscore the clinical relevance and growing potential of occupational therapy as a key contributor to long-term functional outcomes in chronic pain rehabilitation [30].

Although the study conducted by Brendbekken et al. did not explicitly include occupational therapy, it investigated a multidisciplinary intervention aimed at improving work participation among individuals with chronic musculoskeletal pain [31]. The therapeutic team consisted of a physician, a physiotherapist, and a social worker, and the intervention focused on identifying psychosocial and occupational barriers to returning to work. The program was compared to a brief educational intervention focused on self-help and active coping strategies. While no significant differences were found between groups regarding full return to work at 12 and 24 months, patients in the multidisciplinary group returned to work part-time more quickly. Although this study does not reflect methods characteristic of occupational therapy, it highlights the relevance of individualized, work-focused interventions in multidisciplinary rehabilitation settings—an approach that partially overlaps with OT objectives [31].

A qualitative study by de Vries et al. investigated the experiences of individuals who continued working despite living with chronic nonspecific musculoskeletal pain [32]. Participants described a variety of self-initiated strategies to stay engaged in their work, such as modifying tasks, pacing activities, managing workloads, and implementing practical coping techniques. Although the study did not explicitly examine occupational therapy or involve occupational therapists, the approaches described by participants reflect core principles often emphasized in OT practice—such as activity adaptation, energy conservation, and support for maintaining meaningful occupational roles. The findings underline the value of individualized, context-sensitive support in promoting long-term work participation, which aligns conceptually with occupational therapy's broader goals, even if it was not the direct focus of the study [32].

In summary, occupational therapy—whether delivered through structured programs or tailored interventions—has proven to be an effective approach for helping individuals with CMP restore function, return to work, and resume meaningful roles. Primary research supports its benefits not only in improving physical performance but also in enhancing emotional well-being, self-management capacity, and long-term adaptation. Based on current evidence, OT should be regarded as an essential part of interdisciplinary care models for chronic pain.

3.3 Occupational Therapy vs. CFT – differences and similarities

While both occupational therapy programs such as REVEAL(OT) and Cognitive Functional Therapy (CFT) aim to improve the functioning of individuals with chronic pain, they differ in focus and therapeutic emphasis (Table 1.).

Table 1. Comparison of OT and CFT

Aspect	OCCUPATIONAL THERAPY	CFT
Core premise	Reorganization of daily life, activities, and lifestyle	Changing beliefs and behaviours related to pain
Practitioner	Occupational therapist	Physiotherapist trained in CFT
Integration model	Component of multidisciplinary program	Can be delivered as a stand-alone therapy
Scope of focus	Activity, sleep, rest, social relationships	Beliefs, pain control, movement

In clinical practice, these two approaches can complement themselves rather than exclude each other. Incorporating elements of occupational therapy into a CFT program may enhance treatment outcomes by improving patients' daily functioning and their ability to apply coping strategies in real-life contexts. OT may thus reinforce the behavioral and cognitive gains made during CFT by helping patients implement these changes meaningfully in their daily routines.

3.4 Physical activity and core stabilization exercises

Physical activity, particularly exercises targeting deep trunk muscle stabilization, plays a crucial role in both the treatment and prevention of nonspecific chronic LBP. Studies have shown that regular exercise can not only alleviate pain but also improve patients' functional capacity and positively influence psychosocial factors associated with pain. Specifically, stabilization exercises that target deep core muscles such as the transversus abdominis (TrA) and multifidus (MF) have proven effective in reducing pain and enhancing function in individuals with LBP.

In the study by Sipavičienė and Klizienė, conducted on women engaged in sedentary work and suffering from chronic LBP, the effects of two 20-week exercise interventions were compared: lumbar spine stabilization exercises versus lumbar muscle strengthening exercises [33]. Both interventions led to a significant reduction in pain and improvement in function, assessed by the Oswestry Disability Index (ODI). However, the effects were more pronounced and sustained in the stabilization exercise group. Pain reduction and functional improvement persisted significantly for 12 weeks post-intervention in the stabilization group, whereas the strengthening group exhibited a tendency toward deterioration in outcomes after 4–8 weeks. Furthermore, increases in isokinetic strength of trunk muscles (both flexors and extensors) were observed following completion of both exercise programs, but these gains began to progressively diminish after 8 weeks in both cohorts. Moreover, the increase in the cross-sectional area of the multifidus muscle was significantly greater and more enduring in the stabilization group compared to the strengthening group [33]. These findings suggest that lumbar stabilization exercises are more efficacious for the long-term enhancement of deep muscle function and symptom alleviation in individuals with LBP who lead a sedentary lifestyle.

