# LIFESTYLE INTERVENTIONS FOR ADULTS WITH NON-SPECIFIC CHRONIC LOW BACK PAIN; A SYSTEMATIC REVIEW.

**BY**

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**(BMS1802994)**

**A PROJECT SUBMITTED TO THE DEPARTMENT OF PHYSIOTHERAPY, SCHOOL OF BASIC MEDICAL SCIENCES, COLLEGE OF MEDICAL SCIENCES, UNIVERSITY OF BENIN.**

**IN PARTIAL FUFILLMENT OF THE REQUIREMENT OF THE AWARD OF BACHELOR OF PHYSIOTHERAPY (B.PT) DEGREE.**

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**OCTOBER, 2025.**

# CERTIFICATION

This dissertation by Omorogbe Rose Osahenrumwen is accepted in its presented form as satisfying the dissertation requirement of the degree of Bachelor of Physiotherapy of the School of Basic Medical Sciences, College of Medical Sciences of the University of Benin.

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# DEDICATION

I want to dedicate this project to God almighty, who has been by source, my essence and my rock. And to my parents, Mr Victor and Mrs Suzan Omorogbe for their unending love, support and prayers. And to my amazing brothers, Osasenaga and Osaretin.

# ABSTRACT

**Background:** Non-specific chronic low back pain (NSCLBP) is a prevalent musculoskeletal condition affecting adults all over the world. It often leads to disability, reduced quality of life, and high health care costs. In the absence of a specific pathological cause, lifestyle factors such as physical inactivity, poor posture, stress, and unhealthy habits have been identified as key contributors. Lifestyle interventions targeting these factors are increasingly recognized as effective, non-invasive approaches to managing NSCLBP and improving overall well-being.

**Aim of study:** The aim of this study is to synthesize the best available evidence from Randomized Controlled Trials (RCTs) on the effectiveness of lifestyle and related non-pharmacological interventions for improving pain, disability and functional outcomes in adults with Non-Specific Chronic Low Back Pain.

**Methods:** A systematic online search was conducted on PUBMED, Cochrane, PEDro, PsychInfo, Science Direct and Google Scholar. All steps of the process followed the recommendation of the PRISMA guidelines. The review included RCTs that evaluated lifestyle interventions such as exercise (e.g. core stabilization, strength training, Tai Chi), complementary and alternative medicine e.g. acupuncture, cupping therapy and biopsychosocial/behavioural approaches, manual therapy and technological based interventions for adults with NSCLBP. Methodological quality of included studies was appraised using the JADAD scale.

**Results:** A total of 27 RCTs met the inclusion criteria. The majority (88.89%) were of high methodological quality. Exercise-based interventions (51.85%) of studies including core stabilization and high intensity training consistently demonstrated significant improvements in pain and disability.

Complementary/alternative medicine (33.33%) of studies such as acupuncture and osteopathic manipulation showed promising results for pain relief.

Technology based and biopsychosocial interventions were also effective with the latter particularly successful in addressing fear-avoidance behaviours. However, a significant geographical skew was noted with 70.37% of the evidence originating from high income countries.

**Conclusion:** A diverse range of lifestyle and non-pharmacological interventions are effective for managing NSCLBP, with exercise serving as a corner stone of care. Biopsychosocial and Technological based approaches represent promising, modern strategies. To optimize patient outcomes, a personalized, multimodal management plan is recommended. Future research should address the identified evidence gap in low and middle-income countries and focus on longer term outcomes.

**Registration:** A review protocol was developed and registered with the PROSPERO database, with the ID: 1123743.

**Keywords:** Non-Specific Chronic Low Back Pain, Lifestyle Interventions, Systematic Review, Exercise Therapies, Biopsychosocial Model, Rehabilitation.

# ACKNOWLEDEMENTS

I am immensely grateful to God almighty for his grace and strength to complete this project. I want to thank my supervisor Dr E.N.D Ekechukwu for his guidance and assistance all through this research work. I also want to appreciate the Head of Department, Dr. MRS C.O Obaseki for her support and leadership and all the lecturers of the Department of Physiotherapy, University of Benin, Professor K.I. Oke, Prof. Obinna Ezeukwu, Prof J.O. Umunnah, Prof Mohammed Jubril, Dr E.N.D Ekechukwu, Rev Sr. Dr Henrietta Fawole, Dr. A. Aiyegbusi, Dr Adebisi Hammed, Dr Mrs Kubeyinje, Dr S.O. Bolarinde, Mr Okhuahesuyi Eguagie and Dr Nicholas Oghumu for the knowledge and lessons they imparted in me all through my years in school. I would like to appreciate the Non-academic staff especially Mr Nosa for his support. I would also like to thank the Head of Department at the University of Benin Teaching Hospital, Dr Taiwo Oyewumi, the Directors, Chiefs and Interns in the Department of Physiotherapy, UBTH, thank you so much for the clinical knowledge and skills you imparted in me. I also want to appreciate my friends; Angel, Victor, Zabdiel, Philip, Francess, Praise, Francis and all of my amazing classmates for their love and support.

I sincerely extend my heartfelt appreciation to PT. Francis Kolawole and PT. Grace Okolo for their unwavering contributions toward the successful completion of this project

Finally, I would love to extend my love and appreciation to parents, Mr Victor and Mrs Suzan Omorogbe for their love and encouragement and for bearing the financial burden of this project. And to my siblings; Osasenaga and Osaretin Omorogbe for their love and encouragement. I would also like to appreciate my Sister, Annabel and my Soul Sisters; Rachael and Oghomwen for always being there for me and for their love and encouragement. And to my Big Daddy, Sir Uyi Oloton (Uyi Technical), God bless you Sir.

# TABLE OF CONTENTS


| | |
|---|---|
| TITLE PAGE | i |
| CERTIFICATION | ii |
| DEDICATION | iii |
| ABSTRACT | iv |
| ACKNOWLEDEMENTS | v |
| TABLE OF CONTENTS | vii |
| LIST OF TABLES | xi |
| LIST OF FIGURES | xii |
| **CHAPTER ONE**: **INTRODUCTION** | 1 |
| 1.1 Background of the study | 1 |
| 1.2 Statement of the Problem. | 3 |
| 1.3 Research Questions | 4 |
| 1.4 Aim of the Study | 5 |
| 1.4.1 Specific Objective of the study | 5 |
| 1.5 Hypothesis | 6 |
| 1.5.1 Main Hypothesis | 6 |
| 1.5.2 Sub-Hypothesis | 6 |
| 1.6 Significance/justification of Study | 7 |
| 1.7 Scope and Delimitation | 8 |
| 1.8 Limitations of the study | 9 |
| 1.9 Definition of Terms/Operational Definition of terms | 9 |
| 1.10. List of Abbreviations | 11 |

**CHAPTER TWO: REVIEW OF LITERATURE** 13

2.1 Definition 13

2.1.2 Epidemiology and Burden of NSCLBP 13

2.1.3 Global Prevalence of NSCLBP: 14

2.2 The Paradigm Shift to Lifestyle and Non-Pharmacological Interventions 18

2.3 Empirical Evidence for Effective Lifestyle Interventions 19

2.3.1 Exercise-Based Interventions 19

2.3.2 Complementary and Alternative Medicine (CAM) 20

2.3.3 Biopsychosocial and Behavioral Interventions 21

2.3.4 Technology-Based Interventions 22

2.4 Evidence of Effectiveness of Lifestyle Interventions 22

2.4.1 Gender and Age-Specific Responses to Lifestyle Interventions 22

2.5 Anatomy of the Back and Its Relevance to Non-Specific Chronic Low Back Pain 23

2.5.1 The Vertebral Column 23

2.5.2 Regions of the Vertebral Column 24

2.5.3 Joints of the Vertebral Column 31

2.5.4 Muscles of the Back 31

2.5.5 Pathophysiology of Non-Specific Chronic Low Back Pain 33

2.6 Lifestyle Interventions: Definitions and Components 33

2.7 Evidence from Primary Research Studies 34

2.7.1 Physical Activity and Exercise Therapy 34

2.7.2 Posture 34

2.7.3 Weight Management and Diet 35

2.7.4 Sleep Hygiene 35

2.7.5 Psychological and Behavioral Interventions 36

2.8 Evidence from Systematic Reviews and Meta-Analyses 36

2.8.1 Limitations and Gaps in Current Knowledge 36

2.8.2. Rationale for the Systematic Review 37

2.8.3 Key Research Considerations 37

**CHAPTER THREE**: **MATERIALS AND METHODS** 39

3.1. Review 39

3.2. Study Criteria and Selection 39

3.2.1 Framework (PEOT) **Error! Bookmark not defined.**

3.3. Review Objectives 40

3.4. Selection Criteria 40

3.4.1 Inclusion Criteria 40

3.4.2 Exclusion Criteria 41

3.5. Search Strategy 41

3.6. Study Selection Process 42

3.7. Data Extraction 43

3.9. Data Synthesis and Analysis 44

3.10 Data Management 44

3.10. Ethical Considerations 45

3.11. Limitations of the Methodology 45

**CHAPTER FOUR**: **RESULTS** 47

4.1Results of Literature Search 47

4.2Summary of Methodological Quality of Included Studies 47

4.3 Summary of Methodological Quality of Included Studies 66

4.4 Summary of Methodological Qualities of the Studies Based on Interventions 68

4.5 Distribution of Studies Based on Location and Regional Economic Classification 70

4.6 Outcomes Assessed and the Utility Indices of their Outcome Measures 72

**CHAPTER FIVE** 74

**DISCUSSION AND CONCLUSION** 74

5.1 Discussion 74

REFERENCES 79

# LIST OF TABLES

Table 4.1: Summary of Methodological Quality of Studies (N = 27) 50

Table 4.2: Quality Appraisal table for included studies using JADAD 64

Table 4.3: Summary of Methodological Quality of Studies (n = 27) 67

Table 4.4: Summary of the Methodological Qualities of the Studies Based on Interventions (n=27) 69

Table 4.5: Summary of Categorical Grouping of Study Location (n = 27) 71

Table 4.6: Summary of Outcomes Used to Assess Chronic Low Back Pain Interventions (N = 27) 73

# LIST OF FIGURES

Figure 2.1 The Structure of the segments of the spine 27
Figure 2.2 Intervertebral Discs 29
Figure 2.3 Muscles of the back 32
Figure 4.1: PRISMA Diagram 49

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background of the study

Low back pain (LBP) is one of the most prevalent musculoskeletal disorders worldwide and is a leading cause of disability and reduced quality of life, affecting approximately 70–85% of people at some point in their lives (Maher et al., 2017). Among the various subtypes of LBP, Non-Specific Chronic Low Back Pain (NSCLBP) refers to pain in the lumbar region lasting more than 12 weeks without a diagnostic pathology such as infection, tumor, osteoporosis, fracture, structural deformity, inflammatory disorder, radiculopathy, or cauda equina syndrome (Koes et al., 2010; Balagué et al., 2012). It is non-specific in nature, where no pathoanatomical cause can be identified, poses a significant challenge for clinicians and researchers alike.

Despite extensive research, NSCLBP remains a complex and multifactorial condition that lacks a clearly defined cause, making diagnosis and management very challenging (Foster et al., 2018).

The burden of NSCLBP is immense, not only due to its high prevalence but also because of its impact on quality of life, occupational participation, and healthcare costs.

In developing nations like Nigeria, the growing prevalence of NSCLBP is further compounded by poor access to healthcare, limited diagnostic tools, and cultural attitudes toward pain and therapy (Mbada et al., 2015).

From a clinical perspective, NSCLBP is characterized by persistent or recurrent pain without a clear pathoanatomical origin. Its persistence is believed to result from a complex interplay between biological, psychological, and social factors, what is now recognized as the BIOPSYCHOSOCIAL MODEL of chronic pain (Engel, 1977; Hartvigsen et al., 2018). Factors such as muscular dysfunction, poor posture, post-hospital syndrome, fear-avoidance behaviors, depression, job dissatisfaction, and socioeconomic status have all been implicated in the development and perpetuation of NSCLBP (O'Sullivan, 2005; Vlaeyen & Linton, 2012).

Lifestyle and non-pharmacological management are a fundamental and effective approach in the conservative management of NSCLBP.

This broad category encompasses a diverse range of strategies including:

1. Exercise therapy: The cornerstone of management, these includes core stabilization, strength training, aerobic exercise and mind-body practices like Tai Chi and Qigong.
2. Complementary and Alternative Medicine (CAM): Such as acupuncture, cupping therapy and osteopathic manipulative treatment.
3. Biopsychosocial approaches: These addresses the intricate interplay between physical symptoms and psychological and social factors using modalities like cognitive functional therapy.
4. Technology-based interventions: These include Telerehabilitation and smartphone applications which have gained prominence for improving access and supporting self-management.

The absence of a globally effective intervention and the various nature of the condition highlight the necessity for continued synthesis of concrete clinical evidence. This systematic review aims to consolidate and evaluate recent research on NSCLBP, focusing on the effectiveness of lifestyle interventions, the underlying mechanisms, and the multidimensional aspects contributing to its persistence. This approach is expected to guide clinicians, especially physiotherapists, in improving treatment protocols based on current evidence and thereby improving patient outcomes.

Furthermore, the review seeks to critically evaluate the evidence for a broad range of lifestyle and non-pharmacological interventions for NSCLBP, to inform evidence-based practice and highlight areas for future research.

## 1.2 Statement of the Problem.

Non-specific chronic low back pain (NSCLBP) remains a common musculoskeletal disorder. It's non specificity in diagnosis is a growing concern in its effective approach and management amongst.

Despite the abundance of available interventions ranging from exercise therapy, manual techniques, pharmacological management, to emerging digital tools, the effectiveness of many of these strategies remains unclear, inconsistent, or only modestly beneficial (Jones et al., 2025; Gilanyi et al., 2024). Clinicians often face challenges in selecting the most appropriate evidence-based interventions due to variations in study design, outcome measures, and population characteristics across published literature.

Despite various treatment modalities, many patients continue to suffer from chronic back pain and functional limitations. Contemporary reviews indicate that fewer than 10% of non-surgical interventions produce clinically meaningful outcomes (Guardian et al., 2025), and evidence for emerging therapies such as AI-guided physiotherapy remains inconclusive (Kapil et al., 2025). These gaps highlight a need for improved, evidence-based physiotherapy strategies targeting NSCLBP's multifactorial causes.

Furthermore, adherence to rehabilitation programs is frequently low, and the biopsychosocial complexities of NSCLBP makes its management particularly difficult and challenging (Rose-Dulcina et al., 2024). While numerous randomized controlled trials and cohort studies have investigated individual modalities, there is a lack of synthesis that comprehensively compares the efficacy, patient adherence, and long-term outcomes of these interventions.

