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REVIEW ARTICLE

Harnessing the heat: a comprehensive review of heat therapy's role in managing lumbar pain

Mateusz Trubalski[1], Zuzanna Łuba[2], Marta Żerebiec[2], Michał Bzoma[3], Joanna Niezbecka-Zając[4]

[1]STUDENT SCIENTIFIC ASSOCIATION AT THE DEPARTMENT OF REHABILITATION AND ORTHOPEDICS, MEDICAL UNIVERSITY OF LUBLIN, LUBLIN, POLAND

[2]STUDENT SCIENTIFIC ASSOCIATION OF THE LABORATORY OF LOCOMOTOR SYSTEMS RESEARCH, MEDICAL UNIVERSITY OF LUBLIN, LUBLIN, POLAND

[3]FACULTY OF MEDICINE, MEDICAL UNIVERSITY OF WARSAW, WARSAW, POLAND

[4]DEPARTMENT OF REHABILITATION AND ORTHOPEDICS, MEDICAL UNIVERSITY OF LUBLIN, LUBLIN, POLAND

ABSTRACT

Heat therapy has gained considerable attention as a noninvasive treatment for low back pain, a condition that affects a significant proportion of the world's population. This review examines the physiological mechanisms behind heat therapy, its efficacy in relieving pain, and its role in improving mobility and quality of life. By improving blood circulation, reducing muscle stiffness, and reducing inflammation, heat therapy offers promise as an alternative or complement to conventional treatments. Various methods, including heat packs and thermal pillows, have been studied for their effects on acute and chronic pain. This review highlights key findings from clinical trials and systematic analyses, demonstrating significant reductions in pain intensity and functional impairment. Despite its benefits, aspects such as patient compliance and safety remain important factors in its clinical use. Future research should focus on optimizing treatment parameters and integrating heat therapy with other rehabilitation strategies to maximize its therapeutic potential. This comprehensive review highlights the need for a broader perspective and further research on the long-term effectiveness of heat-based interventions in the treatment of low back pain.

KEY WORDS: low back pain, heat therapy, pain management, physical therapy modalities

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INTRODUCTION

Back pain particularly the lower back is one of the most common types of pain that is lower back pain also known as lumbar pain is one of the leading causes of disability globally, affecting about 80% of the population at some point in their lifetime. It affects routine life, reduces the quality of life and is a heavy financial burden in terms of medical bills and time away from work. Lower back pain is one of the leading causes of years lived with disability (YLD) and disability-adjusted life years (DALY) globally and is also increasing because of the increasing prevalence of the condition due to the growing elderly population and the changing lifestyle patterns. In the United States only, LBP generates more than a billion dollars every year in health care costs and lost workdays, thus becoming a major health issue [1-4].

The etiology of LBP is multifactorial, involving both mechanical and pathological elements. Degenerative changes, such as IDD, are highly prevalent in the aging population and often catalyzed by sedentary behavior. Pathological conditions, including herniated discs, spinal stenosis, and sacroiliac joint dysfunction, commonly contribute to persistent lumbar pain through nerve compression and inflammation. While lifestyle factors such as obesity, poor ergonomics, and repetitive movements further worsen the situation, the psychological factors of anxiety and depression amplify the perception and chronicity of pain [5-7].

In this respect, the pathophysiology of back pain represents interdependent mechanical, inflammatory, and neurophysiological events. Degenerative changes in general, and intervertebral disc degeneration in particular, become a common contributor to pain in aging populations. Indeed, IDD results in lost disc height and elasticity with an alteration in spinal biomechanics, increasing the stress on adjacent structures. Degradation causes either microtears in the annulus fibrosus or herniation of the nucleus pulposus, which in turn compresses the nerves with inflammation, thus triggering pain both locally and radiating [5, 7].

Inflammation is a very important component during the course of LBP. This generally consists of the release of pro-inflammatory cytokines, such as TNF-α and mainly IL-1 and IL-6, due to mechanical injuries or degenerative changes. These mediators sensitize the nociceptors, enhancing pain perception and contributing to symptom chronicity. Chronic inflammation can lead to structural changes in surrounding tissues, thus further exacerbating the condition [1, 3].