In a randomized controlled trial conducted by Akhtar et al., the effectiveness of core stabilization exercises, targeting the deep trunk muscles, was compared with routine exercise therapy in 60 patients with chronic non-specific LBP [34]. Following a six-week intervention program, the group performing deep muscle stabilization exercises demonstrated a significantly greater reduction in pain intensity, assessed by the Visual Analog Scale (VAS), and improvement in function, measured by the modified ODI, compared to the group receiving conventional exercise therapy. These findings underscore the superiority of exercises focused on deep trunk muscle activation in the management of chronic non-specific LBP [34].

In a randomized controlled trial conducted by Areeudomwong and Buttagat, the effects of core stabilization exercises (CSE) and proprioceptive neuromuscular facilitation (PNF) training were compared in 45 patients with chronic non-specific low back pain [35]. Participants were randomly assigned to either a CSE group, a PNF training group, or a control group receiving standard advice. Following a four-week intervention and at three-month follow-up, both the CSE and PNF groups demonstrated significantly greater reductions in pain intensity (measured by VAS), functional disability (assessed by the modified ODI), and greater patient satisfaction compared to the control group ($p < 0.001$). Additionally, electromyographic analysis revealed significant improvements in bilateral activity of the transversus abdominis and superficial fibers of the lumbar multifidus muscles in both intervention groups ($p < 0.05$). These improvements were maintained at the three-month follow-up. The findings suggest that both CSE and PNF are effective in reducing pain and disability and enhancing neuromuscular control in individuals with chronic non-specific low back pain, with no adverse effects reported [35].

The review by Akuthota et al. thoroughly discusses the principles and foundational concepts of core stability training, emphasizing its crucial role in enhancing neuromuscular control and spinal stability [36]. The authors highlight that properly designed stabilization exercise programs can counteract biomechanical dysfunctions that contribute to the development of LBP. This training aims to activate and strengthen the deep trunk muscles, promoting better segmental spinal stability, reducing mechanical overload, and improving functional movement in patients with lumbar pain [36].

In the study by Heo et al., participants were divided into three groups: one performing lumbar stabilization exercises, one undergoing thoracic mobilization and exercises, and a control group receiving conventional physical therapy [37]. All groups experienced a significant reduction in pain as measured by VAS. However, the greatest improvements in lumbar stability and balance index scores were observed in the lumbar stabilization exercise group, followed by the thoracic mobilization group, with the least improvement seen in the conventional physical therapy group. These results suggest that although all interventions effectively reduced pain, lumbar stabilization exercises provided superior benefits in enhancing functional movement and postural control in patients with chronic LBP [37].

In summary, core stabilization exercises are an effective therapeutic approach for managing chronic nonspecific LBP. Regular performance of such exercises leads to pain relief, improved function, and enhanced postural control. Incorporating stabilization exercises into rehabilitation programs is therefore recommended for patients with LBP.

3.5 Aquatic exercises as a form of low back pain therapy

Exercise performed in an aquatic environment, commonly referred to as aquatic therapy or hydrotherapy, is gaining increasing recognition as an effective treatment for chronic low back pain, especially among individuals with sedentary lifestyles. The physical properties of water—such as buoyancy, resistance, and hydrostatic pressure—reduce joint and spinal load during movement, facilitating safe exercise performance even in individuals with reduced functional capacity.

In a controlled clinical trial conducted by Baena-Beato et al., the effectiveness of an intensive eight-week aquatic exercise program, performed five times per week, was evaluated in sedentary adults with chronic nonspecific low back pain [38]. Out of 49 participants who completed the study, the aquatic therapy group demonstrated significant reductions in pain intensity, measured by VAS, and disability, assessed by ODI. Additionally, significant improvements were observed in the physical component of quality of life (SF-36), while no significant changes were found in the mental component. The active group also showed favorable changes in body composition, including reductions in body weight, BMI, and body fat percentage. Skeletal muscle mass showed a trend toward increase. Participants improved physical fitness, as evidenced by statistically significant gains in flexibility (sit-and-reach test), abdominal muscle endurance (curl-up test), handgrip strength, and cardiorespiratory fitness (VO2max). No significant changes were observed in these parameters in the control group, which received standard care [38].