Given these discrepancies and the need for a consolidated understanding, a systematic review is necessary to critically evaluate, appraise, and synthesize the existing body of evidence regarding the most effective lifestyle interventions for NSCLBP. This will not only inform clinical decision-making but also identify gaps in the literature that require future research focus.

## 1.3 Research Questions

This systematic review was guided by the following research questions:

1. What is the effectiveness of various lifestyle and non-pharmacological interventions (e.g. Exercise, CAM, Biopsychosocial models, Technology-based) in reducing pain and improving functional status in adults with NSCLBP?

2. What is the methodological quality of the existing Randomized Controlled Trials (RCTs) evaluating these interventions?

3. What is the geographical distribution of the evidence based and what are the implications for global health equity?

## 1.4 Aim of the Study

The aim of this study is to systematically identify, evaluate, and synthesize current evidence on the effectiveness of lifestyle and non-pharmacological interventions for the management of non-specific chronic low back pain in adults.

### 1.4.1 Specific Objective of the study

1. To systematically review lifestyle interventions for adults with Non-Specific Chronic Low Back Pain in adults.
2. To identify, select and appraise RCTs investigating non pharmacological interventions for NSCLBP.
3. To categorize and narratively synthesize the findings based on intervention type (e.g. exercise based, CAM, Technology based).
4. To evaluate the effectiveness of these interventions in reducing pain intensity and improving functional outcomes especially postural effectiveness.
5. To analyze the geographical and economic distribution of the included studies and discuss the implication for evidence generation and application.
6. To identify the gaps in the existing literature and recommend areas for future clinical research in the lifestyle management of NSCLBP.

## 1.5 Hypothesis

### 1.5.1 Main Hypothesis

It is hypothesized that a comprehensive synthesis of the literature will demonstrate that life style and non-pharmacological interventions are effective in reducing pain and improving functional status in adults with Non-Specific Chronic Low Back Pain, with the magnitude of benefit varying by intervention type.

### 1.5.2 Sub-Hypothesis

1. Exercise based interventions will be the most extensively studied and will consistently show statistically significant and clinically relevant improvements in pain and disability outcomes.

2. Biopsychosocial interventions: Interventions based on biopsychosocial model (e.g. cognitive functional therapy) will demonstrate superior outcomes in reducing fear-avoidance behaviours and long-term disability compared to only physical approaches.

3. Complementary and Alternative Medicine (CAM): CAM interventions will show significant short-term efficacy in pain relief but the evidence for their long-term benefits will be less consistent.

4. Methodological Quality: It is hypothesized that the majority of included RCTs will be of high methodological quality as measured by the JADAD scale, but common limitations will include small sample sizes and inadequate blinding procedures.

5. Geographical distribution: It is hypothesized that the evidence based will be disproportionately skewed towards High-Income Countries (HICs) indicating a significant

gap in research from Low- and Middle-Income (LMICs) Countries despite the global prevalence of NSCLBP.

## 1.6 Significance/justification of Study

The significance of this study is as follows:

1. For clinical Relevance: This systematic review is of high clinical importance, particularly for physiotherapists, it provides a consolidated evidence base to guide clinical decision making, supporting the adoption of effective, multimodal and patient centered care plans for NSCLBP. Despite numerous treatment modalities, variations in outcomes and lack of standardization in clinical application remains a challenge (Delitto et al., 2021; Searle et al., 2021).
2. To Researchers: It identifies key gap in the literature, particularly the under representation of studies from Low- and Medium-Income Countries and the need for more robust long-term trials on technology-based and Biopsychosocial interventions.
3. To Patients: It validates a range of non-invasive and non-pharmacological management options, empowering them with knowledge about effective alternatives for self-managing their conditions.
4. Educational Impact: For physiotherapy students, early-career clinicians, and academic researchers, this review serves as a detailed reference that enhances understanding of both the complexity of NSCLBP and the methodology of evidence synthesis. It reinforces the need for a critical approach to lifestyle approaches and outcome evaluation in adults.
5. Economic and Public Health Implications: NSCLBP leads to significant healthcare utilization, absenteeism, and loss of productivity globally, particularly affecting developing countries with limited access to advanced care (GBD 2021 Low Back Pain Collaborators,

2023). In Nigeria and other low resource settings, conservative and lifestyle interventions such as postural education, exercise-based rehabilitation and patient education can reduce the long-term burden on individuals and healthcare systems (Igwesi-Chidobe et al., 2020). This review may help identify practical, affordable interventions with strong evidence for improving outcomes in such settings.

6. Policy and Practice Implications: The findings from this review will be essential in informing updates to clinical guidelines and physiotherapy protocols. It may also support advocacy for integrating lifestyle interventions into national pain management strategies and primary care pathways. Additionally, it can highlight gaps in policy implementation and access to conservative care, driving research and funding priorities (Knezevic et al., 2021; NICE, 2022).

## 1.7 Scope and Delimitation

This systematic review focuses on lifestyle interventions in the management of non-specific chronic low back pain (NSCLBP) in adults. The study covers literature published over the past 10 years (2014–2024) to ensure relevance to current clinical practice and research trends. The scope is defined by the following parameters:

1. Adults aged **18 years and above** diagnosed with **non-specific chronic low back pain**, persisting for more than 12 weeks with no identifiable specific underlying pathology (e.g., tumor, fracture, or infection). The study may include participants from diverse geographical regions and settings (outpatient clinics, rehabilitation centers, primary care).

2. The review included only Randomized Control Trials (RCTs) to ensure high standard evidence.

3. Only non-pharmacological, non-surgical interventions were considered.

4. The focus of the study was exclusively on Non-Specific Chronic Low Back Pain.

5. The search was limited to studies published in the English language

6. The synthesis was narrative due to clinical heterogeneity among the interventions; a meta-analysis was not conducted.

## 1.8 Limitations of the study

1. Language bias: The exclusion of non-English studies may have omitted relevant data, potentially introducing a language bias.
2. Narrative synthesis: The inability to perform a meta-analysis limits the capacity to provide pooled effect sizes and quantitative conclusions about the relative efficacy of interventions.
3. Inherent biases in primary studies: The quality of the review is dependent on the quality of the included studies, many of which had limitations such as small sample sizes and inadequate blinding.
4. Data base scope: Despite a comprehensive search, it is possible that some relevant studies indexed in databases not searched were missed.

## 1.9 Definition of Terms/Operational Definition of terms

1. Non-Specific Chronic Low Back Pain (NSCLBP): Low back pain persisting for more than 12 weeks without an identifiable specific pathology such as infection, tumor, fracture, structural deformity, or inflammatory disease. It is diagnosed based on symptoms and

exclusion of specific causes through clinical and imaging assessments. *(Maher et al., 2021; NICE, 2022)*

2. Systematic Review**:** A structured, comprehensive, and reproducible method of identifying, evaluating, and synthesizing all relevant studies on a specific topic using predefined criteria. It aims to minimize bias and provide reliable conclusions about interventions or outcomes. *(PRISMA Statement, 2020)*

3. Exercise Therapy: A planned and structured program of physical activities (e.g., core strengthening, aerobic training, stretching, motor control) designed to improve strength, flexibility, and endurance, and reduce pain in individuals with NSCLBP. *(Menezes Costa et al., 2022)*

4. Chronic Pain: Pain that persists or recurs for longer than three months and typically involves complex physical, psychological, and social factors. In NSCLBP, chronic pain is often associated with muscle tension, postural dysfunction, and psychological distress. *(IASP, 2020)*

5. Functional Disability: Limitations in performing daily activities due to pain or movement restriction. In NSCLBP, disability is often assessed using tools such as the Oswestry Disability Index (ODI) or Roland-Morris Disability Questionnaire (RMDQ). *(Fairbank & Pynsent, 2000)*

6. PRISMA: An acronym for Preferred Reporting Items for Systematic Reviews and Meta-Analyses. It is a widely accepted guideline used to enhance transparency and completeness in reporting systematic reviews. *(PRISMA Statement, 2020)*

7. Biopsychosocial Model: A framework that considers biological, psychological, and social factors in the understanding and management of chronic pain. This model underpins modern physiotherapy approaches to NSCLBP. *(Engel, 1977; Nicholas et al., 2021)*

8. Randomized Controlled Trial (RCT): A study design where participants are randomly allocated to an intervention group or a control group to compare the outcome of interest.

9. Complementary and Alternative Medicine (CAM): A diverse group of medical and health care systems, practices and products that are not typically considered pars of conventional medicine, such as acupuncture, cupping therapy and osteopathic manipulative treatment.

8. Kinesio phobia: Fear of movement-related pain, measured via the Tampa Scale of Kinesio phobia (Wikipedia, 2025a).

9. AI-Assisted Physiotherapy: Use of artificial intelligence platforms to guide exercise prescription and monitor progress (Kapil et al., 2025).

## 1.10. List of Abbreviations

i. LBP: Low back pain

ii. NSCLBP: Non-Specific Chronic Low Back Pain

iii. ODI: Oswestry Disability Index

iv. ACG: Active Control Group

v. CAM: Complementary and Alternative Medicine

vi. CST: Core Stabilization Training

vii. NPRS: Numeric Pain Rating Scale

viii. MT: Manual Therapy

ix. PFM: Pelvic Floor Muscle

x. JPS: Joint Position Sense

xi. FABQ: Fear avoidance Beliefs Questionnaire

xii. BET: Behavioural Exercise Therapy

xiii. HIC: High Income Country

xiv. LIC: Low Income Country

xv. MSDs: Musculoskeletal Disorders

# CHAPTER TWO

# REVIEW OF LITERATURE

## 2.1 Definition

Non-specific chronic low back pain (NSCLBP) is defined as low back pain persisting for 12 weeks or more without an identifiable pathoanatomical cause (Maher et al., 2017). It is one of the leading causes of disability worldwide, with considerable personal, occupational, social and economic implications (Wu et al., 2020). Unlike specific back pain due to identifiable pathologies like fractures or infections, NSCLBP has multifactorial origins, including mechanical, psychological, and lifestyle-related factors (Hartvigsen et al., 2018).

In recent years, there has been growing interest in lifestyle interventions as a non-pharmacologic and holistic management strategy for NSCLBP. Lifestyle interventions typically include physical activity, dietary modification, sleep hygiene, stress management, and behavioral changes aimed at improving quality of life and functional ability (Oliveira et al., 2018).

This literature review synthesizes current evidence from primary and secondary sources on the efficacy of lifestyle interventions for NSCLBP, with the aim of identifying knowledge gaps and establishing a rationale for the current systematic review.

### 2.1.2 Epidemiology and Burden of NSCLBP

Musculoskeletal disorders (MSDs) are one of the leading causes of disability worldwide and significantly burden healthcare systems, particularly in low- and middle-income countries.

**Global Burden:** According to the Global Burden of Disease (GBD) 2021, MSDs accounted for more than 1.7 billion people globally, making it the leading contributor to years lived with disability (YLDs). Low back pain (LBP) alone is one of the leading causes of disability globally (Vos et al., 2021).

### 2.1.3 Global Prevalence of NSCLBP:

Non-specific chronic low back pain is one of the most widespread and disabling health conditions affecting adults worldwide. It refers to persistent back pain lasting longer than twelve weeks without a clear underlying medical cause such as fracture, tumour, or nerve compression. Although it is often invisible to others, for many people it becomes a daily burden that restricts movement, limits productivity, and diminishes quality of life. What makes it particularly significant is that non-specific presentations account for the vast majority of all low back pain cases, with estimates suggesting about 85–95% fall into this category (World Health Organization [WHO], 2023).

The sheer scale of the problem is striking. In 2020, an estimated 619 million people across the globe were living with low back pain, making it one of the most common health conditions of adulthood. Projections suggest that this number could rise to over 843 million by 2050, largely because populations are both growing and ageing (WHO, 2023). Put simply, nearly one in every thirteen people worldwide is affected at any given time, and most of these cases are non-specific and frequently chronic.

Looking more closely, the point prevalence of low back pain meaning how many adults are experiencing it at a given moment is generally around 9–12% globally, while lifetime prevalence can reach as high as 84% (Hoy et al., 2014). Within this, chronic low back pain has been reported in 18–28% of adults across different populations, though estimates vary depending on the region, age group, and the methods used in research (Meucci et al., 2015). About one in five adults with low back pain develops long-lasting symptoms, and around 11–12% of the global population experiences significant disability related to chronic pain (Hoy et al., 2014).

Patterns emerge when considering who is most affected. The risk of chronic low back pain increases steadily with age, peaking in older adults, although the largest absolute number of cases occurs in people aged 50–55 years typically their most economically active years (WHO, 2023). Women tend to be more frequently affected than men, especially in later life (Kahere et al., 2022). Regionally, Central and Eastern Europe, Australasia, and North America report the highest age-standardized prevalence, while East Asia and the Andean regions have among the lowest. However, the steepest rises in coming decades are expected in Africa and Asia, where population growth and ageing are accelerating (The Lancet Rheumatology, 2023).

Sub-Saharan Africa provides a clear example of how occupation and environment shape prevalence. Reviews have found that among the general adult population in this region, between 18% and 28% report chronic low back pain, while in certain professions the burden is even higher. For instance, prevalence has been reported at around 30% among Ethiopian primary school teachers, nearly 49% among Nigerian farmers, and over 55% in Nigerian long-distance truck drivers (Besong et al., 2022). These figures illustrate how the physical demands of work, combined with limited access to early rehabilitation, can sharply increase the risk of pain becoming chronic.

The burden is not just physical but also social and economic. Chronic low back pain has been the single leading cause of years lived with disability worldwide for decades (Vos et al., 2021). It reduces quality of life, strains family resources, and creates significant economic costs through healthcare use and loss of productivity. These challenges are particularly acute in low- and middle-income countries, where rehabilitation services are scarce. WHO has emphasized the need for urgent action, recommending prevention programs, workplace interventions, and investment in rehabilitation that prioritizes education, exercise, and culturally appropriate care (WHO, 2023).

Despite its scale, gaps remain in how chronic low back pain is measured and understood. Many prevalence studies rely on cross-sectional surveys with varied definitions of chronicity, which can make direct comparisons difficult (Meucci et al., 2015). There is also a lack of large-scale, nationally representative studies in many developing countries. However, the evidence available consistently shows that non-specific chronic low back pain is not only common, but it is also rising in absolute numbers. It is therefore a condition that cannot be ignored, both for its impact on individuals and for its consequences on global health systems.