In addition to mechanical and inflammatory mechanisms, neurophysiological processes are considered to make major contributions to the persistence of LBP. Peripheral sensitization includes a lowering of the threshold for the activation of nociceptors by repeated inflammatory or mechanical stimuli, whereby the area becomes hyperresponsive to pain. Over time, this can lead to central sensitization where the presence of persistent pain signals leads to changes within the CNS, such as increased synaptic transmission and decreased inhibitory control. Central sensitization forms the hallmark feature in chronic pain syndromes such as lumbar radiculopathy [5,8,9].

Other critical factors in the pathophysiology of LBP include muscle dysfunction. Most chronic pains lead to compensatory muscle spasms and imbalances—these involve mainly the paraspinal and core muscles. These dysfunctions promote instability in the lumbar spine, hence a vicious cycle of pain and muscular strain that complicates recovery [6, 10, 11]. Stress, anxiety, and depression are among such psychological factors that enhance the perception of pain and reduce the effectiveness of traditional treatments. These point to the need to address the biopsychosocial aspects of LBP [3, 7].

The conventional treatments performed on LBP frequently employ medicines and physical and alternative methodology. The pharmacological interventions, mainly NSAIDs and muscle relaxants, though widely prescribed, usually induce some adverse side effects, especially after considerable and continuous use. Considering other pillars of intervention: exercises that emphasize enhancing stamina, flexibility, and ensuring a correct posture—an often-used physical treatment option—can result only if patients use their full compliance. Since compliance cannot be entirely harnessed, further developments would have to depend fundamentally upon medications. Alternative interventions, such as acupuncture, massage, and yoga, have gained acceptance but are usually restricted in their availability and cost [3, 8, 10, 12].

Among these conventional methods, heat wraps have carved their niche as a non-invasive, easy, and inexpensive modality in the management of lower back pain. The principle behind heat wrapping is to increase blood flow to the affected area, relieving stiffness of the muscles, hence decreasing discomfort in the lumbar region. It has been shown in studies that heat wraps can reduce pain intensity, increase mobility, and reduce drug intake. Portable and easy to use, they prove quite useful for patients requiring immediate and sustained relief. Recent research further highlights the potential of continuous low-level heat therapy as a standalone or adjunctive treatment for managing lumbar pain [1, 3, 13, 14].

A common heat wrap would be made of a soft, breathable, flexible outer layer that contours easily around the lumbar region for comfort. In the core of the wrap, it contains the heating components, such as heat-emitting natural minerals that undergo an exothermic reaction with air, providing therapeutic heat. Advanced models of heat wraps can use additional layers to further improve heat distribution, retain moisture, and insulate the produced temperature. Some products incorporate adhesives or straps to secure the wrap in place, allowing users to move freely while undergoing therapy [3, 14].

The recommended usage for heat wraps typically involves applying the wrap directly to the skin over the lumbar region for 8-12 hours. This duration ensures a steady supply of low-level heat, which is crucial for sustained pain relief and improved mobility. The temperature is calibrated to remain within a therapeutic range, often between 40°C and 45°C (104°F to 113°F), to optimize comfort and efficacy while minimizing the risk of burns or irritation. Manufacturers often advise against prolonged use beyond the recommended time or applying the wrap to areas with compromised skin integrity [10, 12, 15, 16].

Heat wraps rely on controlled exothermic chemical reactions for heat generation, commonly involving the oxidation of iron. When the materials in the heat pad come into contact with oxygen, the resulting reaction produces a consistent, low-level heat output for several hours. Advanced versions of heat wraps incorporate temperature-regulating technology and sensors to maintain safety and efficacy. Some reusable wraps use electronic heating elements powered by batteries or USB connections, allowing users to adjust temperature settings according to their comfort and therapeutic needs [1, 13, 17, 18].

AIM

This review examines the physiological mechanisms behind heat therapy, its efficacy in relieving pain, and its role in improving mobility and quality of life.

MATERIALS AND METHODS

To provide a comprehensive review of scientific studies on the application of heat therapy for lumbar pain, a structured approach was employed to identify, analyze, and synthesize relevant literature. This methodology ensured a thorough exploration of evidence supporting the efficacy, mechanisms, and practical applications of heat therapy.

SEARCH STRATEGY

The review was based on a systematic search of peer-reviewed journals and databases, including PubMed, Scopus, Web of Science, and Google Scholar. Keywords were: "heat therapy," "heat wraps," "low back pain," "lumbar pain management," and "continuous low-level heat therapy". Boolean operators (AND, OR) were applied to refine searches and ensure comprehensiveness.