Psychological benefits of aquatic therapy, such as greater patient acceptability and the perception of exercises as less painful compared to land-based therapy, may enhance adherence and engagement with therapeutic recommendations. Furthermore, the aquatic environment allows targeted training of trunk stabilization and movement control, which is particularly important for patients with chronic low back pain who often exhibit dysfunction in deep trunk muscles and motor control [38].

Furthermore, Baena-Beato et al. demonstrated that both twice-weekly and three-times-weekly aquatic exercise sessions led to significant improvements in physical function and pain reduction in adults with chronic low back pain, with no statistically significant differences between the two frequencies [39].

It is also worth noting that aquatic exercises yield positive outcomes in pregnant women experiencing LBP. A study by Kihlstrand et al. found that a well-designed pool-based activity program significantly reduced pain and improved the well-being of pregnant participants [40].

3.6 Abdominal Drawing-In Maneuver (ADIM) technique

The abdominal drawing-in maneuver (ADIM) technique involves gently drawing the lower abdomen towards the spine while maintaining a neutral position of the pelvis and thorax. The aim of this technique is the selective activation of TrA and MF muscles without excessive tension of the superficial muscle groups, such as the rectus abdominis or iliopsoas muscles. By improving neuromuscular coordination and training the reflexive activation of these muscles, ADIM supports the restoration of segmental spinal stability, thereby reducing pain symptoms and improving motor function.

In patients with LBP, delayed activation of deep muscles in response to motor stimuli, asymmetrical activation, and reduced muscle thickness and endurance are often observed. This dysfunction results in impaired movement control and insufficient segmental spinal support, which may lead to overload, micro-injuries, and the persistence of pain symptoms. Therefore, therapeutic approaches focused on re-educating and strengthening the deep trunk muscles are considered a crucial element of effective rehabilitation [41].

The study conducted by Saiklang et al. examined the immediate effect of ADIM technique on changes in body height among seated office workers with chronic LBP [42]. 40 participants took part in the study, of whom 24 were ultimately included in the analysis. These participants were assigned to two conditions: sitting without using ADIM (control group) and sitting while applying the ADIM technique. During the 41-minute sitting period, participants performed ADIM three times, each time for one minute. The results showed that, unlike the control group which experienced a significant decrease in body height over time, the decrease was significantly smaller at all measured time points in the ADIM condition (p-values ranging from 0.05 to 0.001). This suggests that activation of deep trunk muscles through the ADIM technique may counteract spinal compression and postural deterioration during prolonged sitting. Additionally, activity of the transverse abdominis and internal oblique muscles was significantly higher during ADIM use, indicating effective engagement of the deep stabilizing muscles compared to the control condition [42].

Additionally, a study by Park and Yu analyzed the effects of the ADIM technique and stabilization exercises on abdominal muscle thickness and ODI in patients with chronic LBP [43]. Both ADIM and stabilization exercises significantly increased the thickness of the internal and external oblique muscles. The thickness of the transversus abdominis muscle increased significantly only in the ADIM group, while the increase in the stabilization exercise group was not statistically significant. Both interventions significantly reduced ODI scores, indicating improved muscle function and decreased disability [43].

Furthermore, research by Kim et al. evaluated the impact of ADIM on the muscle activation timing during hip extension in individuals with lumbar hyperlordosis [44]. The study found that ADIM significantly advanced the activation of the gluteus maximus muscle in participants with a high lumbar lordotic angle, while no significant changes were observed in the onset timing of the hamstrings or lumbar erector spinae [44]. These results suggest that ADIM may help improve neuromuscular control of the gluteus maximus in individuals with postural deviations related to LBP.

3.7 Telerehabilitation in the management of chronic musculoskeletal pain

In response to the growing demand for accessible and cost-effective rehabilitation services, telerehabilitation has gained attention as a promising approach in managing chronic musculoskeletal pain, especially in cases of chronic LBP. By delivering therapeutic interventions remotely—through mobile apps, video consultations, or digital platforms—telerehabilitation offers a way to overcome barriers related to limited mobility, geographic constraints, and healthcare resource shortages. In recent years, this approach has been widely examined in randomized controlled trials, confirming its relevance in modern pain care.

A study conducted in Nigeria by Fatoye et al. evaluated the effectiveness of an eight-week McKenzie-based telerehabilitation program, delivered three times per week, in patients with nonspecific chronic low back pain [45]. While both the telerehabilitation and conventional clinic-based groups showed significant improvements in pain and disability, no statistically significant differences were found between them. This suggests that telerehabilitation may serve as a viable alternative to in-person therapy, particularly in low-resource settings, due to its potential for lower costs and greater accessibility [45].