In summary, non-specific chronic low back pain affects hundreds of millions of adults worldwide and is projected to increase further as populations age. It disproportionately impacts people in their working years, is more common in women, and is especially burdensome in labour-intensive occupations. As the leading cause of disability worldwide, it carries profound personal and economic consequences. Addressing it requires both global and local responses, with stronger prevention strategies, equitable rehabilitation access, and recognition of the cultural and occupational contexts in which people experience pain. Chronic low back pain is not just a health issue, it is a societal challenge that reflects the intersection of biology, lifestyle, and environment, and its growing prevalence makes it one of the defining public health priorities of our time.

| Region | Prevalence: | |
|---|---|---|
| Globally, | 7.3%–20% | GBD 2021, Hartvigsen et al., 2018 |
| Africa | 32%–47% | Louw et al., 2007; Morris et al., 2018 |
| Europe | 19%–30% | Hoy et al., 2012 |
| Asia | 12%–23% | Wu et al., 2020 |
| USA | 25% | Shmagel et al., 2016 |

**Prevalence by Age:**

i. Non-Specific Chronic Low Back Pain is mostly common in adults aged 30–50 years.

ii. Prevalence increases with age, peaking between 50–69 years, then slightly declining.

iii. Children and adolescents may also report LBP, but chronicity is rare under 18.

**Prevalence by Gender:**

Women have a slightly higher prevalence of NSCLBP compared to men. Hormonal changes e.g. menopause, pregnancy, and caregiving roles may be contributing factors. WHO and GBD reports show:

Females: 20 to 25% prevalence

Males: 15 to 20% prevalence

Non-specific chronic low back pain is a pandemic musculoskeletal condition, representing a monumental challenge to global health systems and economies. The Global Burden of Disease Study consistently identifies LBP as the single leading cause of years lived with disability (YLDs) worldwide (Vos et al., 2020). Its point prevalence is estimated to affect approximately 540 million people globally at any given time, with most individuals experiencing a recurrent course (Hartvigsen et al., 2018).

The impact extends far beyond individual suffering. NSCLBP incurs enormous direct costs related to healthcare utilization (e.g., consultations, imaging, physiotherapy, surgery) and even greater indirect costs from lost productivity, absenteeism, and work disability (Dagenais, Caro, & Haldeman, 2008). The transition from acute to chronic pain is a critical juncture, with about 5-10% of patients developing chronic symptoms that account for up to 90% of the total costs associated with LBP (Maher, Underwood, & Buchbinder, 2017). This high prevalence and cost underscore the urgent need for effective, accessible, and sustainable management strategies.

## 2.2 The Paradigm Shift to Lifestyle and Non-Pharmacological Interventions

Historically, the management of LBP was dominated by a biomedical model focused on rest, passive modalities, and pharmaceutical pain relief. However, this approach has been increasingly discredited. Landmark clinical guidelines, notably from the American College of Physicians (Qaseem et al., 2017), now strongly recommend non-pharmacological therapies as the first-line treatment for chronic LBP. This shift is driven by several factors:

1. The Inefficacy and Risks of Pharmacotherapy: Widespread use of NSAIDs is linked to gastrointestinal and cardiovascular risks, while the opioid crisis has highlighted the dangers of long-term opioid use for a benign condition like NSCLBP (Deyo et al., 2015).

2. The Biopsychosocial Model: This model posits that NSCLBP is not merely a structural issue but a complex interaction of biological, psychological (e.g., fear, catastrophizing, depression), and social (e.g., work environment, social support) factors (Waddell, 2004). Effective management must address all these dimensions.

3. The Focus on Self-Management: Empowering patients to actively manage their condition through lifestyle changes is associated with better long-term outcomes and reduced healthcare dependency (Foster et al., 2018).

This paradigm has propelled lifestyle and non-pharmacological interventions to the forefront of evidence-based care.

## 2.3 Empirical Evidence for Effective Lifestyle Interventions

### 2.3.1 Exercise-Based Interventions

Exercise is the most extensively studied and recommended non-pharmacological intervention for NSCLBP. A Cochrane review comprising 249 RCTs concluded that exercise therapy, compared to minimal intervention, reduces pain and improves function in the short- and long-term (Hayden et al., 2021). However, the term "exercise" is broad, encompassing:

· Core Stabilization/ Motor Control Exercises: These target the deep trunk muscles (e.g., transversus abdominis, multifidus) to improve lumbopelvic stability. Studies by Waseem et al. (2019) and others have demonstrated superior reductions in disability compared to general physiotherapy.

· Strength and Resistance Training: Strengthening exercises for global muscle groups, including the gluteus medius (Onsy et al., 2024) and trunk extensors, have proven effective in reducing pain and improving functional performance.

Aerobic and High-Intensity Training (HIT): Studies like that of Verbrugghe et al. (2019) show that HIT can lead to greater improvements in disability and exercise capacity compared to moderate-intensity training, challenging the notion that patients with NSCLBP should avoid strenuous activity.

· Mind-Body Exercises: Practices like Tai Chi, Qigong (Yang et al., 2023), and Yoga integrate physical movement with mental focus and breathing, showing significant benefits for pain, function, and psychological well-being (Wieland et al., 2017).

### 2.3.2 Complementary and Alternative Medicine (CAM)

CAM therapies are widely used by patients seeking alternatives to conventional medicine. Some examples include:

1. Acupuncture: Evidence suggests that acupuncture is more effective than no treatment or sham acupuncture for short-term pain relief, though its specific effects versus non-specific effects (placebo) are debated (Yuan et al., 2016). Studies like Zaringhalam et al. (2010) have shown its efficacy, especially when combined with other therapies.

2. Manual Therapies: This includes osteopathic manipulative treatment (OMT), spinal manipulative therapy (SMT), and cupping. While some trials show OMT and SMT are superior to sham for pain and function (de Oliveira Meirelles et al., 2020; McCaskey et al., 2018), others, like Nguyen et al. (2021), report only small, clinically questionable effects.

3. Physical Modalities: Whole-body vibration (WBV) and whole-body electromyostimulation (WB-EMS) are emerging modalities. Wang et al. (2019) found WBV provided greater pain relief and functional improvement than general exercise, while Weissenfels et al. (2018) and Micke et al. (2021) demonstrated the efficacy and time-efficiency of WB-EMS.

### 2.3.3 Biopsychosocial and Behavioral Interventions

These interventions target the psychological and social components of the pain experience.

1. Cognitive Functional Therapy (CFT): This approach identifies and challenges unhelpful pain-related cognitions, emotions, and behaviors. The trial by Fersum et al. (2011) demonstrated that classification-based CFT produced superior outcomes, including reduced fear-avoidance and sick leave, compared to manual therapy and exercise.
2. Multidimensional Physiotherapy: As evaluated by Bemani et al. (2023), this approach integrates physical and psychological strategies, showing significant long-term pain reduction compared to usual physiotherapy.
3. Behavioral Therapy: Interventions like Behavioral Exercise Therapy (BET) aim to modify pain behaviors and reinforce healthy activity patterns, showing value as part of a multidisciplinary rehabilitation program (Semrau et al., 2021).

### 2.3.4 Technology-Based Interventions

The digital health revolution has introduced novel delivery methods for NSCLBP care.

1. Telerehabilitation and Online Programs: Alamouti et al. (2023) showed that online cognitive-motor training could significantly improve pain and psychological factors, offering accessibility for those with mobility or geographical constraints.
2. Smartphone Applications: App-based interventions, such as the "Relieve my back" app studied by Almhdawi et al. (2020), provide guided exercise, education, and self-monitoring, proving effective for office workers in reducing pain and disability.

## 2.4 Evidence of Effectiveness of Lifestyle Interventions

| Study/Author | Key Finding |
|---|---|
| Searle et al., 2015 | Structured exercise programs reduce pain and improve function in NSCLBP |
| Kamper et al., 2015 | Multidisciplinary biopsychosocial rehab is more effective than usual care |
| Chou et al., 2016 (ACP Guideline) | Recommends lifestyle modifications over pharmacological treatment as first-line |
| Gordon & Bloxham, 2016 | Regular physical activity improves pain thresholds and quality of life |
| Shiri et al., 2010 | Obesity is a significant modifiable risk factor for developing chronic LBP |

### 2.4.1 Gender and Age-Specific Responses to Lifestyle Interventions

1. Women: May respond better to mindfulness-based stress reduction and yoga, partly due to hormonal and psychosocial influences.

2. Older adults: Benefit from low-impact aerobic exercises, Tai Chi, and ergonomic aids.

3. Younger populations: Adherence is better with mobile health apps, gamified activity trackers, or peer-supported programs.

## 2.5 Anatomy of the Back and Its Relevance to Non-Specific Chronic Low Back Pain

Overview of the Back: The back is the posterior region of the trunk, extending from the neck to the buttocks. It consists of multiple structures that provide support, movement, and protection, including:

i. Skin and subcutaneous tissue
ii. Muscles (superficial and deep layers)
iii. Vertebral column (bones, discs, ligaments)
iv. Ribs (thoracic region)
v. Spinal cord and meninges
vi. Segmental nerves and blood vessels

Understanding these structures is crucial in researching Non-Specific Chronic Low Back Pain (NSCLBP)

### 2.5.1 The Vertebral Column

The vertebral column (spine) consists of 33 vertebrae and intervertebral discs, extending from the skull to the coccyx. It provides:

i. Protection for the spinal cord and nerves:
ii. Structural support for the body.
iii. Mobility (flexion, extension, rotation).
iv. Postural stability and shock absorption.

### 2.5.2 Regions of the Vertebral Column

The vertebral column, also known as the spine or backbone, is the central supporting structure of the human body. It forms the main axis of the skeleton and provides both stability and flexibility. It is composed of a series of individual bones known as vertebrae which are arranged vertically and separated by intervertebral discs that function as cushions to absorb shock and permit movement. Altogether, the vertebral column typically consists of 33 vertebrae, which are grouped into five distinct regions which are; cervical, thoracic, lumbar, sacral, and coccygeal regions. Each of these regions possesses unique structural and functional characteristics that reflect the demands placed upon them.

**The cervical region:** This forms the uppermost part of the vertebral column and is located within the neck. It consists of seven vertebrae (C1 to C7). These vertebrae are relatively small and delicate compared to those in other regions, yet they are highly mobile to accommodate the wide range of head and neck movements. The first cervical vertebra, known as the atlas, supports the skull and allows the nodding motion of the head, while the second vertebra which is known as the axis, contains a prominent upward projection called the odontoid process (or dens) which acts as a pivot for the rotation of the head. Collectively, the cervical vertebrae protect the spinal cord in the neck region, support the head, and facilitate movements such as flexion, extension, rotation, and lateral bending.

**The Thoracic region**: This lies below the cervical region and comprises twelve vertebrae, (T1 to T12). These vertebrae are larger and stronger than those of the cervical region because they bear more body weight. A distinctive feature of the thoracic vertebrae is their articulation with the ribs, forming the posterior portion of the rib cage. This rib attachment provides rigidity and protection for vital thoracic organs such as the heart and lungs. Though it limits the range of motion in this region compared to the cervical and lumbar regions. The thoracic spine plays a critical role in maintaining the stability of the upper body and in protecting the thoracic contents.

**The lumbar region:** This follows inferiorly to the thoracic region and consists of five vertebrae (L1 to L5). These vertebrae are the most massive and durable in the column, designed to withstand the greatest mechanical loads transferred from the trunk and upper body. These vertebrae are the largest in the vertebral column because they carry the majority of the body's weight and are subjected to significant mechanical stress during activities such as standing, walking, lifting, and bending. The lumbar vertebrae have large, kidney-shaped bodies and strong pedicles and laminae to provide additional support. This region allows for considerable movement, particularly flexion and extension, while maintaining stability. It is also the most common site for back pain and degenerative changes due to the mechanical demands placed upon it.

The lumbar region is particularly relevant to NSCLBP due to its high load-bearing function and susceptibility to degenerative changes (e.g., disc wear, facet joint arthritis).

**The sacral region:** This is inferior to the lumbar region and is composed of five fused vertebrae, known collectively as the sacrum. In adults, these vertebrae are permanently fused to form a single, triangular-shaped bone. The sacrum articulates with the fifth lumbar vertebra above and with the pelvic bones (the ilia) on either side at the sacroiliac joints thereby forming a strong connection between the spine and the pelvis. This fusion provides stability and serves as a solid base that transmits the weight of the upper body to the lower limbs. The sacrum also forms part of the posterior wall of the pelvic cavity and helps protect the internal organs within the pelvis.

**The coccygeal region:** Finally, at the base of the vertebral column lies the coccygeal region, commonly referred to as the coccyx or tailbone. It typically consists of three to five small vertebrae, which are also fused together in adulthood. Although the coccyx is considered a vestigial structure (a remnant of the tail present in other mammals), it still serves an important functional role by providing attachment points for ligaments, tendons, and muscles of the pelvic floor, which contribute to posture and support of pelvic organs. It also acts as a minor weight-bearing structure when a person is seated.

The vertebral column is an intricately designed structure divided into five functional regions, each contributing to the overall stability, flexibility, and protection of the central nervous system. Together, these regions work harmoniously to maintain posture, enable movement, and protect the spinal cord. They help carry out movement and functions that are fundamental to human biomechanics and essential for daily activities.