INCLUSION AND EXCLUSION CRITERIA

Inclusion criteria:

Articles published between 2010 and 2024 to ensure relevance and the inclusion of the most recent findings.

Studies examining the effects of heat therapy (e.g., heat wraps, thermal pads, electronic heating devices) on lumbar pain.

Research with clinical outcomes, including pain reduction, mobility improvement, and patient satisfaction.

Randomized controlled trials, observational studies, and meta-analyses providing quantitative or qualitative data.

Exclusion criteria:

Studies focusing on other pain conditions not related to the lumbar region.

Non-English articles unless a reliable translation was available.

Grey literature, including conference abstracts and unpublished theses.

DATA EXTRACTION

Key data were extracted from each selected study, including:

Study design and methodology.

Characteristics of the study population (e.g., age, severity of lumbar pain).

Type of heat therapy used (e.g., continuous low-level heat wraps, electronic devices).

Duration, frequency, and temperature parameters.

Measured outcomes, such as pain intensity (e.g., Visual Analog Scale), functional mobility, and quality of life metrics.

QUALITY ASSESSMENT

The methodological quality of the included studies was assessed using established criteria, such as the Cochrane Risk of Bias tool for RCTs and the Newcastle-Ottawa Scale for observational studies. Studies with low methodological rigor were excluded or their limitations noted in the analysis.

DATA SYNTHESIS

Findings from the reviewed studies were synthesized to highlight:

The physiological mechanisms underlying heat therapy.

Comparative efficacy of heat therapy versus other treatments for lumbar pain.

Optimal usage parameters (temperature, duration, and frequency).

Benefits, limitations, and patient-reported outcomes.

OVERVIEW OF REVIEWED STUDIES

Over 50 studies were initially identified, with 30 meeting the inclusion criteria after full-text review.

Studies spanned various geographic regions and settings, encompassing both acute and chronic lumbar pain cases.

The review incorporated findings from high-quality RCTs, observational studies, and systematic reviews to ensure robustness.

REVIEW AND DISCUSSION

Heat therapy has emerged as a versatile, non-invasive solution for managing lumbar pain, with consistent evidence supporting its efficacy across diverse populations and clinical contexts. The reviewed 30 studies highlight the broad applicability of heat therapy in reducing pain intensity, enhancing functional mobility, and improving quality of life. By integrating findings from clinical trials, systematic reviews, and observational studies, this discussion delves deeper into the specific outcomes, mechanisms, and limitations of heat therapy, supported by data and insights from diverse modalities and patient groups.

EFFECTIVENESS OF HEAT THERAPY

Numerous studies underscore the significant impact of heat therapy on lumbar pain management. In a randomized controlled trial, Chen et al. (2024) demonstrated that continuous low-level heat wraps, applied for 8 hours daily over 5 days, resulted in a 35% reduction in pain intensity and a 50% improvement in mobility, as measured by the Visual Analog Scale (VAS) and Oswestry Disability Index (ODI) [14,19]. Similarly, Desai et al. (2024) reported that deep heat therapy applied for 4 hours daily over a week achieved a 40% reduction in pain scores among 200 patients with herniated discs [15].

A systematic review by Ventriglia et al. (2024), analyzing 12 studies involving over 1,000 patients, concluded that continuous low-level heat therapy provided superior pain relief and functional recovery compared to placebo or cold therapy [3]. These findings confirm the robust physiological benefits of heat therapy in managing acute and chronic lumbar pain.

COMPARISON OF HEAT THERAPY MODALITIES

Different heat therapy modalities offer distinct advantages. Moist heat therapy has been particularly effective for patients with mixed chronic pain conditions. For example, Çolak et al. (2024) found that pregnant women using traditional heat compresses experienced a 60% reduction in pain intensity over a 4-week period [10]. In contrast, portable heating wraps demonstrated similar pain reduction while offering convenience, making them ideal for patients with active lifestyles or limited access to healthcare. Jo et al. (2024) observed a 40% reduction in pain and a 30% improvement in mobility in 90 patients using portable wraps for 6 hours daily [20, 21].

Studies also highlight the role of heat therapy in sports and occupational health. Aljameel et al. (2024) reported enhanced flexibility and reduced injury recurrence in athletes using pre-exercise heat therapy [7]. Such findings suggest that tailoring heat therapy to individual needs can maximize its therapeutic potential.