Another study which compared telerehabilitation with conventional physiotherapy for chronic LBP found that both groups achieved similar improvements in pain intensity, disability, and psychological factors such as pain catastrophizing. Although some strength and movement parameters improved more significantly in the clinic-based group, the overall findings suggest that remote exercise programs can be a viable alternative to face-to-face rehabilitation, offering comparable functional benefits [46].

A randomized study by Akodu et al. evaluated the effects of core-stability exercises delivered via telerehabilitation compared to a clinical-based setting in individuals with chronic nonspecific low back pain. Both groups experienced significant reductions in pain-related disability and improvements in pain self-efficacy. Additionally, psychological factors such as depression, anxiety, and stress improved in both groups; however, greater improvements in these domains were observed in the clinic-based intervention. These findings highlight the potential of telerehabilitation as a viable alternative to in-person care, although supervised settings may offer enhanced psychological support [47].

In addition to findings focused on LBP, telerehabilitation has shown promising results in other chronic musculoskeletal conditions such as fibromyalgia. A recent randomized controlled trial compared asynchronous telerehabilitation delivered via a mobile app with synchronous video-based rehabilitation in patients with fibromyalgia. Both modes of delivery led to significant improvements in pain intensity, functional capacity, depression, and quality of life. While the synchronous model resulted in slightly greater reductions in anxiety and back/neck pain, overall outcomes were largely comparable. These findings support the flexibility of digital care models, demonstrating that even app-based interventions can provide meaningful clinical benefits for diverse patient populations [48].

The collective evidence suggests that telerehabilitation—whether synchronous or asynchronous—offers a clinically effective and scalable alternative to conventional rehabilitation for various forms of chronic musculoskeletal pain. With the potential to improve access and reduce barriers to care, it represents a valuable tool in the multidisciplinary management of these conditions.

3.8 The impact of lifestyle on chronic musculoskeletal pain management

3.8.1 Cumulative lifestyle interventions

In recent years, increasing attention has been given to the role of a healthy lifestyle in the treatment and management of chronic musculoskeletal pain, including LBP, chronic neck pain, and knee osteoarthritis. Regular physical activity, maintaining a healthy body weight, avoiding smoking, and ensuring adequate sleep quality are not only preventive factors but also crucial elements supporting the management of chronic pain.

A study by Roberts et al. [49], conducted as part of the Australian AUTBACK project, evaluated the combined effect of adherence to four healthy behaviors—physical activity, non-smoking, normal BMI, and sufficient sleep quality—on the course of LBP in 340 individuals with a history of spinal pain. The results showed that while there was no significant effect on the total number of weeks free from activity-limiting pain (IRR: 1.02; 95% CI: 1.00–1.05), a higher healthy lifestyle index was associated with a significant reduction in healthcare utilization, including: i) overall healthcare use (IRR: 0.69), ii) specialist visits (IRR: 0.62), iii) self-management of pain (IRR: 0.74), and iv) use of analgesics (IRR: 0.55). This suggests that individuals leading a healthier lifestyle may exhibit greater independence and resilience in coping with chronic pain [49].

In a systematic review by Huijbers et al., the effectiveness and cost-effectiveness of combined lifestyle interventions (including physical exercise, dietary changes, and behavioral support) were assessed in individuals with chronic LBP and coexisting overweight or obesity [50]. Based on three clinical trials involving a total of 216 participants, the interventions did not yield clinically significant improvements in pain reduction or physical function compared to usual care (low-certainty evidence) [50]. However, it should be noted that this evidence is limited due to small sample sizes and low adherence to the interventions. Further studies with larger participant groups and longer follow-up periods are needed to better understand the potential benefits of combined lifestyle interventions in the management of chronic LBP.

Overall, the evidence indicates that combined healthy behaviors such as regular physical activity, a balanced diet, adequate sleep, and smoking avoidance can significantly support the management of chronic musculoskeletal pain. Although not all studies demonstrate significant pain reduction, many highlight the cost-effectiveness and quality-of-life improvements associated with comprehensive lifestyle-based care [50, 51].

3.8.2 Lifestyle impact—dietary perspective and body weight

While this review primarily focuses on psychological and physiotherapeutic interventions for chronic musculoskeletal pain, growing literature highlights the importance of general lifestyle factors such as body weight, nutrition, and metabolic health. Obesity and overweight have been linked to an increased risk of low back pain, knee pain, and chronic neck pain, although the underlying mechanisms remain not fully understood. Both mechanical overload of anatomical structures and chronic inflammation associated with excess adipose tissue are suggested contributors to exacerbated pain symptoms [20].