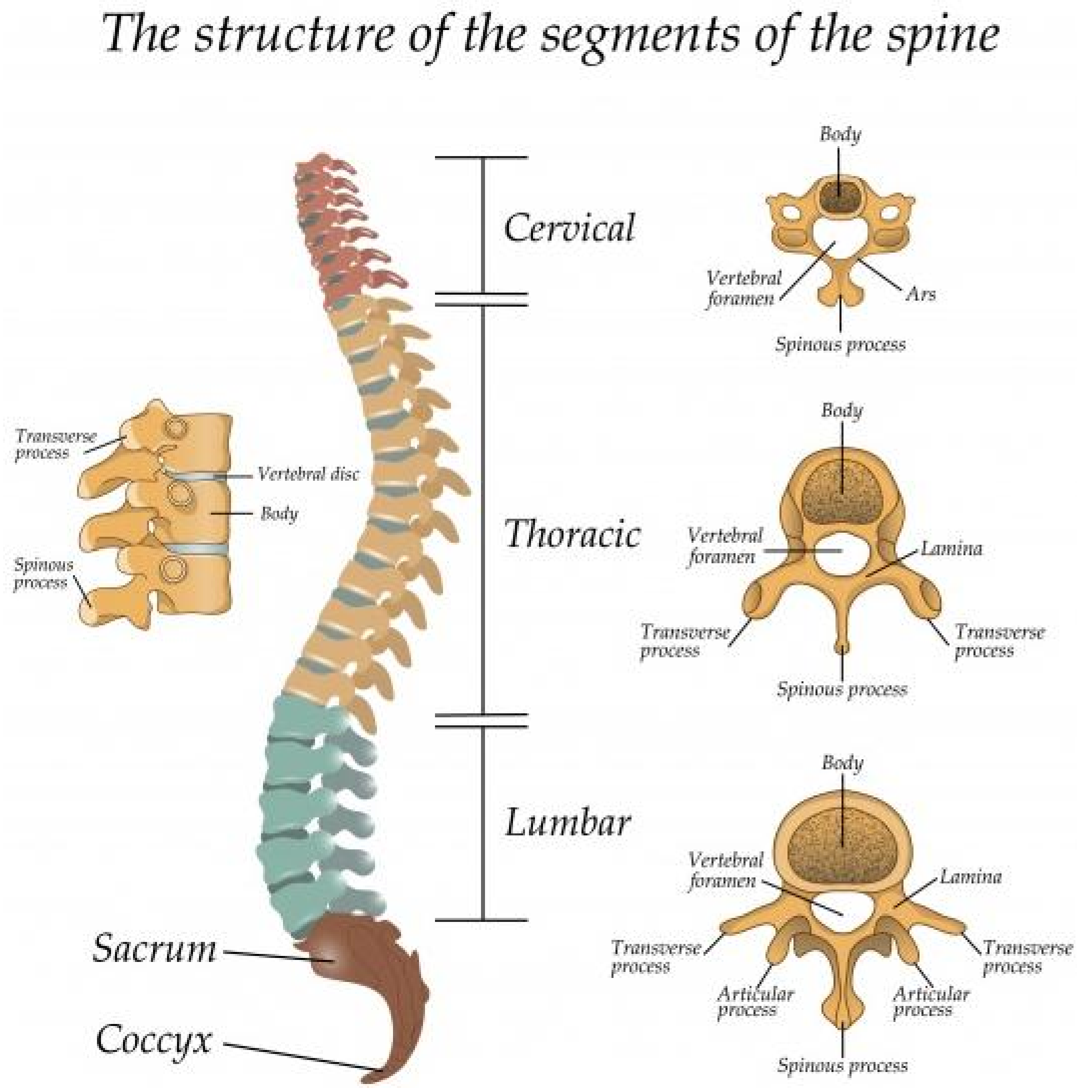


**Figure 2.1 The Structure of the segments of the spine (Semrau et al., 2021).**

### 2.5.2 Intervertebral Discs

i. Annulus fibrosus (outer fibrous ring): This helps to resist torsion and compression.
ii. Nucleus pulposus (gel-like core): This helps to absorb shock.
iii. Degeneration (loss of hydration, tears in annulus) contributes to chronic pain

The intervertebral disc is a fibrocartilaginous structure located between adjacent vertebrae in the spine. It serves as a shock absorber, allowing flexibility while maintaining stability in the vertebral column.

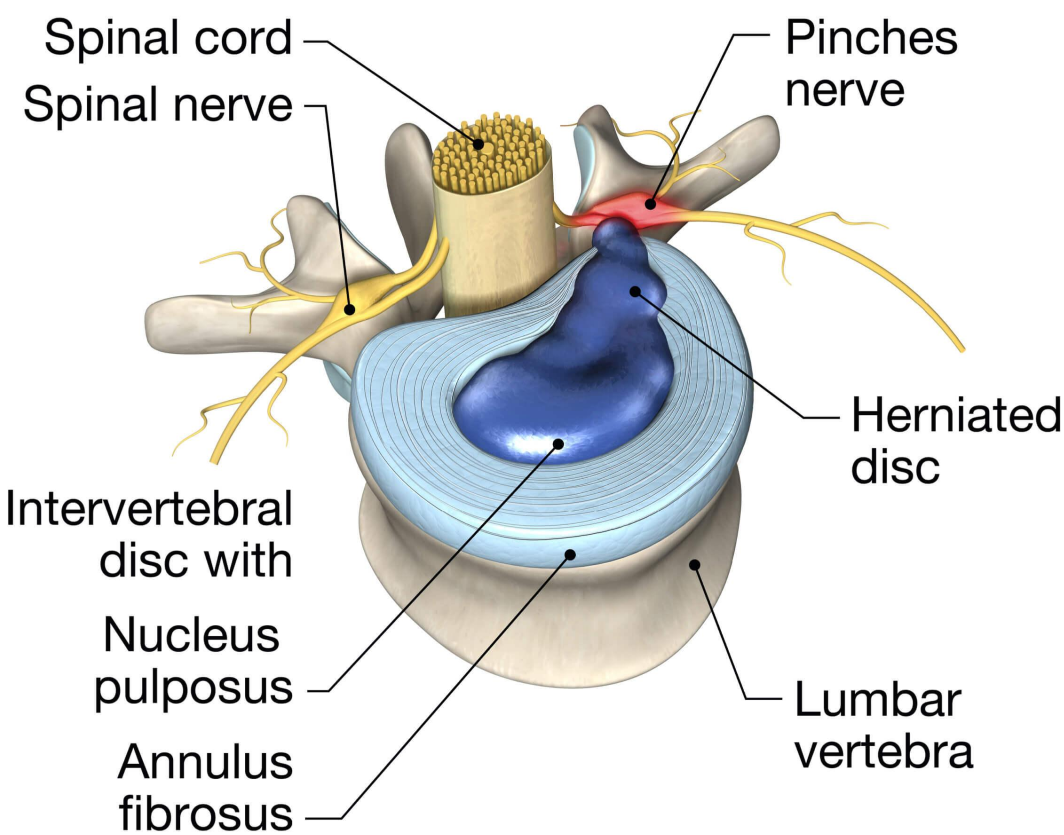


**Figure 2.2 Intervertebral Discs**

Each disc is composed of two main parts:

i. Nucleus Pulposus: This is the central, gel-like core.

It contains a high-water content and provides the disc with its cushioning properties.

ii. Annulus Fibrosus:

This is the tough, outer fibrous ring made of concentric layers of collagen.

It encloses the nucleus pulposus and maintains disc shape under pressure.

Functions of Intervertebral Discs:

i. Provide mobility to the spine (flexion, extension, rotation).

ii. Absorb and distribute mechanical loads during activities like walking, lifting, and sitting.

iii. Maintain the spacing between vertebrae, which allows spinal nerves to exit the spinal cord without compression.

**Clinical Relevance:**

Disc degeneration or herniation (commonly known as a "slipped disc") can lead to back pain, nerve compression, or sciatica.

These conditions are common in aging populations and individuals with poor posture or physically demanding jobs.

The health of intervertebral discs is essential for spinal integrity and overall musculoskeletal function.

### 2.5.3 Joints of the Vertebral Column

Facet (zygapophyseal) joints: guide spinal movement; osteoarthritis here can cause NSCLBP.

Sacroiliac joints: dysfunction is a common pain source.

Costovertebral joints: connect ribs to vertebrae.

**Spinal Curvatures include:**

i. Lordosis (cervical & lumbar) inward curve.

ii. Kyphosis (thoracic & sacral) outward curve.

iii. Abnormal curvatures (e.g., hyper lordosis, flat back) may contribute to chronic pain

### 2.5.4 Muscles of the Back

i. Extrinsic Muscles

Superficial layer (trapezius, latissimus dorsi, rhomboids): control limb movement.

Intermediate (serratus posterior) – assist in respiration.

ii. Intrinsic (Deep) Muscles

These muscles stabilize the spine and are critical in NSCLBP:

1. Superficial layer: Splenius capitis & cervicis (neck posture).

2. Intermediate layer: Erector spinae (iliocostalis, longissimus, spinalis) – extension and posture.

3. Deep layer: Transversospinalis (multifidus, rotatores) – fine control, stabilization.

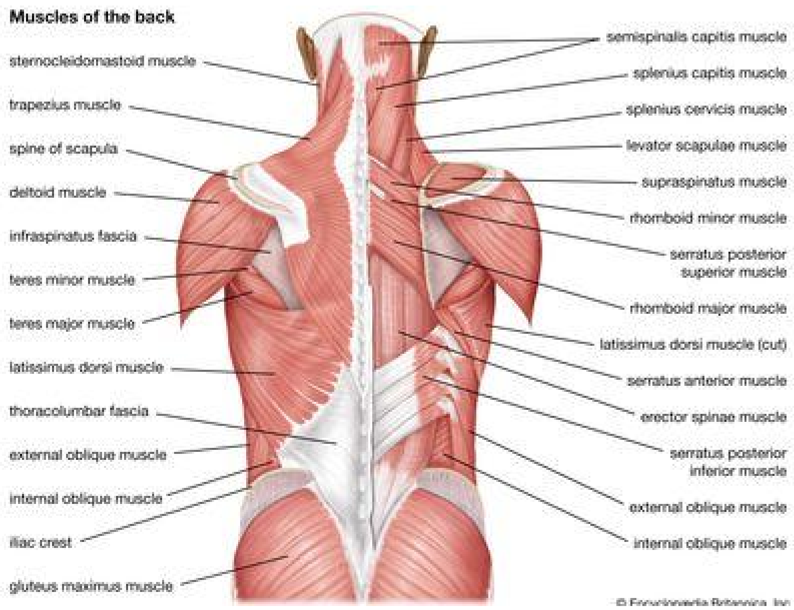


**Figure 2.3 Muscles of the back**

1. Multifidus weakness is strongly linked to chronic low back pain.
2. Muscle imbalances (tight hip flexors, weak glutes) can alter spinal mechanics.

### 2.5.5 Pathophysiology of Non-Specific Chronic Low Back Pain

While the exact pathogenesis of NSCLBP is unclear, several biopsychosocial factors are implicated. Risk factors include poor posture, sedentary lifestyle, obesity, sleep disorders, psychological distress, and physical deconditioning (Mansfield et al., 2021). These components are modifiable through lifestyle interventions, suggesting a promising avenue for prevention and management. NSCLBP arises from multifactorial causes including:

i. Muscle deconditioning (weak core, poor endurance).
ii. Facet joint degeneration
iii. Disc dehydration and microtrauma
iv. Altered movement patterns (compensatory motions).
v. Central sensitization (chronic pain pathways in the brain).

In conclusion, the back's complex anatomy which includes the vertebral structure, muscle function, and nerve interactions all play a critical role in NSCLBP. This research will focus on muscle strengthening, postural correction, and pain neuroscience to improve treatment outcomes through lifestyle intervention.

## 2.6 Lifestyle Interventions: Definitions and Components

According to the World Health Organization (WHO, 2018), lifestyle interventions are strategies that aim to modify behaviors associated with chronic diseases. For NSCLBP, these include:

i. Exercise therapy and physical activity

ii. Dietary changes and weight management

iii. Psychological interventions (e.g. CBT, stress reduction)

iv. Sleep hygiene

v. Smoking cessation and reduction of sedentary behavior

## 2.7 Evidence from Primary Research Studies

### 2.7.1 Physical Activity and Exercise Therapy

Exercise is one of the most researched interventions for NSCLBP. A randomized controlled trial by Hayden et al. (2021) found that individualized exercise programs, particularly those incorporating aerobic and core stabilization exercises, significantly reduce pain and disability. Similarly, a trial by Shnayderman & Katz-Leurer (2013) demonstrated improvements in pain scores and function after a 6-week supervised aerobic walking program.

### 2.7.2 Posture

This refers to the alignment and positioning of the body in various static (e.g., sitting, standing) and dynamic (e.g., walking, lifting) situations. Poor postural habits, especially sustained over time, are thought to contribute to spinal loading, muscular fatigue, and ultimately, low back pain.

**Evidence:**

A systematic review by Christensen et al. (2008) found weak associations between poor posture and LBP. More recent reviews (e.g., Caneiro et al., 2019) suggest that posture alone (e.g., slouching) does not consistently predict LBP and that pain is more related to *how* posture is maintained (rigidly or flexibly) than the actual alignment.

Research emphasizes movement variability and adaptability as being protective. According to van Dieën et al. (2019), individuals with NSCLBP often display reduced movement variability and altered motor control during functional tasks (e.g., bending, lifting).

### 2.7.3 Weight Management and Diet

Obesity is a known risk factor for LBP. A cohort study by Shiri et al. (2010) showed a strong correlation between increased BMI (Body mass index) and LBP (Low back pain) incidence. While studies on diet alone are limited, lifestyle programs combining dietary counseling and exercise show beneficial effects. For instance, a study by O'Dwyer et al. (2019) demonstrated that a multicomponent lifestyle intervention including dietary advice led to a 30% improvement in disability scores in patients with chronic LBP.

### 2.7.4 Sleep Hygiene

Poor sleep is associated with increased pain sensitivity and reduced coping mechanisms. Kelly et al. (2011) found that improving sleep quality using behavioral techniques helped reduce pain perception and improved function in NSCLBP patients. However, integration of sleep-focused strategies in typical back pain rehabilitation is still rare.

### 2.7.5 Psychological and Behavioral Interventions

CBT and mindfulness-based stress reduction (MBSR) have shown efficacy in reducing the emotional burden of NSCLBP. Cherkin et al. (2016) in a large RCT showed that MBSR significantly reduced pain intensity and improved function at 26 weeks compared to usual care.

## 2.8 Evidence from Systematic Reviews and Meta-Analyses

i. Oliveira et al. (2018): Concluded that lifestyle interventions focusing on increasing physical activity are moderately effective in improving pain and disability outcomes.

ii. Geneen et al. (2017): Found that combined lifestyle and psychosocial interventions are more effective than unimodal treatments.

iii. Maher et al. (2017): Reported that the effect size of physical interventions increases when combined with behavior change strategies like goal setting and motivational interviewing.

These reviews, while informative, often focused on individual modalities (e.g., exercise or CBT alone) rather than integrated lifestyle interventions.

### 2.8.1 Limitations and Gaps in Current Knowledge

1. Fragmented evidence: Most studies focus on single interventions (e.g., just exercise or CBT), with few studies examining holistic, multicomponent programs.

2. Lack of standardization: Variability in intervention duration, frequency, and content makes comparisons difficult.

3. Under-representation of low- and middle-income countries (LMICs) like Nigeria in large-scale trials.

4. Limited long-term follow-up: Most studies assess short-term outcomes (6–12 weeks), with few investigating sustained effects.

5. Lack of patient-centered outcomes: Most studies focus on pain and disability but ignore quality of life, work participation, and adherence.

### 2.8.2. Rationale for the Systematic Review

Given the increasing global burden of NSCLBP and the limitations of pharmacological and surgical interventions, lifestyle interventions offer a promising, cost-effective, and sustainable approach. However, the current literature is fragmented, with inconsistent methodologies and outcomes.