DURATION AND FREQUENCY

The duration and frequency of heat therapy applications significantly influence outcomes. Mokdad et al. (2024) found that 8 hours of heat therapy daily over a 7-day period reduced pain intensity by 45%, compared to a 25% reduction for shorter durations [1]. Similarly, Sikander et al. (2024) observed that combining shorter heat therapy sessions (2-3 hours daily) with massage yielded comparable benefits, highlighting the importance of complementary interventions [6].

PHYSIOLOGICAL MECHANISMS

The effectiveness of heat therapy lies in its ability to address multiple physiological mechanisms. Heat increases localized blood flow, delivering oxygen and nutrients to tissues while promoting the removal of inflammatory metabolites. This not only alleviates pain but also supports tissue repair. Karri et al. (2024) found that thermal pads used for 6 hours daily significantly lowered levels of inflammatory cytokines, such as TNF-α and IL-6, in post-surgical lumbar pain patients [22].

Moreover, heat therapy reduces muscle stiffness and relaxes the surrounding musculature, alleviating pressure on spinal structures and nerve roots. These effects are particularly beneficial in cases of chronic lumbar pain caused by muscular imbalances or inflammation.

APPLICATIONS IN SPECIAL POPULATIONS

Heat therapy has shown efficacy across diverse patient populations, including those with unique clinical needs. Pregnant women with lumbar pain benefited from traditional heat compresses, experiencing not only pain relief but also improved sleep quality [10, 23, 24]. Similarly, elderly patients using low-level heat therapy devices reported substantial improvements in mobility and reduced dependency on pain medications [25-27].

Athletes also experienced significant benefits from heat therapy. Pre-exercise sessions using localized heat enhanced flexibility, reduced muscular stiffness, and improved performance, as reported by Jo et al. (2024) [21]. These findings highlight the adaptability of heat therapy in addressing varied etiologies and patient profiles.

LIMITATIONS OF HEAT THERAPY

Despite its numerous benefits, heat therapy is not without limitations. Adherence to therapy recommendations is a common challenge. Rotramel et al. (2024) noted that 15% of patients struggled to maintain the recommended 8-hour daily application, potentially limiting its effectiveness [28].

Safety concerns also arise, particularly with chemical heat wraps and devices capable of reaching high temperatures. Cases of minor burns and skin irritation have been reported, especially in patients with reduced sensation, such as those with diabetic neuropathy [29-31]. Clear guidelines on application duration and temperature regulation are essential to mitigate these risks.

Additionally, individual variability in response to heat therapy poses challenges. Factors such as the severity of lumbar pain, underlying conditions, and baseline functional status influence outcomes. For instance, patients with inflammatory or neurological lumbar pain may require adjunct treatments to achieve optimal relief.

INTEGRATION INTO CLINICAL PRACTICE

Heat therapy's versatility and cost-effectiveness make it an invaluable component of lumbar pain management. It is particularly appealing as a non-invasive and patient-friendly option. However, integrating heat therapy into clinical practice requires standardized protocols to address its limitations. Future research should focus on optimizing treatment durations, improving device safety, and exploring its synergistic effects with other modalities, such as physical therapy and pharmacological interventions.

CONCLUSIONS

The reviewed evidence highlights the significant role of heat therapy in lumbar pain management. By reducing pain intensity, improving mobility, and addressing underlying physiological mechanisms, heat therapy offers a robust, non-invasive solution for patients across diverse populations. While limitations such as adherence and individual variability exist, the overall evidence strongly supports its integration into multidisciplinary treatment strategies. Continued research and innovation in heat therapy technology hold promise for further enhancing its efficacy and accessibility.

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CONFLICT OF INTEREST
The Authors declare no conflict of interest.

CORRESPONDING AUTHOR
Mateusz Trubalski
Student Scientific Association
at the Department of Rehabilitation and Orthopedics,
Medical University of Lublin,
Lublin, Poland;
email: mateusztrub@gmail.com

ORCID AND CONTRIBUTIONSHIP
Mateusz Trubalski: 0000-0002-2656-5398 A B D
Zuzanna Łuba: 0009-0003-2191-1321 B D
Marta Żerebiec: 0009-0003-7438-238X B D
Michał Bzoma: 0009-0008-9165-8735 B D
Joanna Niezbecka-Zając: 0000-0001-8591-4490 D E F

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