Given the association between overweight/obesity and an increased risk of chronic low back pain [20], it is plausible that maintaining a healthy body weight may serve as a protective factor. In the case of knee osteoarthritis, studies such as Vincent et al. confirm that interventions combining weight loss and physical exercise improve function and reduce pain in these patients [51]. However, direct evidence confirming the protective effect of weight loss on the development or progression of chronic low back pain is still lacking.

A literature review conducted by Asensi et al. indicates that the consumption of ultra-processed foods may promote the development of chronic low-grade inflammation, which in turn is associated with increased musculoskeletal pain symptoms and worsened body composition parameters [52].

Despite these promising data, current well-designed primary studies evaluating dietary interventions as standalone or adjunct treatments for chronic musculoskeletal pain are lacking. Future research should more comprehensively investigate the role of diet, body weight, and metabolic health in chronic pain management.

3.8.3 Sleep-improving interventions and reduction of musculoskeletal pain

Sleep disturbances are common among individuals suffering from chronic musculoskeletal pain (MSK) and have a bidirectional relationship with pain symptoms—poor sleep quality can worsen pain, while chronic pain can disrupt sleep. To address this issue, interventions aimed at improving sleep—such as cognitive behavioral therapy for insomnia (CBT-I), relaxation techniques, and meditation—are increasingly employed.

Observational studies reveal that both short (<7 hours) and long (>9 hours) sleep durations are associated with a higher risk of chronic musculoskeletal pain, including low back pain. The optimal sleep duration minimizing pain risk is approximately seven hours per night [53]. Furthermore, individuals with chronic pain often report poorer sleep quality, increased daytime sleepiness, and difficulties with sleep initiation and maintenance. For example, a study among dental students found that those with musculoskeletal pain had significantly poorer sleep quality and higher daytime sleepiness compared to pain-free peers [54].

In a comparative study by Edinger et al., the effectiveness of CBT-I, supportive therapy (SH), and usual care (UC) was evaluated in patients with fibromyalgia and comorbid insomnia [55]. CBT-I produced significant improvements in sleep parameters (total sleep time, sleep efficiency, and night-to-night variability) but did not clearly reduce pain intensity compared to controls. Interestingly, pain reduction occurred only in a subgroup of SH participants who spontaneously adopted CBT strategies, indicating that sleep improvement might indirectly influence pain perception [55].

Additionally McCrae et al. compared CBT-I, CBT for pain (CBT-P), and a combined approach (CBT-C) in fibromyalgia patients [56]. CBT-I led to significant and sustained improvements in subjective sleep quality, sleep efficiency, and beliefs about sleep. However, no significant differences between groups were observed for pain severity across primary outcomes, although CBT-I showed some advantage in moderate reductions in morning and evening pain at follow-up. These findings suggest that CBT-I may effectively target sleep in fibromyalgia, but its impact on pain is modest and may not surpass that of pain-focused treatments [56].

A recent randomized controlled trial by Vinaya et al. assessed the effects of the Mind Sound Resonance Technique (MSRT) meditation on elderly individuals with musculoskeletal complaints [57]. The study demonstrated statistically significant improvements in sleep quality, stress reduction, and anxiety symptoms compared to the control group, indicating that MSRT may serve as an effective, non-invasive intervention to enhance well-being in older adults [57].

Analysis of primary studies suggests that sleep-focused interventions, particularly CBT-I, effectively alleviate insomnia symptoms in patients with chronic musculoskeletal pain. However, their impact on pain reduction remains inconclusive and warrants further long-term investigation. Relaxation and meditation techniques appear to have greater potential in alleviating both sleep disturbances and pain symptoms, though more high-quality evidence is needed. Incorporating sleep quality improvement as part of an integrated treatment plan may significantly enhance patients' quality of life.

Discussion

The aim of this review was to provide a comprehensive overview of the effectiveness of lifestyle-based interventions in managing chronic musculoskeletal pain, with particular emphasis on LBP. The findings suggest that a multidimensional approach—integrating physical, psychological, educational, and environmental components—can effectively alleviate pain symptoms and improve patients' quality of life.

The strongest evidence for effectiveness pertains to interventions based on physical activity, particularly those targeting deep trunk muscle stabilization (transversus abdominis, multifidus). These exercises, whether implemented in clinical settings or remotely, significantly reduced pain levels, decreased functional disability, and improved patients' perceived ability to manage pain [33-37, 47]. Importantly, many studies indicate that these effects persist beyond the intervention period, suggesting a beneficial impact of motor relearning on daily movement patterns.