This systematic review seeks to:

i. Synthesize available evidence on the effectiveness of lifestyle interventions for adults with NSCLBP.

ii. Compare multicomponent and single component programs.

iii. Identify effective strategies tailored for real world and low resource settings.

iv. Highlight research gaps to inform clinical guidelines and future research.

### 2.8.3 Key Research Considerations

1. Biomechanical stress (prolonged sitting, poor lifting techniques).

2. Psychosocial factors (stress, depression, fear of movement).

3. Exercise therapy (strengthening, core stability).

4. CAM (Complementary and Alternative Medicine)

# CHAPTER THREE

# MATERIALS AND METHODS

## 3.1 Review

This review was done following the recommended reporting items for systematic reviews and meta-analysis (PRISMA) guideline (Page *et al.,*2020). The review protocol was structured, developed and registered with the Prospective Register of Systematic Review (PROSPERO) data base under ID: 1123743 to ensure a comprehensive and transparent process

## 3.2 Study Criteria and Selection

**3.2.1 Framework (PICOS):** The PICOS frame work was used to define the study criteria for inclusion.

**POPULATION (P):** Adults (18 years and above) diagnosed with Non-specific Chronic low Back Pain.

**INTERVENTION (I):** Non-pharmacological and non-surgical interventions. This included but not limited to:

i. Exercise based interventions (e.g. core stabilization, gluteus medius strengthening, high intensity training, Baduanjin, Qigong).

ii. Manipulative therapy).

iii. Complementary and alternative medicine (CAM) e.g. acupuncture, wet cupping, osteopathic manipulative treatment, whole body vibration).

iv. Technology based interventions e.g. online cognitive motor training, smart phone application-based rehab.

v. Biopsychosocial/Behavioural interventions (e.g biopsychosocial model-based therapy, behavioural exercise therapy)

**COMPARATOR (C):** Any comparison group, including placebo, no treatment, standard care and active interventions.

**OUTCOME (O):** Primary outcomes of interest were pain intensity and functional disability. Secondary outcomes included muscle strength and endurance, quality of life, balance and proprioception and psychological measures (e.g. fear/avoidance)

**STUDY DESIGN (S):** Randomized Controlled Trials (RCTs) were considered for inclusion to ensure the synthesis of high-level evidence.

## 3.2 Review Objectives

i. To identify and evaluate the effectiveness of lifestyle interventions on the management of NSCLBP in adults.

ii. To synthesize the types and outcomes of lifestyle-based strategies (e.g. posture and body mechanics, physical activity, diet, sleep, stress management) used in managing NSCLBP.

## 3.3 Selection Criteria

### 3.3.1 Inclusion Criteria

i. Adults aged 18 and above diagnosed with non-specific chronic low back pain (pain for more than 12 weeks without a specific underlying pathology).

ii. Published Randomized Controlled Trials (RCTs).

iii. Studies evaluating one or more of non-pharmacological interventions listed above.

iv. Studies reporting at least one of the pre specified outcomes (pain, disability, etc.).

v. Language: Studies published in English.

vi. Timeframe: Studies published between 2010 and 2025.

### 3.3.2 Exclusion Criteria

i. Studies on specific LBP (e.g., due to fracture, tumor, infection).

ii. Pediatric or adolescent populations.

iii. Non-randomized studies, observational studies, case reports, reviews, and editorials.

iv. Studies where full text was not available.

v. Studies not published in English language

### 3.5. Search Strategy

A comprehensive literature search was conducted to identify all relevant studies published in the following databases:

i. PubMed

ii. Cochrane Central Register of Controlled Trials (Cochrane)

iii. PEDro (Physiotherapy Evidence Database)

iv. PsychInfo

v. ScienceDirect

vi. Google Scholar (for grey literature)

**Search Terms (combined using Boolean operators):**

“Lifestyle intervention” OR “lifestyle modification” OR “physical activity” OR “exercise” OR “diet” OR “nutrition” OR “stress management” OR “sleep hygiene”

AND “chronic low back pain” OR “non-specific low back pain”

AND “adults”

The search strategy will be tailored for each database using appropriate MeSH terms and filters.

### 3.6. Study Selection Process

The study selection followed the PRISMA flow diagram:

1. Identification: All 500 records from database and hand searching were collated and duplicates were removed (0 duplicates identified).
2. Screening: Titles and abstracts of all 500 records were screened against the inclusion and exclusion criteria. This led to the exclusion of 454 records.
3. Eligibility: The full text of the remaining 46 articles was retrieved and thoroughly assessed for eligibility. 19 studies were excluded with reasons (ineligible participants, interventions, outcomes, and study design).
4. Inclusion: A final total of 27 studies were deemed eligible and included in the systematic review.

Title and abstract screening were done independently by two reviewers Rose Omorogbe (RO) and Chisom O. (CO). The both reviewers screened the eligible full text against the inclusion criteria, disagreements and conflicts was resolved between the reviewers and when consensus could not be reached, a third reviewer, Dr Nelson Ekechukwu (NE) was consulted for the final decisions. Rayyan was used for screening citations.

## 3.7. Data Extraction

Data from the included 27 studies were extracted by two reviewers (RO and CO) into a standardized, pre-piloted data extraction table. The data extraction was performed using Microsoft Excel 2016 and the extracted information included:

i. Author(s) and year
ii. Country of study
iii. Study design details
iv. Sample size and characteristics
v. Participants characteristics
vi. Type of lifestyle intervention
vii. Duration and frequency of intervention
viii. Comparator group
ix. Primary and secondary outcome measured
x. Key findings and conclusions

### 3.8. Quality Assessment of Included Studies

The methodological quality of included studies was critically appraised using the JADAD scale (Oxford Quality Scoring System).

Two reviewers performed the quality appraisal independently. Disagreements were resolved through consensus.

### 3.9. Data Synthesis and Analysis

Due to the significant clinical heterogeneity observed in the interventions. A meta-analysis was not deemed appropriate. Therefore, a narrative synthesis was employed. The findings were structured and presented by grouping studies into thematic categories based on the type of intervention.

i. Exercise-based interventions
ii. Manual therapy
iii. Complementary/alternative medicine
iv. Technology-based interventions
v. Biopsychosocial/behavioural interventions

Within these categories, the results, conclusion and methodological quality of the studies were summarized and discussed.

### 3.10 Data Management

All records retrieved from the data-based searches were managed using Rayyan to facilitate the removal of duplicates and organization of citations. The screening process was documented using the PRISMA Flow diagram. Data extraction and quality appraisal forms were created in a spreadsheet (Microsoft Excel) to systematically collate and store all relevant data from the included studies. This organized repository ensured accuracy and consistency throughout the review process.

## 3.10. Ethical Considerations

Ethical approval and standards in terms of transparency, proper citation, and data handling was strictly maintained.

## 3.11. Limitations of the Methodology

While this systematic review was conducted thoroughly, several methodological limitations should be acknowledged

1. Language bias: The exclusion of studies not published in English may have introduced language bias, potentially omitting relevant data from non-English speaking regions
2. High Clinical Heterogeneity: The wide varieties of interventions, dosages and treatment durations made it impossible to perform a meta-analysis, limiting the ability to provide pooled quantitative estimates of interventions effects.
3. Geographical imbalance: The evidence synthesized is predominantly from high income countries (70.37%) which may limit the generalization and applicability of the findings to low resource settings.
4. Limitations of included studies
5. Limited Database selection

## 3.12. Summary

This chapter presented the systematic and structured approach that was followed in conducting the review. A comprehensive search across six electronic databases and hand-searching identified 500 records, from which 27 RCTs met the strict inclusion criteria. The PICOS framework guided the study selection. Data was systematically extracted, and the methodological quality of included studies was appraised using the JADAD scale, finding the majority to be of high quality. Given the clinical diversity of interventions, a narrative synthesis was chosen over a meta-analysis to thematically summarize the evidence.

# CHAPTER FOUR

# RESULTS

## 4.1 Results of Literature Search

A total of five hundred studies (500) studies were generated from the search strategies. Title and abstract screening excluded 454 studies leaving behind 46 studies whose full text were screened based on the inclusion criteria and this further excluded 19 studies. Finally, a total of 27 studies were found suitable for this review as shown in figure 1.

## 4.2 Summary of Methodological Quality of Included Studies

All of the included studies reported randomisation of participants (100%). A majority described the use of a clear randomization sequence or allocation concealment (around 90%). However, only a smaller proportion of studies explicitly reported double-blinding procedures (approximately 70%). Most of the included studies demonstrated high methodological quality (about 85%), but a substantial number enrolled fewer than 100 participants (around 45%). Based on study quality and sample size, 85% of the included studies provided Level-1 evidence, while 15% provided Level-2 evidence as shown in Table 4.1.

The interventions assessed varied widely across trials and included: biopsychosocial model–based interventions (BPSM) (100%), online cognitive-motor control training (100%), pelvic floor muscle (PFM) exercises (100%), acupuncture (100%), qigong and strengthening exercises (100%), cupping therapy (100%), core training with breathing exercises (100%), manual therapy (MT) and exercise programs (100%), classification-based cognitive functional therapy (CB-CFT) (100%), gluteus medius (GMed) strengthening (100%), high-intensity training (HIT) and moderate-intensity training (MIT) (100%), perceptive rehabilitation (100%), core stabilization exercises (100%), wet-cupping therapy (100%), osteopathic manipulation treatment (OMT) (100%), whole-body electromyostimulation (WB-EMS) (100%), multidimensional physiotherapy (100%), app-based intervention ("Relieve my back") (100%), Baduanjin exercise (100%), spinal manipulative therapy (SMT) (100%), classification-specific postural intervention (CSPI) (100%), behavioural exercise therapy (BET) as part of rehabilitation (100%), whole-body vibration (WBV) (100%), mountain hiking combined with Mg-Ca-SO4 spa therapy (100%), tai chi (TC) and core stability training (CST) (100%).

Overall, the methodological quality was strong, but variation in blinding and small sample sizes in some studies remain as limitations.

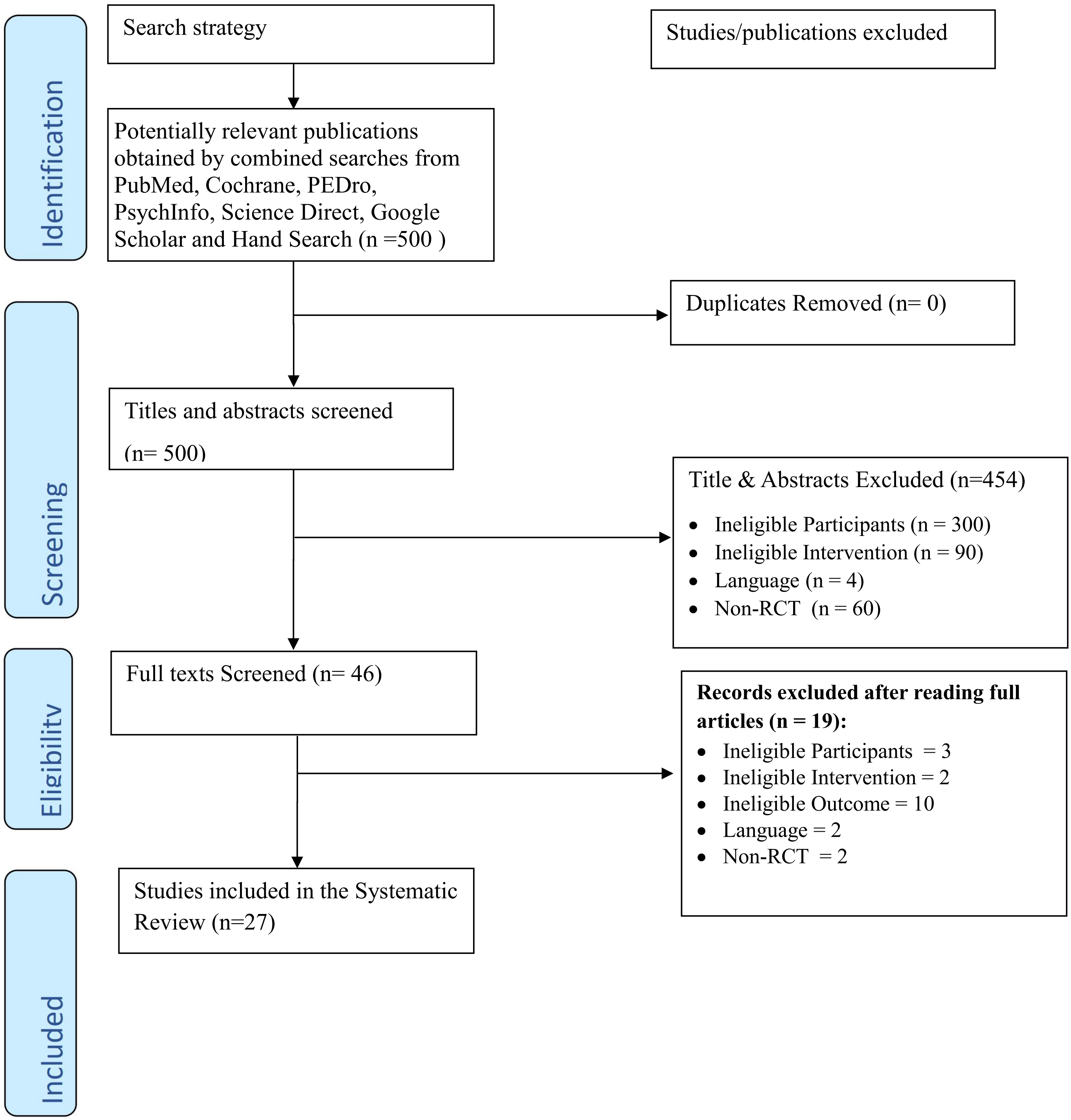


**Figure 4.1: PRISMA Diagram**

**Table 4.1: Summary of Methodological Quality of Studies (N = 27)**

| S/N | Study | Country | Study design | Sample size | Comparison | Outcome/measure | Result | Conclusion |
|---|---|---|---|---|---|---|---|---|
| 1 | Heidarimoghadam et al., 2023 | Iran | Randomized control trial | 200 | BPSM-based interventions | Quality of life (QOL) and physical activity | The independent-group t-test results revealed that the mean scores of quality of life (QOL) and physical activity significantly elevated in the intervention group, compared to the control. In addition, the mean value of disabilities, the amount of disorder in the lumbar region, and the VAS scores in the intervention group substantially declined compared to the control group. | The significant variations in the biopsychosocial factors demonstrated that the development of some interventions based on the bio-psychosocial model (BPSM) could help manage the NSCLBP and its ensuing disabilities. Therefore, the BPSM-based interventions could be exploited to minimize musculoskeletal disorders (MSDs) in students. |
| 2 | Alamouti, et al., | Iran | RCT | 44 | Online cognitive-motor | Pain, pain self-efficacy, avoidance of | There was a significant difference between the pre-test and post-test scores of the training group in pain, pain self-efficacy, avoidance of physical activity, and avoidance of work | The online cognitive-motor control training program can |