For patients with limited exercise tolerance, aquatic therapy proved to be a viable alternative, offering psychophysical comfort along with reduced mechanical load on musculoskeletal structures [38, 39]. Meanwhile, the abdominal drawing-in maneuver, which enhances deep muscle activation and postural control, may serve as a valuable component of home-based programs—especially when paired with telerehabilitation [43, 44].

Particular attention should be given to Cognitive Functional Therapy, which combines education, graded movement exposure, and restructuring of maladaptive beliefs related to pain. Based on the biopsychosocial model, CFT has demonstrated high efficacy in reducing pain and functional disability [23,24,27]. Additionally, it improves patients' capacity to cope with pain and enhances their sense of control over health, by addressing pain-related fear, avoidance behaviors, and negative emotional responses. These psychological benefits may foster long-term engagement in daily activities and support functional recovery.

Occupational therapy may complement this approach by focusing on empowering patients to function in daily life despite persistent pain. OT interventions help improve self-management, increase patient agency, and provide strategies for resuming meaningful activities. Programs such as REVEAL(OT), which combine functional training with patient education and psychosocial support, have been shown to improve psychosocial functioning and quality of life in patients with chronic pain [28,29].

The use of remote rehabilitation (telerehabilitation) represents a significant step toward greater accessibility and flexibility of care. The reviewed studies indicate that both synchronous (real-time interaction with a therapist) and asynchronous (e.g. mobile app-based) telerehabilitation formats lead to significant improvements in pain intensity, functional capacity, and psychological outcomes such as depression, anxiety, and stress [46–48]. Although synchronous interventions occasionally yielded slightly better outcomes—particularly in reducing neck pain and anxiety—these differences were not clinically significant, highlighting the value of more flexible, automated approaches [48].

Particularly promising results were observed in studies involving patients with fibromyalgia. Both synchronous and asynchronous telerehabilitation significantly improved pain intensity, functional capacity, quality of life, and psychological parameters, with no clinically meaningful differences between the groups [47,48]. These findings underscore the potential of mobile apps and video-based programs as scalable and accessible tools equivalent to traditional therapy.

Importantly, a growing body of evidence suggests that the accumulation of healthy habits—regular physical activity, non-smoking, healthy weight maintenance, and good sleep quality—exerts a protective effect against chronic pain [50]. Observational studies have shown that individuals adhering to more than one of these four core behaviors were less likely to rely on medical services and more likely to self-manage pain symptoms. Although this effect did not always translate into full remission, it implies that the synergy of healthy behaviors may boost resilience and reduce strain on healthcare systems [50,51].

However, limitations of the reviewed studies must be acknowledged. Many trials included small sample sizes, lacked randomization, had short follow-up durations, and relied on subjective outcome measures. Moreover, the heterogeneity of interventions and the lack of standardization make direct comparisons of method effectiveness more difficult.

From a clinical perspective, the findings strongly support the shift away from an exclusively pharmacological model toward integrated, personalized treatment plans in which lifestyle factors play an equal role. Given their low cost, minimal risk of adverse effects, and high patient acceptability, lifestyle interventions hold significant promise for reducing healthcare burdens and improving long-term treatment outcomes.

4. Conclusions

This literature review indicates that lifestyle interventions offer an effective and increasingly well-supported approach for managing chronic musculoskeletal pain. Strategies that integrate physical, psychological, and behavioral elements—such as Cognitive Functional Therapy (CFT), occupational therapy, and targeted exercise programs (including stabilization exercises, aquatic therapy, and the ADIM method)—appear particularly beneficial.

There is also growing evidence for the value of remote rehabilitation (telerehabilitation), which can improve access to care and enhance treatment flexibility. Moreover, adopting multiple healthy behaviors—regular physical activity, balanced nutrition, maintaining a healthy weight, good sleep hygiene, and avoiding smoking—may act synergistically to support recovery, reduce reliance on medication, and decrease healthcare utilization.

Despite positive findings, many studies face limitations including small sample sizes, low adherence to protocols, and a lack of long-term follow-up data. High-quality research is needed to establish clearer clinical guidelines and standardized intervention programs.

In conclusion, incorporating lifestyle-based interventions alongside conventional treatments should be considered an essential component of a comprehensive approach to chronic musculoskeletal pain management. This integrated model not only improves treatment outcomes but also aligns with the increasing patient demand for holistic, cause-oriented care rather than solely symptomatic relief.

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