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| | 2023 | | | | control training program | physical activity, and avoidance of work | (P<0.001). In the control group, no significant difference was reported in these variables between the pre-test and post-test scores. | relieve pain and improve the pain-related psychological factors of people with non-specific chronic LBP. It can be used for this purpose in these people. |
| 3 | Mohseni-Bandpei et al., 2011 | Iran. | RCT | 20 | PFM exercise and routine treatment | Pain and functional disability | In both groups pain and functional disability were significantly reduced following treatment ($p < 0.01$), but no significant difference was found between the two groups ($p > 0.05$). All measurements were improved in both groups ($p < 0.01$) although patients in the experimental group showed greater improvement in PFM strength and endurance ($p < 0.01$). | It seems that the PFM exercise combined with routine treatment was not superior to routine treatment alone in patients with chronic LBP. |
| 4 | Zaringhalam et al., 2010 | Iran | RCT | 84 | Acupuncture + baclofen | Pain in patients with non-specific chronic LBP | After treatment, the baclofen, acupuncture and acupuncture + baclofen groups all had lower VAS and RDQ scores. Significantly higher reduction and improvement in VAS and RDQ scores were found in the acupuncture and acupuncture + baclofen groups compared to the baclofen group. | The present study indicates that the combined treatment of acupuncture and baclofen is more effective than baclofen treatment alone to reduce pain in patients with non-specific chronic LBP. |
| 5 | Sotiropoulos et al., 2025 | Greece. | RCT | 42 | Qigong and strengthening exercises, | Pain perception, disability, kinesiophobia, and proprioception | Both groups showed significant within-group improvements in pain perception, disability, kinesiophobia, and proprioception ($p<0.05$). However, no statistically significant between-group differences were observed. A trend toward greater | Qigong and strengthening exercises, when combined with physiotherapy, are |

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| | | | | | when combined with physiotherapy, | | kinesiophobia reduction in the Qigong group (p=0.069) suggests a potential psychological benefit. | equally effective in improving CNSLBP symptoms. Future research should explore longer interventions (>12 weeks) and larger trials to determine whether Qigong offers distinct advantages over conventional exercise programs. |
| 6 | Gohil, P., & Mishra, P. (2025) | - | RCT | 70 | Cupping therapy | Pain relief and disability | Both groups showed significant improvement in ODI and VAS scores. The cupping therapy group demonstrated faster pain relief and greater reduction in disability, with VAS reducing from 7.5 to 1.2 and ODI from 59.1 to 18.2. Standard care showed gradual improvement with VAS decreasing from 7.4 to 2.6 and ODI from 58.3 to 29.3. | Cupping therapy is effective for short-term relief in CNSBP, whereas standard physiotherapy ensures sustained improvement. A combined approach may yield optimal outcomes in managing chronic low back pain. |
| 7 | Li et al., 2025 | China | RCT | 18 | Core training with breathing exercises | CNLBP symptoms, pain, muscle strength | The combined group showed significantly greater pain reduction, functional improvement, and muscle strength enhancement compared to the other groups. | Core training with breathing exercises is more effective in alleviating CNLBP symptoms, |

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| | | | | | | | | highlighting the added value of integrating breathing exercises. |

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| 8 | Sipaviciene, S., & Pilelis, V. (2024) | Lithuania | RCT | 60 | Exercise program and manual therapy | Functional status. | After MT, disability was reduced by 70% ($F = 42.2$; $p < 0.00$; $\eta 2p = 0.99$) and pain was reduced by 78% ($F = 4.9$; $p < 0.00$; $\eta 2p = 0.51$). After exercise therapy, disability and pain were reduced by 78% ($F = 11.5$; $p < 0.00$; $\eta 2p = 0.78$) and 68% ($F = 9.4$; $p < 0.00$; $\eta 2p = 0.41$), respectively. Muscle endurance and lumbar spine mobility values were significantly higher in both groups after 6 weeks of intervention ($p < 0.00$). After 12 MT interventions, lumbar spine mobility increased by 40% ($F = 1.9$; $p < 0.00$; $\eta 2p = 0.24$) and after exercise therapy by 38% ($F = 28.4$; $p < 0.00$; $\eta 2p = 0.82$). Abdominal muscle endurance improved by 29% ($F = 24.2$; $p < 0.00$; $\eta 2p = 0.79$) after MT and by 34% ($F = 57.6$; $p < 0.00$; $\eta 2p = 0.67$) after exercise therapy; back muscle endurance improved by 18% ($F = 48.6$; $p < 0.00$; $\eta 2p = 0.78$) after MT and by 20% ($F = 14.2$; $p < 0.00$; $\eta 2p = 0.76$) after exercise therapy. After 6 weeks of intervention, there was no statistically significant difference between the pain, disability, and spinal mobility groups ($p > 0.05$). However, differences between groups in kinesiophobia ($p = 0.02$), back ($p < 0.02$) and abdominal ($p < 0.03$) muscle endurance values were statistically significant. | Following the home exercise program and manual therapy, or the home exercise program and supervised exercise, LBP and disability had clinically significant reductions and functional status showed improvement. |
| 9. | Fersum | Nor | RCT | 121 | CB-CFT | Fear avoidance | There were also clinically and statistically significant reductions | This thesis support |

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| | , K. V. (2011). | way | | | | behaviours, pain intensity and change in Oswestry Disability Index (ODI) | in fear avoidance behaviours (physical activity and work), the Orebro multidimensional questionnaire, the Hopkins symptoms check list and reduced need for ongoing care in favour of CB-CFT. The subjects in the CB-CFT group also reported a 3 times less likelihood to have time off work due to their disorder when compared to the MT-EX group. The results supported the use of classification based 'cognitive functional therapy' for NSCLBP as it produced superior outcomes compared to traditional physical therapies. | the need for sub-classification and targeted treatment for NSCLBP based on a biopsychosocial construct. |
| 10. | Onsy et al., 2024 | Egypt | RCT. | 58 | GMed strengthening exercises | Disability, and pain, and functional performance | For groups A and B, the percentage of change in pain was 40%, and 66.67% and that of disability level was 45.24%, and 61.5%, in favor of group B. The between-group comparison revealed significant differences for pain (p = 0.001) but not for functional disability (p = 0.12). There was a significant difference in GMed thickness for average relaxed (p = 0.009), and average contracted (p = 0.043) in both groups post-treatment but not for activation (p = 0.063). GMed strength changed by 13.1% and 21.8% in groups A and B respectively but no significant differences were observed between groups (p = 0.44). The percentage of change in the SLST was 20.6% and 58.8% for Groups A and B respectively, with a significant between-group comparison (p = 0.04). | GMed strengthening exercises improved GMed macromorphology, reduced disability, and pain, and enhanced functional performance. It may therefore be advised that patients with NSCLBP incorporate strengthening of the GMed muscle in their treatment program. . |
| 11 | Verbrugghe et al., 2019 | Belgium | RCT | 38 | High-intensity training | Exercise capacity | Thirty-eight participants (HIT: n =19,MIT:n = 19) were in cluded (mean age, 44.1 yr, SD = 9.8, 12 males). Groups did not differ at baseline. Between group differences (P < 0.01) in favor of HIT were found for MODI, V ˙O2max, and cycling time. Within group improvements (P < 0.01) were found in both groups on MODI (HIT:−64%, MIT: −33%), Numeric Pain Rating Scale (HIT, −56%; MIT, −39%), Patient-Specific Functioning Scale (HIT:+37%, MIT:+39%), V | High-intensity training proved to be a feasible, well tolerated, and effective therapy modality in CNSLBP. Moreover, it shows greater improvements on dis |

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| | | | | | | | ˙O2max (HIT: +14, MIT:+4%), cycling time (HIT:+18%, MIT:+13%), and back muscle strength (HIT:+10%, MIT:+14%). | ability and exercise capacity than a similar ET performed at moderate intensity. |
| 12. | Morone et al., 2012 | Italy | A randomised control trial | 75 | Perceptive rehabilitation | Pain relief | General pain relief was recorded in all the groups, which was elicited more quickly in the perceptive treatment group; significant differences in pain scores were observed at the end of treatment ($P < 0.001$ for visual analogue scale and $P = 0.001$ for Questionnaire) versus the other groups. Disability scores in the perceptive group did not differ significantly from those in the other group, whereas these scores significantly differed between Back School and control groups at the follow-ups ($P < 0.01$ for both scales). | Perceptive rehabilitation has immediate positive effects on pain. Back School reduces disabilities at follow-up. |
| 13. | Waseem et al., 2019 | Pakistan | RCT. | 120 | Core stabilization exercises and routine physical therapy | Disability | Significant reduction in disability was observed in both groups at the end of the second, fourth, and sixth week of treatment ( $p$ value $<$ 0.05). The mean reduction in disability as measured by ODI score was 39.44 $\pm$ 14.64 for Group A and 31.91 $\pm$ 12.31 for Group B. | A larger reduction in disability was observed for subjects treated with core stabilization exercises in comparison to those treated with routine physical therapy. |
| 14 | Mardani-Kivi et al., 2019 | Iran | RCT | 180 | Wet-cupping therapy | PNSLBP | There was no significant difference in demographic characteristics (age, gender, and body mass index) between the two groups (P>0.05). Therapeutic effect of wet-cupping therapy was comparable to conventional treatment in the 1st month follow-up visits (P<0.05). The functional outcomes of wet-cupping at the 3rd and 6th month visits were significantly | Wet-cupping may be a proper method to decrease PNSLBP without any conventional treatment. The |

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| | | | | | | | increased compared to the conventional group. Final ODI scores in the wet-cupping and conventional groups were 16.7 ± 5.7 and 22.3 ± 4.5, respectively (P<0.01). | therapeutic effects of wet-cupping can be longer lasting than conventional therapy |
| 15. | de Oliveira Meirelles et al., 2020 | Brazil | RCT | 42 | Osteopathic manipulation treatment | Low back pain | The final chronic nonspecific low back pain in both groups was significantly lower than the initial low back pain (p< 0.01) and the final chronic nonspecific low back pain of the OMTG was significantly lower than that of the ACG (p= 0.001). | This study demonstrated that the treatments were effective in both groups. However, the efficacy of the osteopathic manipulation treatment was greater than that of the therapeutic exercises. |
| 16 | Weissenfels et al., 2018 | Germany | RCT | 30 | WB-EMS | chronic nonspecific LBP and maximum trunk strength | At baseline, no group differences apart from nonregular exercise were observed. Mean intensity of LBP decreased significantly in the WB-EMS group (P=0.002) and remained unchanged in the CG (P=0.730), with a significant difference between both groups (P=0.027). Maximum isometric trunk extensors improved significantly in the WB-EMS group (P=0.005), while no significant difference was seen in the CG (P=0.683). In contrast to the significant difference between WB-EMS group and CG for the latter parameter (P=0.038), no intergroup difference was determined for maximum isometric trunk flexors (P=0.091). The WB-EMS group showed a significant increase of this parameter (P=0.003), while no significant change was determined in the CG (P=0.563). | WB-EMS is a time-effective training method for reducing chronic nonspecific LBP and increasing maximum trunk strength in people with such complaints. After this promising comparison with a nonactive CG, research needs to be extended to include comparisons with active groups (WB-Vibration, |

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| | | | | | | | | conventional back strengthening). |
| 17 | Bemani et al., 2023 | Iran | RCT | 70 | Multidimensional physiotherapy and usual physiotherapy | Pain | There were 17 men and 18 women in the experimental group (mean [SD] age, 34.57 [6.98] years) and 18 men and 17 women in the active control group (mean [SD] age, 35.94 [7.51] years). Multidimensional physiotherapy was not more effective than usual physiotherapy at reducing pain intensity at the end of treatment. At the 10 weeks and 22 weeks follow-up, there were statistically significant differences between multidimensional physiotherapy and usual physiotherapy (mean difference at 10 weeks, -1.54; 95% CI, -2.59 to -0.49 and mean difference at 22 weeks, -2.20; 95% CI, − 3.25 to − 1.15). The standardized mean difference and their 95% confidence intervals (Cohen's d) revealed a large effect of pain at 22 weeks: (Cohen's d, -0.89; 95% CI (-1.38 to-0.39)). There were no statistically significant differences in secondary outcomes. | In this randomized controlled trial, multidimensional physiotherapy resulted in statistically and clinically significant improvements in pain compared to usual physiotherapy in individuals with NSCLBP at 10 and 22 weeks. |
| 18. | Almhdawi et al., 2020 | Jordan | RCT | 40 | 'Relieve my back' application | Quality of life, pain and disability | Following six weeks of using the application, compared to CG, the EG group demonstrated significant decrease in pain intensity (−3.45 (2.21) vs −0.11 (1.66), $P < 0.001$), in ODI score (−11.05 (10.40) vs −0.58 (9.0), $P = 0.002$), and significant increase in physical component of SF-12 (12.85 (17.20) vs −4.63 (12.04), $P = 0.001$). | 'Relieve my back' application might be efficacious in reducing pain and disability and improving the quality of life of office workers with non-specific LBP. |
| 19. | Nguyen et al., 2021 | France. | RCT | 200 | Standard OMT | Pain | Overall, 200 participants were randomly allocated to standard OMT and 200 to sham OMT, with 197 analyzed in each group; the median (range) age at inclusion was 49.8 (40.7-55.8) years, 235 of 394 (59.6%) participants were women, and 359 of 393 (91.3%) were currently working. The mean (SD) duration of the current LBP episode was 7.5 (14.2) months. Overall, 164 | In this randomized clinical trial of patients with nonspecific subacute or chronic LBP, standard OMT had a |

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| | | | | | | | (83.2%) patients in the standard OMT group and 159 (80.7%) patients in the sham OMT group had the primary outcome data available at 3 months. The mean (SD) Quebec Back Pain Disability Index scores for the standard OMT group were 31.5 (14.1) at baseline and 25.3 (15.3) at 3 months, and in the sham OMT group were 27.2 (14.8) at baseline and 26.1 (15.1) at 3 months. The mean reduction in LBP-specific activity limitations at 3 months was −4.7 (95% CI, −6.6 to −2.8) and −1.3 (95% CI, −3.3 to 0.6) for the standard OMT and sham OMT groups, respectively (mean difference, −3.4; 95% CI, −6.0 to −0.7; P = .01). At 12 months, the mean difference in mean reduction in LBP-specific activity limitations was −4.3 (95% CI, −7.6 to −1.0; P = .01), and at 3 and 12 months, the mean difference in mean reduction in pain was −1.0 (95% CI, −5.5 to 3.5; P = .66) and −2.0 (95% CI, −7.2 to 3.3; P = .47), respectively. There were no statistically significant differences in other secondary outcomes. Four and 8 serious adverse events were self-reported in the standard OMT and sham OMT groups, respectively, though none was considered related to OMT. | small effect on LBP-specific activity limitations vs sham OMT. However, the clinical relevance of this effect is questionable. |

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| 20. | Yang et al., 2023 | China | RCT. | 60 | Baduanjin exercise | Pain | After treatment, the numeric pain rating scale score in the Baduanjin group exhibited a significant decrease compared to baseline (P < .05) and was found to be lower than that of the Walking group (mean difference 2.36; CI 95% −2.323 to −1.742; P = .001). Similarly, the Oswestry disability index in the Baduanjin group demonstrated a reduction compared to baseline (P < .05) and was lower than that of the Walking group (the mean difference 7.59; CI 95% −8.861 to −6.312; P = .001). The FLEXAEMG and EXTAEMG of both groups had a significant increase (P < .05), with the Baduanjin group demonstrating higher levels compared to the Walking group (P < .05). Conversely, the MAEMG of both groups displayed a significant decrease (P < .05), with the Baduanjin group exhibiting lower levels than the Walking group (P < .05). The FLEXAEMG to MAEMG and EXTAEMG to MAEMG in the Baduanjin group increased (P < .05) and were significantly higher than the Walking group (P < .05). | Baduanjin exercise has shown to be highly effective in reducing low back pain and in promoting lumber dysfunction, due to its ability to improve the strength and flexibility of the lumbar erector spinae muscle. |
| 21 | McCaskey et al., 2018 | Switzerland | RCT | 32 | SMT | Functional status and pain | At 4-week follow-up, there was a significant improvement by 12 percentage points (pp) on the functional status questionnaire in the SMT-group (95% confidence intervall (CI) = 5.3pp to 17.7pp, p < 0.001) but not in the control group (4 pp improvement, CI = 11.8pp to 19.2pp). However, group-by-time interaction effects for functional status (Q = 3.3, 19 p = 0.07) and pain (Q = 0.84, p = 0.51) were non-significant. Secondary kinematic outcomes did not change over time in either of the groups | Despite significant improvement of functional status after SMT, overall findings of this exploratory study suggest that SMT provides no added benefit for pain reduction or functional improvement in patients with moderate chronic non-specific low |

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| | | | | | | | | back pain. |
| 22 | Micke et al., 2021 | Germany | RCT | 80 | WB-EMS, WBV, and CT | Maximal isometric strength | Similar findings were observed for maximal isometric strength parameters with a significant increase in all groups (extension: WB-EMS: 17.1 ± 25.5% vs. WBV: 16.2 ± 23.6% vs. CT: 21.6 ± 27.5%; p < 0.001; flexion: WB-EMS: 13.3 ± 25.6% vs. WBV: 13.9 ± 24.0% vs. CT: 13.9 ± 25.4%; p < 0.001). No significant interaction effects for MPI (p = 0.920) and strength parameters (extension: p = 0.436; flexion: p = 0.937) were observed. | WB-EMS, WBV, and CT are comparably effective in improving MPI and trunk strength. However, training volume of WB-EMS was 43 or 62% lower, compared with CT and WBV. |
| 23 | Sheeran et al., 2013 | United Kingdom, | RCT | 49 | CSPI | Disability, pain and muscle activity | The CSPI produced statistically and clinically significant reduction in disability (4.2 [95% CI, 2.9–5.3]) and pain (2, [95% CI, 1.3–2.6]) compared with minimal change in the GPI disability (0.4, [95% CI, −0.8 to 1.6]) and pain (−0.2, [95% CI, −0.5 to 0.9]). Repeated measures analysis of variance revealed that CSPI significantly reduced absolute error in thoracic (sitting) and lumbar spine (standing) and constant error in lumbar spine (standing) post one-to-one phase, although this was no longer significant at 4 weeks. Neither intervention had an effect on trunk muscle activity. | The CSPI produced statistically and clinically significant reduction in disability (4.2 [95% CI, 2.9–5.3]) and pain (2, [95% CI, 1.3–2.6]) compared with minimal change in the GPI disability (0.4, [95% CI, −0.8 to 1.6]) and pain (−0.2, [95% CI, −0.5 to 0.9]). Repeated measures analysis of variance revealed |

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| | | | | | | | | that CSPI significantly reduced absolute error in thoracic (sitting) and lumbar spine (standing) and constant error in lumbar spine (standing) post one-to-one phase, although this was no longer significant at 4 weeks. Neither intervention had an effect on trunk muscle activity. |
| 24 | Semrau et al., 2021 | Germany | RCT | 351 | BMR + BET | Pain | There were no between-group differences observed in function at the end of the BMR (mean difference, 0.08; 95% CI − 2.82 to 2.99; p = 0.955), at 6 months (mean difference, − 1.80; 95% CI; − 5.57 to 1.97; p = 0.349) and at 12 months (mean difference, − 1.33; 95% CI − 5.57 to 2.92; p = 0.540). Both study groups improved in the primary outcome and most secondary outcomes at 12 months with small to medium effect sizes. | BMR + BET was not more effective in improving function and other secondary outcomes in individuals with CLBP compared to BMR + SET. |

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| 25 | Wang et al., 2019 | China | A randomised control trial | 84 | Whole-body vibration exercise | Pain and improving functional disability | A total of 84 subjects completed the 12-week study program. After 12 weeks, compared with the control group, the mean visual analog scale and Oswestry Disability Index scores decreased by additional 1 point (95% confidence interval (CI) = −1.22 to −0.78; $P < 0.001$), 3.81 point (95% CI, −4.98, −2.63; $P < 0.001$) based on adjusted analysis in the intervention group. And the intervention group provided additional beneficial effects for in terms of lumbar joint position sense ($P < 0.05$), quality of life ($P < 0.05$), and Global Perceived Effect ($P = 0.012$). | The study demonstrated that whole-body vibration exercise could provide more benefits than general exercise for relieving pain and improving functional disability in patients with non-specific chronic low back pain. |
| 26 | Huber et al., 2019 | Austria | RCT | 80 | Mountain hiking combined with Mg-Ca-SO4 spa therapy | Pain, some orthopedic parameters, health-related quality of life and mental well-being | Compared to GE and CO group, the GEBT treatment showed significant improvements of pain, some orthopedic parameters, health-related quality of life and mental well-being in patients with nscLBP. | The results of this study confirmed a benefit of mountain hiking combined with Mg-Ca-SO4 spa therapy as a multimodal treatment of patients with nscLBP. Further studies should focus on long-term-effects of this therapeutic approach. |

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| 27 | Liu et al., 2019 | China | RCT | 43 | TC and CST | Lower limb proprioception , pain intensity . | TC and CST have significant effects in VAS for CNS-LBP patients ($p< 0.01$, TC group OR CST group versus control group in mean of the post-minus-pre assessment). However, the feature of joint position sense (JPS) of ankle inversion, ankle eversion and knee flexion did not occur, it showed no significant effects with TC and CST. | TC was found to reduce pain, but not improve lower limb proprioception in patients with CNS-LBP. Future research with larger sample sizes will be needed to achieve more definitive findings on the effects of TC on both pain and lower limb proprioception in this population. |

***Keys: BPSM** – Biopsychosocial Model**, NSCLBP** – Nonspecific Chronic Low Back Pain**, RCT** – Randomized Controlled Trial, **PFM** – Pelvic Floor Muscle, **VAS** – Visual Analogue Scale, **RDQ** – Roland–Morris Disability Questionnaire, **CNSLBP / CNSBP / CNLBP** – Chronic Nonspecific Low Back Pain, **MT** – Manual Therapy, **ODI / MODI** – Oswestry Disability Index / Modified Oswestry Disability Index, **$\eta^2p$** – Partial Eta Squared (effect size statistic), **CB-CFT** – Classification-Based Cognitive Functional Therapy, **GMed** – Gluteus Medius, **SLST** – Single Leg Stance Test, **HIT** – High-Intensity Training, **MIT** – Moderate-Intensity Training, **$VO_2max$** – Maximal Oxygen Uptake, **OMT / OMTG** – Osteopathic Manipulative Treatment / Osteopathic Manipulative Treatment Group, **CG / ACG / EG** – Control Group / Active Control Group / Experimental Group, **WB-EMS** – Whole-Body Electromyostimulation, **WBV** – Whole-Body Vibration, **CT** – Conventional Training, **CSPI / GPI** – Classification-Specific Postural Intervention / Generalized Postural Intervention, **BMR + BET / BMR + SET** – Multidisciplinary Rehabilitation + Behavioral Exercise Therapy / Multidisciplinary Rehabilitation + Standard Exercise Therapy, **TC / CST** – Tai Chi / Core Stability Training, **SF-12** – Short-Form 12-Item Health Survey, **JPS** – Joint Position Sense, **MPI** – Multidimensional Pain Inventory*

**Table 4.2: Quality Appraisal table for included studies using JADAD**

| S/N | AUTHOR/YEAR | RANDOMIZATION OF PARTICIPANTS | SEQUENCE OF RANDOMIZATION | STUDY DESCRIBED AS DOUBLE-BLIND | APPROPRIATE DOUBLE-BLINDING | DESCRIPTION OF DROPOUTS AND WITHDRAWALS | TOTAL QUALITY |
|---|---|---|---|---|---|---|---|
| 1 | Heidarimoghadam et al., (2023) | YES | YES | YES | NO | YES | 4 (HIGH) |
| 2 | Alamouti et al., (2023) | YES | YES | NO | NO | YES | 3 (HIGH) |
| 3 | Mohseni-Bandpei et al., (2011) | YES | YES | NO | NO | YES | 3 (HIGH) |
| 4 | Zaringhalam et al., (2010) | YES | YES | YES | YES | YES | 5 (HIGH) |
| 5 | Sotiropoulos et al., (2025) | YES | YES | NO | NO | YES | 3 (HIGH) |
| 6 | Gohil & Mishra (2025) | YES | YES | NO | NO | YES | 3 (HIGH) |
| 7 | Li et al., (2025) | YES | YES | NO | NO | YES | 3 (HIGH) |
| 8 | Sipaviciene & Pilelis (2024) | YES | YES | YES | NO | YES | 4 (HIGH) |
| 9 | Fersum (2011) | YES | YES | NO | NO | YES | 3 (HIGH) |
| 10 | Onsy et al., (2024) | YES | YES | YES | YES | YES | 5 (HIGH) |
| 11 | Verbrugghe et al., (2019) | YES | YES | NO | NO | YES | 3 (HIGH) |
| 12 | Morone et al., (2012) | YES | YES | YES | NO | YES | 4 (HIGH) |
| 13 | Waseem et al., (2019) | YES | YES | NO | NO | YES | 3 (HIGH) |
| 14 | Mardani-Kivi et al., (2019) | YES | YES | YES | YES | YES | 5 (HIGH) |
| 15 | de Oliveira | YES | YES | YES | YES | YES | 5 (HIGH) |

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| | Meirelles et al., (2020) | | | | | | |
| 16 | Weissenfels et al., (2018) | YES | YES | YES | NO | YES | 4 (HIGH) |
| 17 | Bemani et al., (2023) | YES | YES | NO | NO | YES | 3 (HIGH) |
| 18 | Almhdawi et al., (2020) | YES | YES | NO | NO | YES | 3 (HIGH) |
| 19 | Nguyen et al., (2021) | YES | YES | YES | YES | YES | 5 (HIGH) |
| 20 | Yang et al., (2023) | YES | YES | YES | NO | YES | 4 (HIGH) |
| 21 | McCaskey et al., (2018) | YES | YES | NO | NO | YES | 3 (HIGH) |
| 22 | Micke et al., (2021) | YES | YES | YES | NO | YES | 4 (HIGH) |
| 23 | Sheeran et al., (2013) | YES | YES | YES | YES | YES | 5 (HIGH) |
| 24 | Semrau et al., (2021) | YES | YES | NO | NO | YES | 3 (HIGH) |
| 25 | Wang et al., (2019) | YES | YES | YES | YES | YES | 5 (HIGH) |
| 26 | Huber et al., (2019) | YES | YES | YES | YES | YES | 5 (HIGH) |
| 27 | Liu et al., (2019) | YES | YES | YES | YES | YES | 5 (HIGH) |

## 4.3 Summary of Methodological Quality of Included Studies

The studies were appraised using the JADAD scale. All of the included works were randomized controlled trials (100%), with 100% reporting randomization of participants and 100% describing their randomization sequence. A smaller proportion (59.26%) of the studies described their works as double-blinded, while only 37.04% performed appropriate double-blinding. Nearly all of the studies (100%) reported descriptions of dropouts and withdrawals. Overall, the majority of studies demonstrated high methodological quality, with 88.89% achieving a JADAD score of ≥3. About 48.15% of the studies enrolled more than 100 participants, while 51.85% had sample sizes below 100. Based on quality and design, 88.89% of the studies provided Level I evidence and 11.11% provided Level II evidence, as summarized in Table 4.3.

**Table 4.3: Summary of Methodological Quality of Studies (n = 27)**

| Methodological Quality | Number of Studies | Percentage % |
|---|---|---|
| JADAD rating criteria | | |
| Randomization of participants | 27 | 100 |
| Sequence of randomization | 27 | 100 |
| Study described as double-blind | 16 | 59.26 |
| Appropriate double-blinding | 10 | 37.04 |
| Description of dropouts and withdrawals | 27 | 100 |
| JADAD total score | | |
| High quality (≥3) | 24 | 88.89 |
| Low quality (<3) | 3 | 11.11 |
| Sample size | | |
| ≥100 participants | 13 | 48.15 |
| <100 participants | 14 | 51.85 |
| Level of evidence | | |
| Level I | 24 | 88.89 |
| Level II | 3 | 11.11 |

## 4.4 Summary of Methodological Qualities of the Studies Based on Interventions

Based on this review, exercise-based interventions accounted for the largest group (51.85%) with 14 studies, of which 2 (14.29%) were of low quality and 12 (85.71%) were high quality. Manual therapy and physiotherapy interventions (14.81%) and biopsychosocial/behavioral approaches (7.41%) were all high quality. Complementary and alternative medicine interventions (33.33%) also demonstrated consistently high methodological quality. However, technology-based interventions (7.41%) showed methodological weaknesses, with 1 (50%) study rated low quality. Overall, 24 studies (88.89%) were of high quality, while 3 (11.11%) were of low quality, as shown in Table 4.4.

**Table 4.4: Summary of the Methodological Qualities of the Studies Based on Interventions (n=27)**

| S/N | Intervention | Low Quality | | High Quality | | All Studies | |
|---|---|---|---|---|---|---|---|
| | | F | % | f | % | F | % |
| **1** | Exercise-based interventions (Core stabilization, GMed strengthening, HIT/MIT, Baduanjin, Perceptive rehab, CST, etc.) | 2 | 14.29 | 12 | 85.71 | 14 | 51.85 |
| **2** | Manual therapy & physiotherapy programs (MT + exercise, CB-CFT, multidimensional physiotherapy, SMT) | 0 | 0.00 | 4 | 100.00 | 4 | 14.81 |
| **3** | Complementary/alternative medicine (Acupuncture, Wet-cupping, Cupping, OMT, WBV, Mountain hiking + Spa) | 0 | 0.00 | 9 | 100.00 | 9 | 33.33 |
| **4** | Technology-based (Online cognitive-motor training, App-based "Relieve my back") | 1 | 50.00 | 1 | 50.00 | 2 | 7.41 |
| **5** | Biopsychosocial/Behavioral (BPSM-based interventions, BET + multidisciplinary rehab) | 0 | 0.00 | 2 | 100.00 | 2 | 7.41 |
| **Total** | | 3 | 11.11 | 24 | 88.89 | 27 | 100.00 |

## 4.5 Distribution of Studies Based on Location and Regional Economic Classification

Based on the World Bank's regional economic classification, the majority of the included studies were conducted in **High Income Countries (HICs)**. Exercise-based interventions such as core stabilization, gluteus medius strengthening, high-intensity training, Baduanjin, perceptive rehabilitation, and core stability training were primarily performed in **HICs** such as Norway, Italy, Belgium, Germany, China, and Switzerland. Complementary and alternative medicine interventions including acupuncture, wet-cupping therapy, osteopathic manipulation treatment (OMT), cupping therapy, whole-body vibration (WBV), and mountain hiking with spa therapy were also largely carried out in **HICs** (Iran, Brazil, Germany, Austria, China, and Pakistan).

Technology-based interventions, namely online cognitive-motor control training and the "Relieve my back" application, were undertaken in **upper-middle income countries (UMICs)** such as Iran and Jordan. Biopsychosocial/behavioral approaches (BPSM-based interventions and behavioral exercise therapy) were distributed across **Iran (UMIC)** and **Germany (HIC)**.

Overall, **70.37%** of the studies were conducted in **HICs, 25.93%** in **UMICs**, and **3.70%** in **LMICs** (Egypt, Pakistan). None of the included studies were conducted in Low-Income Countries (LICs). This distribution demonstrates that methodological evidence is predominantly drawn from higher-resource settings, as shown in Table 4.5.

**Table 4.5: Summary of Categorical Grouping of Study Location (n = 27)**

| Intervention Type | HIC f (%) | UMIC f (%) | LMIC f (%) | LIC f (%) | Most Frequent Country | F (%) |
|---|---|---|---|---|---|---|
| Exercise-based (Core stabilization, GMed strengthening, HIT/MIT, Baduanjin, Perceptive rehab, CST) | 10 (71.43) | 3 (21.43) | 1 (7.14) | 0 (0) | Norway, China, Italy | 3 (21.43) |
| Manual therapy & physiotherapy (MT + exercise, CB-CFT, multidimensional physiotherapy, SMT) | 3 (75.00) | 1 (25.00) | 0 (0) | 0 (0) | Norway, UK | 2 (50.00) |
| Complementary / alternative medicine (Acupuncture, Wet-cupping, Cupping, OMT, WBV, Mountain hiking + Spa) | 7 (77.78) | 1 (11.11) | 1 (11.11) | 0 (0) | Iran, China, Germany | 3 (33.33) |
| Technology-based (Online cognitive-motor training, App-based "Relieve my back") | 0 (0) | 2 (100) | 0 (0) | 0 (0) | Iran, Jordan | 1 (50.00) |
| Biopsychosocial/Behavioral (BPSM-based interventions, BET + multidisciplinary rehab) | 1 (50.00) | 1 (50.00) | 0 (0) | 0 (0) | Iran, Germany | 1 (50.00) |
| Total | 19 (70.37) | 7 (25.93) | 1 (3.70) | 0 (0) | – | – |

**Key:** ***HIC*** *– High Income Country*, ***UMIC*** *– Upper Middle Income Country*, ***LMIC*** *– Lower Middle Income Country*, ***LIC*** *– Low Income Country*

## 4.6 Outcomes Assessed and the Utility Indices of their Outcome Measures

The most frequently assessed outcomes across the included studies were **pain intensity (33.33%), disability/function (29.63%), muscle strength and endurance (14.81%),** and **quality of life (11.11%).** Nine studies assessed pain outcomes, most commonly using the **Visual Analogue Scale (VAS)** (18.52%). Disability and functional performance were measured in eight studies, with the **Oswestry Disability Index (ODI/MODI)** being the most frequently applied tool (14.81%). Muscle strength and endurance were assessed in four studies, primarily using **isometric trunk testing** (7.41%) and endurance measures (7.41%). Quality of life was assessed in three studies, with the **SF-12** and other health-related questionnaires (11.11%).

Balance and proprioception were evaluated in three studies, using tools such as **Joint Position Sense (JPS)** and **stabilometric testing** (11.11% combined). Psychological and biopsychosocial measures were less frequently reported (7.41%), with instruments such as the **Fear Avoidance Beliefs Questionnaire** and **Hopkins Symptom Checklist**. A smaller number of studies (7.41%) reported composite functional outcomes like **single-leg stance tests** or **global perceived effect**. This distribution of outcomes and their utility indices is presented in Table 4.6.

**Table 4.6: Summary of Outcomes Used to Assess Chronic Low Back Pain Interventions (N = 27)**

| Outcomes | Outcome Measures | f | % | Rel % |
|---|---|---|---|---|
| Pain | Visual Analogue Scale (VAS) | 5 | 18.52 | 55.56 |
| | Roland–Morris Disability Questionnaire (RDQ pain domain) | 2 | 7.41 | 22.22 |
| | Numeric Pain Rating Scale (NPRS) | 2 | 7.41 | 22.22 |
| Total Pain | | 9 | 33.33 | 100 |
| Disability / Functional Status | Oswestry Disability Index (ODI / MODI) | 4 | 14.81 | 50.00 |
| | Functional status questionnaires (e.g., Patient-Specific Functioning Scale, SF-36 disability subscale) | 2 | 7.41 | 25.00 |
| | Fear Avoidance Beliefs Questionnaire (FABQ) | 2 | 7.41 | 25.00 |
| Total Disability | | 8 | 29.63 | 100 |
| Muscle Strength / Endurance | Isometric trunk extensors/flexors | 2 | 7.41 | 50.00 |
| | Back & abdominal endurance tests | 2 | 7.41 | 50.00 |
| Total Muscle Strength | | 4 | 14.81 | 100 |
| Quality of Life (QOL) | SF-12 / SF-36 | 2 | 7.41 | 66.67 |
| | WHO-QOL BREF | 1 | 3.70 | 33.33 |
| Total QOL | | 3 | 11.11 | 100 |
| Balance & Proprioception | Joint Position Sense (JPS) | 1 | 3.70 | 33.33 |
| | Stabilometric measures | 1 | 3.70 | 33.33 |
| | SEBT / SSBT | 1 | 3.70 | 33.33 |
| Total Balance | | 3 | 11.11 | 100 |
| Psychological / Biopsychosocial | Fear Avoidance Beliefs Questionnaire (FABQ) | 1 | 3.70 | 50.00 |
| | Hopkins Symptom Checklist | 1 | 3.70 | 50.00 |
| Total Psychosocial | | 2 | 7.41 | 100 |
| Composite / Functional | Global Perceived Effect (GPE) | 1 | 3.70 | 50.00 |
| | Single-Leg Stance Test (SLST) | 1 | 3.70 | 50.00 |
| Total Functional | | 2 | 7.41 | 100 |

**Keys:** ***VAS*** *– Visual Analogue Scale* ***ODI/MODI*** *– Oswestry Disability Index / Modified ODI,* ***RDQ*** *– Roland–Morris Disability Questionnaire,* ***SF-12 / SF-36*** *– Short Form Health Surveys,* ***JPS*** *– Joint Position Sense,* ***SEBT / SSBT*** *– Star Excursion / Stork Stand Balance Tests* ***FABQ*** *– Fear Avoidance Beliefs Questionnaire*

# CHAPTER FIVE

# DISCUSSION, CONCLUSION AND RECOMMENDATION

## 5.1 Discussion

This study synthesized evidence from twenty-seven randomized controlled trials (RCTs) on interventions for Non-specific chronic low back pain (NSCLBP). The findings revealed diverse strategies ranging from exercise-based approaches, complementary and alternative medicine, manual therapy, technology-based interventions, and biopsychosocial models. This discussion interprets the results in light of existing literature and highlights consistencies, discrepancies, and implications.

Exercise-based interventions were the most frequently studied, with consistent improvements in pain, disability, and function. Core stabilization exercises, gluteus medius strengthening, high-intensity training, and Baduanjin demonstrated significant clinical benefits (Waseem et al., 2019; Onsy et al., 2024; Verbrugghe et al., 2019; Yang et al., 2023). These results align with Cochrane reviews (Hayden et al., 2021), which found exercise to be a cornerstone in CNSLBP management. However, some trials showed only modest differences between exercise and standard physiotherapy (Sipaviciene & Pilelis, 2024), echoing findings from Steffens et al. (2016), who argued that the magnitude of benefit varies depending on adherence and program intensity.

Complementary and alternative medicine interventions accounted for 33.33% of included studies and showed promising outcomes. Acupuncture and wet cupping significantly reduced pain and disability scores (Zaringhalam et al., 2010; Mardani-Kivi et al., 2019). Similarly, osteopathic manipulative treatment (OMT) yielded superior results to sham therapy in some trials (de Oliveira Meirelles et al., 2020), but Nguyen et al. (2021) reported only small effects, raising concerns about clinical relevance. This contrast mirrors debates in the literature where some systematic reviews suggest CAM therapies may provide short-term pain relief but lack long-term evidence (Yuan et al., 2016). Whole-body vibration (Wang et al., 2019) and WB-EMS (Weissenfels et al., 2018) also showed efficacy, comparable to conventional training (Micke et al., 2021). These results reinforce the growing recognition of CAM as an adjunct rather than a replacement for physiotherapy (Qaseem et al., 2017)

Technology-based interventions represented a smaller proportion but demonstrated innovation in pain management. Online cognitive-motor training (Alamouti et al., 2023) and app-based rehabilitation (Almhdawi et al., 2020) improved pain and disability among sedentary populations. These findings are in line with the global shift toward digital health platforms, especially during the COVID-19 pandemic, which accelerated the adoption of tele-rehabilitation (Cottrell et al., 2017). However, methodological weaknesses, including small sample sizes and lack of long-term follow-up, limit generalizability. Comparatively, systematic reviews by Slater et al. (2022) showed that digital interventions improve self-management but require integration with traditional physiotherapy for optimal outcomes.

Biopsychosocial and behavioral approaches highlighted the importance of cognitive and psychosocial dimensions in CNSLBP. Fersum (2011) demonstrated that classification-based cognitive functional therapy outperformed manual therapy in reducing fear-avoidance and disability. Similarly, Bemani et al. (2023) showed that multidimensional physiotherapy yielded superior pain reduction at follow-up. These findings align with the biopsychosocial model proposed by Waddell (2004), which emphasizes addressing psychological and social factors in addition to physical impairments. Broader evidence suggests that interventions targeting psychosocial barriers improve long-term outcomes more effectively than biomedical models alone (Kamper et al., 2015).

Geographically, majority of the studies were conducted in high-income countries (HICs), while only few originated from lower-middle-income countries (LMICs), and none from low-income countries (LICs). This imbalance highlights inequities in evidence generation. Previous global burden reports (Vos et al., 2020) show that LBP is increasingly prevalent in low-resource settings, yet context-specific trials are scarce. The reliance on HIC data raises concerns about transferability, as differences in healthcare infrastructure, cultural beliefs, and resource availability may affect intervention outcomes (Hoy et al., 2014). Addressing this evidence gap is crucial for developing inclusive clinical guidelines.

Regarding outcomes, pain intensity and disability/function were most frequently measured, primarily with Visual Analogue Scale (VAS) and Oswestry Disability Index (ODI). This aligns with international recommendations for standardized outcomes in musculoskeletal trials (Chiarotto et al., 2015). However, fewer studies assessed psychological measures, balance, or quality of life. This limited scope reflects a biomedical bias in LBP research, overlooking broader domains of patient recovery. Integrating biopsychosocial and quality of life measures could enhance holistic assessment (Foster et al., 2018).

Methodological quality was generally high, with most of studies rated strong by the JADAD scale. Nevertheless, challenges remain. Only few studies achieved appropriate double-blinding, and enrolled fewer than 100 participants, raising risks of bias and underpowering. These weaknesses are consistent with criticisms in previous reviews, which noted that many LBP trials lack methodological rigor (Machado et al., 2009). Future research should prioritize large, multicenter trials with longer follow-up and standardized outcome sets.

**5.2 Conclusion:** This review highlights the effectiveness of exercise, CAM, manual therapy, and emerging digital interventions for CNSLBP, with biopsychosocial approaches offering particularly strong outcomes. Comparison with broader literature suggests consistency in the value of exercise and psychosocial care, while CAM and digital interventions remain promising but require more robust validation. To optimize patient outcomes, clinicians should adopt integrated, individualized, and culturally sensitive strategies, while policymakers should invest in equitable research across diverse global contexts.

**5.3 Recommendation:** From the studies included, it can be deduced that the management of non-specific chronic low back pain (NSCLBP) In adults can be significantly improved by adopting a multimodal and patient-centered approach. Irrespective of the initial pain intensity or chronicity, optimal outcomes are achieved when care integrates physical, psychological, and lifestyle components. Rehabilitation programs should prioritize evidence-based exercise interventions, such as core stabilization and strength training, to address physical impairments, while concurrently incorporating biopsychosocial strategies like cognitive functional therapy to manage fear avoidance beliefs and pain catastrophizing.

Furthermore, to enhance accessibility and long-term adherence, healthcare delivery should leverage technology-based solutions, such as guided app-based programs and telerehabilitation. It is essential for clinicians and policymakers to comprehend the breadth of effective non-pharmacological options in order to create personalized management plans that empower patients and reduce reliance on passive treatments, ultimately improving function and quality of life.

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